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THE DETERMINANTS AND THE EFFECTS OF THE ENVIRONMENTAL TAXATION IN EUROPEAN COUNTRIES

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Summary

The economic growth has always been associated with increasing use of energy and resource. The countries around the world continue to advance economically and, in this way, they put a strain on the ability of the natural environment to absorb the high level of pollutants that are created as a part of this economic growth. Therefore, solutions need to be found so that the economies of the world can continue to grow, but not at the expense of the public good. In the world of the economics, the amount of environmental quality must be considered as limited in supply and, therefore, it must be treated as a scarce resource. This is a resource to be protected. Taxes are the most important used economic instruments available to deal efficiently with pollution and thereby help to protect the environment.

In the last ten/twelve years, a growing number of European countries implemented the Environmental Tax Reform (ETR). The Reform refers to "changes in the national tax system where the burden of taxes shifts from economic functions, sometimes called "goods", such as labour (personal income tax), capital (corporate income tax) and consumption (VAT and other indirect taxes), to activities that lead to environmental pressures and natural resource use, sometimes called "bads".

Therefore, ETR can provide two benefits: the environmental benefit from charging the full cost of environmental resources, and the economic benefit from the reduction in other distortionary taxes. The reform is thus said to offer the possibility of a "double dividend": it would improve not only the environment but also the economy as a whole.

The main concern of the present work is to analyze the determinants and the effects of the environmental taxation in European countries. Specifically, the research questions are:

- Which institutional and governmental factors affect the level of environmental taxation? Understanding the determinants of the environmental taxation could yield a more efficient taxation system.
- Is the environmental taxation effective in reducing the pollution levels? (First Dividend).
- Is there a tax-shifting between environmental and labour taxes? Moreover, is there an employment gain? (Second Dividend).

The thesis is introduced in Chapter 1, which outlines the context, the motivation and the aim of this research.

Chapter 2 examines the determinants of the environmental taxation using a panel dataset of 22 European countries for the period from 1996 to 2012. The analysis searches for the environmental taxation determinants by concentrating on three groups of factors. The first group includes the variables responsible for consumption and production processes; the second group refers to the factors that reflect environmental quality; the indicators of the quality of governance are included in the third group. The countries of the sample, in turn, are also divided into three groups in order to highlight the heterogeneity existing of European economies depending on the degree of economic development, environmental awareness and quality of institutions. Findings suggest that in order to apply environmental taxation policy, countries should take advantage of the interrelationship between the

economic growth and the institutional enforcement; in other words, the connection between economic development and environmental awareness inevitably requires the application and enforcement of functional environmental policies.

Chapter 3 analyzes the effectiveness of environmental taxes and the other climate change policies and measures, such as feed in tariff, green certificates and loans. Using a panel dataset that covers 22 European countries over the period 2001-2012, I estimate an OLS and an Arellano–Bover's (1995) two-step dynamic panel approach to verify whether the environmental tools and the introduction of the Environmental Tax Reform have a significant impact in improving environmental quality. Results show that the environmental taxes, the climate change direct investments and fiscal and financial incentives have an important role in reducing pollution levels. The introduction of the Environmental tax reform, also, has a high effect in improving environmental quality.

Chapter 4 verifies the existence of the "second dividend". The aim of the chapter is to determine if increasing environmental taxes can reduce other distortionary taxes, in particular labour tax. Depending on which taxes rates are cut and the specific country considered, the second dividend could generate cuts in labor taxes and, therefore, employment gains. I use a panel dataset that covers 22 European countries over the period 2000-2012 to investigate whether the environmental tax affects the labour tax burden and, consequently, the unemployment rate. I handle endogeneity problems through an instrumental variable approach. Results show that environmental taxation has a significant impact on labour tax, but no impact on

unemployment levels.

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Environmental Taxation and Double Dividend hypothesis: an introduction

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs". This is the definition of sustainable development appeared for the first time in the Brundtland Report, Our common Future (1987). Since then, there was a growing interest trough the sustainability concept in all fields, including economics.

The reason lies in the relationship between environment and economic development: as countries continue to advance economically, they put a strain on the ability of the natural environment to absorb the high level of pollutants that are created as a part of this economic growth. Therefore, solutions need to be found so that the economies of the world can continue to grow, but not at the expense of the public good. In the world of economics, the amount of environmental quality must be considered as limited in supply and, therefore, it must be treated as a scarce resource. This is a resource to be protected. Taxes are among the most important used economic instrument available to deal efficiently with pollution and thereby help protect the environment.

In this chapter, I address some of the main economic issues in the design of the environmental taxation.

1.1 The "Polluter Pays" Principle

The first proposal of environmental taxation dates back to 1920, when A.C. Pigou outlined the fundamentals; Pigou believed that the state intervention should correct negative externalities, which he considered a market failure.

The basic rationale for environmental taxation is clear. Pollution imposes costs on society that are not borne by the polluter. Imposing a tax ensures that the polluter takes account of (or "internalizes") these wider costs when deciding how much to pollute. On this basis, a reasonable goal is to reduce pollution to a level that takes full account of both the costs of the pollution and the benefits of the polluting activity. Taxes are often the most effective tool as a way to achieve this.

For these reasons, the environmental taxation is view as the main instrument for the implementation of the "polluter pays" principle and to achieve the level of "optimal pollution".

The "polluter pays" principle (PPP) is the commonly accepted practice that those who produce pollution should bear the costs of managing it to prevent damage to the human health or to the environment. For instance, a factory that produces a potentially poisonous substance as a byproduct of its activities is usually held responsible for its safe disposal. It is regarded as a regional custom because of the strong support that it has received in most OECD countries.

If the marginal cost of pollution abatement is just equal to the marginal benefit from pollution abatement, then we have reached the point where

society's welfare has been maximized with respect to environmental quality: this is the definition of “optimal pollution”.

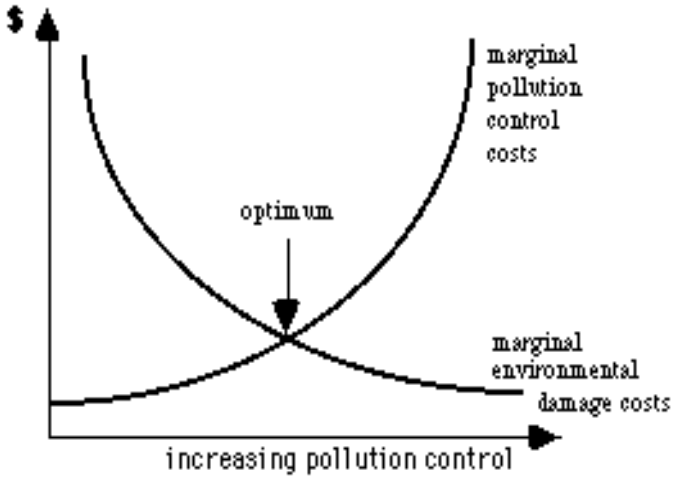
If the marginal benefit of reducing pollution were greater than the marginal cost of reducing pollution, then society would benefit from a reduction in pollution. The benefit would be equal to the amount by which the marginal benefit of the cleanup exceeded the marginal cost of the clean up.

Just as it is possible to have “too dirty” environment, it is also possible to have “too clean” environment. If the marginal cost of pollution abatement exceeds the marginal benefit from the reduction, then the benefit of cleaning the environment is not worth the expense. Consequently, further attempts to clean up the environment will result in a reduction in welfare. Economists have argued that it is not efficient to reduce pollution to zero. The cost of this reduction would probably exceed the benefits. Waterways and the atmosphere have a natural capacity to assimilate at least some pollution with no associated ill-effects on the environment or humans. Not benefit from this natural assimilative capacity would be wasteful. Moreover, one person's pollution may be another person's consumption.

According to Beder (1996), the optimal level of pollution is supposed to be the level at which the costs of cleaning up the pollution equal the costs of environmental damage caused by that pollution. If the pollution charge is equivalent to the cost of environmental damage then the theory says that the polluter will clean up its pollution until any further incremental reduction in pollution would cost more than the remaining charge, that is until it is cheaper to pay the charge than reduce the pollution. This is said to be

economically efficient because if the polluter spends any more than this, the costs (to the firm) of extra pollution control will outweigh the benefits (to those suffering the adverse affects of the pollution). Figure 1.1 shows the costs and the benefits of the pollution control.

Figure 1.1: Costs and benefits of pollution control.



Source: Beder (1996).

The “Polluter Pays” Principle was confirmed as a foundation of European environmental policies and the OECD Council adopted it in 1972 as the primary economic principle for allocating the costs of pollution prevention and control. Economic instruments, such as taxes, are seen as appropriate tools for implementing this principle, which has become the widely accepted framework for internalizing environmental externalities.

The environmental taxes have many important advantages, such as environmental effectiveness, economic efficiency, the ability to raise public

revenue and transparency. Also, the environmental taxes have been successfully used to address a wide range of issues including waste disposal, water pollution and air emissions (OECD, 2010). The next Section shows the definition and the use of the environmentally related taxes in the European countries.

1.2 Environmentally related taxes

Over the last decade, economic instruments have been playing a growing role in environmental policies of the OECD countries. In this context, a distinctive feature is the increasing role of environmentally related taxes. All countries have introduced the environmental taxes to a varying extent, and an increasing number of countries are implementing comprehensive green-tax reforms.

Green tax reforms have been identified as a key framework condition for sustainable development (OECD, 2011).

The definition of an environmental tax, in line with Regulation (EU) No 691/2011 is: "a tax whose tax base is a physical unit (or a proxy of a physical unit) of something that has a proven, specific negative impact on the environment, and which is identified in ESA as a tax".

The definition puts emphasis on the effect of a given tax in terms of its impact on the cost of activities and the prices of products that have a negative effect on the environment (European Commission, 2013).

Furthermore, the definition puts emphasis on the tax base. An environmental tax is a tax on a "base", which has a specific negative impact

on the environment. The tax base was seen as the only objective basis for identifying environmental taxes for the purpose of international comparisons.

For analytical purposes, the environmental taxes are classified into four main categories, which correspond to four categories of tax bases (European Commission, 2013):

- Energy taxes;
- Transport taxes;
- Pollution taxes;
- Resource taxes.

The first category includes taxes on energy production and on energy products used for transport and stationary purposes. The most important energy products for transport purposes are petrol and diesel.

Energy products for stationary use include fuel oils, natural gas, coal and electricity. Taxes on biofuels and on any other form of energy from renewable sources are included. Carbon dioxide (CO2) taxes are included under energy taxes rather than pollution taxes; the main reason is that it is often not possible to identify CO2 taxes separately in tax statistics, because they are integrated with energy taxes. In addition, taxes on greenhouse gas emissions should also be included here.

The transport taxes category mainly includes taxes related to the ownership and use of motor vehicles. Taxes on other transport equipment (e.g. planes, ships or railway stocks) and related transport services (e.g. duties on charter or scheduled flights) are also included here. All taxes on means of transport should be included. Taxes on vehicle insurance should

also be included provided they are specific taxes on the insurance of vehicles and not general insurance taxes levied on all kinds of insurance contracts. Taxes on petrol, diesel and other transport fuels are included under energy taxes.

In a number of countries, taxes on the specific CO2 emissions of vehicles have been introduced which are one-off registration or import taxes or annual vehicle taxes. These taxes are not related to the actual use of the vehicles or to the actual emissions generated. The tax base is a technical property of the vehicle and these taxes are to be considered as transport taxes and not as energy taxes.

The pollution taxes include taxes on measured or estimated emissions to air and water, management of solid waste and noise. An exception is the tax on CO2 emissions, which is included under energy taxes as discussed above.

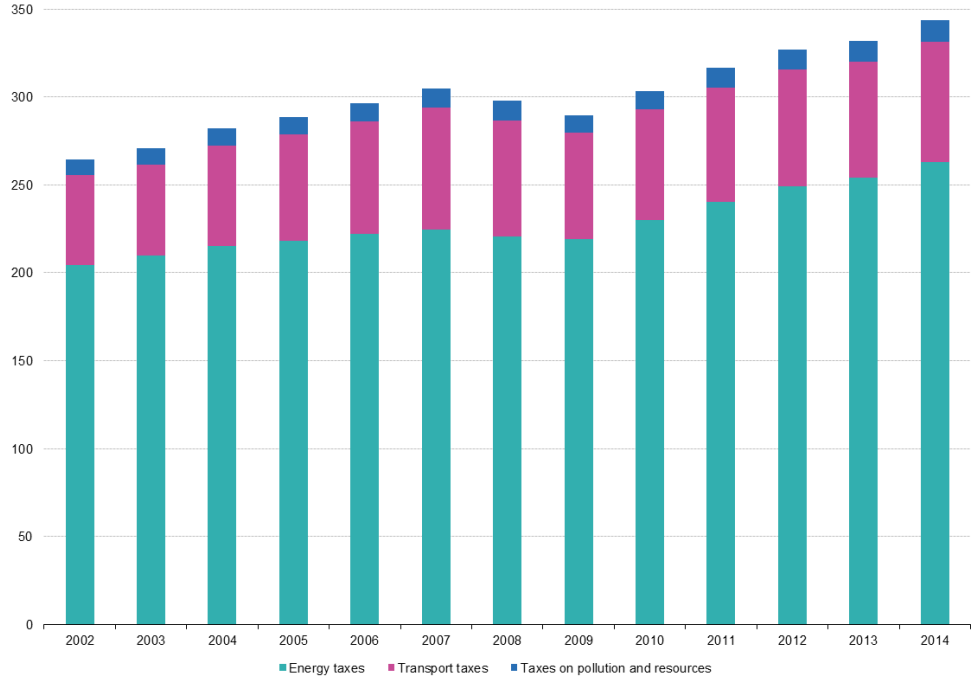
The resource taxes category includes taxes linked to the extraction and to the use of natural resources, such as water, forests, flora and fauna, as these activities deplete natural resources. All taxes designed to capture the resource rent from the extraction of natural resources should be excluded.

As it is possible to see in Figure 1.2, most of the revenue derives from energy taxes which on average account for 75% of the total revenue.

Anyway, the concept of environmental tax is diversified and, over last decades, there was an increasing use of these tools by government. From 2002 to 2014, the total environmental tax revenue in the EU increased by 2.2 % per year (at current prices) on average whereas GDP at market prices rose at an annual average of 2.5%. In 2014, the level of environmental tax

revenues was some EUR 79 billion higher than in 2002 (Figure 1.2). However, from 2008 onwards the financial and economic crisis caused a reduction in economic activity in the EU, leading to lower tax receipts in 2008 and 2009. In 2010, environmental tax revenues returned to an upward path (Eurostat, 2016).

Figure 1.2: Total environmental tax revenue by type of tax, EU-28, 2002–14 (Million EUR).



Source: Eurostat.

The growing use of this tool is, moreover, due to the introduction of the Environmental Tax Reform (ETR) in European countries in 2005. Next Section tackles the main target of the ETR and the Double Dividend hypothesis, which represents the main concern of the present work.

1.3 Environmental Tax Reform and Double Dividend hypothesis

The Environmental Tax Reform (ETR) is defined as a "reform of the national tax system where there is a shift of the burden of taxes, for example on labour, to environmentally damaging activities, such as resource use or pollution" (EEA, 2005).

ETR, therefore, comprises two elements. First, it deters environmentally damaging activities by making them more costly. This can obviously be desirable for numerous reasons, including reducing harm to, alleviating the pollution that can impact human health and standards of living and preserving the natural resources, both today and for the future generations (EEA, 2011).

Anyway, the second aspect of ETR is no less important. It involves recycling the revenues gained from increased environmental taxes and cutting other distortionary taxes, such as labour tax, that can involve in an increasing employment. Therefore, ETR can provide two benefits: the environmental benefit from charging the full cost of environmental resources, and the economic benefit from the reduction in other distortionary taxes. The reform is thus said to offer the possibility of a "double dividend": it would improve not only the environment but also the economy as a whole.

For this reason, since the introduction, there was a growing interest in literature through the role of the environmental taxation as a tool to reach the double dividend goals.

The notion of double dividend was first proposed by Pearce (1991), who noted that swaps of environmental taxes for distortionary taxes may produce a double dividend by discouraging environmentally damaging activities and reducing the distortionary cost of the tax system. The idea is that government should adopt a revenue neutrality approach to levying carbon taxes and use such revenues to reduce other distortionary taxes, maintaining a constant level of total revenue and expenditure.

A critical discussion of the theoretical arguments surrounding the ETR can be found elsewhere (Goulder, 1995; Parry and Oates, 1998; Bosquet, 2000).

Goulder (1995a) analyzes two different notions of double dividend, "weak" and "strong", examining the theoretical and empirical evidence for each. A weak double-dividend claim - returning tax revenues through cuts in distortionary taxes leads to cost savings relative to the case where revenues are returned lump sum - is easily defended on theoretical grounds and also receives support from numerical simulations. The stronger versions contend that revenue-neutral swaps of environmental taxes for ordinary distortionary taxes involve zero or negative gross costs; theoretical analyses and numerical results tend to cast doubt on the strong double-dividend claim. These hypotheses differ in terms of what they propose about the costs of revenue-neutral environmental tax policies. Let gross cost refer to the reduction in individual welfare (in wealth equivalents) of a given tax initiative, abstracting the welfare effect from changes in environmental quality. Let $C(t_E, \Delta T_L)$ denote the gross cost of the new environmental tax t_E in combination with lump-sum tax reductions ΔT_L sufficient to make the

policy revenue neutral. Similarly, let $C(t_E, \Delta T_X)$ denote the gross cost of the new tax t_E accompanied by cuts in the distortionary tax ΔT_X sufficient to achieve revenue neutrality. The weak form of double dividend asserts that:

$$C(t_E, \Delta T_L) < C(t_E, \Delta T_X).$$

The gross cost is lower when revenues are replaced through cuts in the distortionary tax than when revenues are replaced lump-sum. Under this proposition, the second dividend is the lower distortionary cost in the former case (left side) relative to the cost in the latter case (right side).

The strong double-dividend notion involves assertions about the sign of the gross cost of a revenue-neutral policy in which an environmental tax replaces an existing distortionary tax. The assertion is:

$$C(t_E, \Delta T_X) < 0.$$

It means that swapping an environmental tax for a distortionary tax involves a negative overall gross cost (Goulder, 1995a).

Parry and Oates (1998) claim that environmental measures raise costs and prices and thereby reduce the real wage. This rise in the cost of living reduces slightly the quantity of labour supplied in an already highly distorted labor market, giving rise to losses in social welfare that can be large relative to the basic welfare gains from improved environmental policy. These losses may be offset to some extent by using revenues (if any) from the environmental programs to reduce existing taxes on labour. They distinguish

three distinct effects on economic welfare: the “primary welfare gain”, a “revenue-recycling effect” and a “tax-interaction effect”. The first is simply the familiar welfare gain whose source is the benefits net of the costs from the environmental improvement. In the presence of pre-existing tax distortions, the revenues that are raised by the environmental taxes can be used to reduce the rates on existing distorting taxes. In the simple analytical models, this means that they replace revenues from the tax on labor. Hence, there is a second source of welfare gain: the revenue-recycling effect. But, as mentioned earlier, there is a third effect that involves the way in which the environmental tax interacts with the existing tax on labor. In the analytical models (which typically assume the demand for labor to be perfectly elastic) the environmental tax discourages work effort by reducing the real household wage. This is the tax-interaction effect and it reduces welfare.

Bosquet (2000) reviewed a number of studies addressing the effect of the ETR. The main conclusion was that the “reductions in CO2-emissions may be significant, marginal gains in employment and marginal gains or losses in activity may be recorded in the short-to medium-term, and investments decrease and prices increase moderately”. With likely emissions reductions and gains in employment, the trend corroborates the hypothesis that the ETR can, under certain conditions and subject to the limits inherent to modeling techniques, achieve both environmental and economic improvements. In particular, when environmental tax revenues are redistributed to cut distorting taxes on labor, environmental quality improves, small gains tend to be registered in the number of jobs and output in non-polluting sectors.

Carraro et al. (1996) find that, in the long run, employment gains might occur despite decreases in environmental dividends, due to changes in the composition of aggregate demand. Their hypothesis is that the increasing net wages can affect the possibility of gains in employment.

Anyway, the mechanism of revenue recycling allows the government to carry out the operation in a revenue-neutral way, leaving total tax revenues unchanged. However, the ETR can be revenue-positive or revenue negative, depending on how much tax revenue is recycled. In Europe, the ETR is usually advertised under the banner of revenue neutrality, as the overall tax burden in these countries is already high, and additional taxation is economically damaging and politically unpalatable. However, Finland, Sweden, and to a lesser degree Germany, have launched a revenue-negative ETR, thus reducing the overall tax burden on the economy (Bosquet, 2000).

Bovenberg and de Mooij (1994), employing a general equilibrium model, find that the environmental taxes typically render the overall tax system a less efficient instrument to finance public spending.

Bovenberg and de Mooij (1997), explore how an environmental tax reform affects pollution, economic growth and welfare in an endogenous growth model with pre-existing tax distortions. They find that a tax-shifting may raise economic growth through two channels. The first channel is an environmental production externality, which determines positive effects of lower aggregate pollution on the productivity of capital. The second channel is a shift in the tax burden away from the net return on investment towards profits. The paper also shows that the optimal tax on pollution may exceed

its Pigouvian level if tax-shifting towards profits is large and production externalities are important.

Bovenberg and Goulder (1996) analyze the optimal environmental tax policies in the presence of realistic policy constraints. The constraints involve either the inability to alter all tax rates or the inability to use revenues from environmental taxes in optimal ways. They find that these constraints substantially affect the optimal environmental tax rates. They employ analytical and numerical models to examine the general- equilibrium interactions between environmentally motivated taxes and distortionary taxes. The analytical model indicates that in the presence of distortionary taxes, optimal environmental tax rates are generally below the rates suggested by the Pigouvian principle, even when revenues from environmental taxes are used to cut distortionary taxes. The numerical simulation supports this analytical result and it also shows that in the presence of realistic policy constraints, optimal carbon tax rates are far below the marginal environmental damages and may even be negative.

Oueslati (2015) examines the macroeconomic effects of environmental tax reform in a growing economy and results suggest that the magnitude of these effects depends on the type of tax reform and the presence of a convex adjustment cost for investment. Although, the green tax reform that aims to use the revenue from environmental tax in order to reduce tax on wages is always growth improving, its long term welfare effects depend on the capital adjustment cost.

Morley (2012) suggests that the recent introduction of environmental taxes in the EU has had a significantly negative effect on pollution, but

limited effect on the use of energy resources. This suggests that the exemptions for energy-intensive sectors of the economy have had only a limited effect on the efficacy of this policy. These results also provide support for those studies suggesting that the consequences of environmental taxes are dependent on the structure of other tax levels, as measuring environmental taxes relative to total taxes has the most significant effect. Indeed, environmental taxation is usually measured using two indicators: the revenues from environmentally related taxes as a percentage of GDP, and the revenue from environmentally related taxes as a percentage of the total tax revenues for a country. Both indicators have the advantage that the data are gathered by almost all countries on a yearly basis. Moreover, they are easy to aggregate and suitable for international comparison. However, a decrease in environmentally related tax revenues can have two different explanations: a decrease of environmentally friendliness of the tax system, or an erosion of the tax base, which, on the contrary, refers to an improvement of the state of the environment. So, this type of indicator has a problem of conceptual and measurement validity (Bachus, 2012).

Abdullah and Morley (2014) analyze the causal relationship between environmental taxes and economic growth; 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. This suggests that there is little evidence that an expansion of environmentally friendly tax policies will enhance economic growth. The policy interpretation is that more smart approaches for efficient instruments to promote sustainable economic growth and at the same time

manage the natural resources and control pollution levels efficiently are required. Hence, the link between environmentally related taxes and environmental development in association with revenue recycling is important. The policy implications of this study suggest that for countries to meet their pollution targets, environmental taxes and the associated increase in renewable energy will probably need to continue but it is imperative to link these actions to economic development. The evidence suggests that increasing environmental taxes does not appear to have any substantial impact on the economy. Also, it does not indicate any harmful impact from the increase of taxes, which is important for the transition economies to improve their environmental standards.

Arbolino and Romano (2014) illustrate a methodological approach for evaluating the consequences of adopting an Environmental Tax Reform (ETR) in European countries. The evaluation is structured in three integrated steps: 1) Pre-post comparison and with-without comparison; 2) Hierarchical Cluster Analysis; 3) Quantitative SWOT analysis. Results show differences among countries before and after the introduction of the reform on three macro areas, environment, employment and innovation, as well as between adopting and no-adopting countries.

Goulder (2013) investigates in which way the climate change policy initiatives interact with the fiscal system. He explores four issues associated with fiscal interactions. First, the study examines how these interactions influence the prospects for a “double dividend”: both an environmental improvement and a reduction in the costs of the tax system. Second, it analyzes how the use of revenues from a carbon tax or from a cap-and-trade

system involving auctioned emissions allowances influences these policies' economic costs. Third, it addresses the question whether carbon taxes or cap-and-trade programs represent more efficient sources of government revenue than other, more traditional revenue sources such as income, sales, or payroll taxes. Finally, it analyzes how fiscal interactions affect the choice between CO2 emissions pricing instruments (carbon taxes and cap and trade) and other climate policy instruments. Fiscal interactions complicate the analysis of the impacts of climate change policies. The added complexity makes policy analysis more challenging. At the same time, the insights from the recent research help provide a useful compass for policy makers, indicating how the interactions can be exploited productively. The judicious combining of climate policy and tax policy instruments expands opportunities for addressing climate change while meeting other important social objectives.

Bovenberg and de Mooij (1994) show that environmental taxes typically exacerbate, rather than alleviate, preexisting tax distortions, even if revenues are employed to cut preexisting distortionary taxes. They demonstrate that, in the presence of preexisting distortionary taxes, the optimal pollution tax typically lies below the Pigouvian tax, which fully internalizes the marginal social damage from pollution.

Heady et al. (2000) survey the literature on the subject and list the following key factors that will make ETR more likely to raise employment:

- the environmental tax can be passed in to factors of production (other than labour) that are inelastically supplied and relatively under-taxed;

- non-working households are significant as consumers of the dirty goods that are to be taxed;
- through international market power, the environmental tax raises the prices of goods produced with intensive use of dirty inputs;
- capital is relatively immobile internationally (and therefore substitution with labour is difficult);
- exclusively to involuntary unemployment models: 1)the elasticity of substitution between the dirty input and labour is greater than that between the dirty input and capital; 2) the real wage is unresponsive to unemployment (so that tax reductions are not offset by wage rises);
- exclusively to voluntary unemployment models, the environmental tax is levied on goods that are more complementary to leisure than the goods whose taxes are reduced.

Chiroleu-Assouline and Fodha (2005) analyze the double dividend and equity issues within an overlapping generations models framework with involuntary unemployment. They show that the fiscal change does not always harm the welfare of the younger generation and, under certain assumptions about agents' preferences, it is possible to obtain the double dividend and the respect of intergenerational equity. In a following study, Chiroleu-Assouline and Fodha (2006) show that a balanced environmental fiscal reform may result either in an increase or in a decrease of the labor tax rate, depending on the elasticity of consumption and on the initial tax rates. In both cases, the existence conditions of a double dividend rely on the

initial per capita capital stock and on the intertemporal elasticity of substitution.

1.4 Aim, motivation and structure

Due to this background, the present work aims to analyze the role of the environmental taxes in European countries. The main concern of the thesis is to analyze the determinants and the effects of the environmental taxation in European countries.

Chapter 2 aims to analyze the determinants of environmental taxes in European countries. Chapter 3 verifies the effectiveness of the environmental taxation and the other climate change policies and measures taken to reduce pollution, so improve environmental quality. Chapter 4 verifies the existence of the "second dividend". The aim of the chapter is to determine if increasing environmental taxes can reduce other distortionary taxes, in particular labour taxes and reduce, therefore, unemployment rate.

Environmental Taxation and Its Determinants in European Countries.

Abstract

The present work adds to the existing literature the analysis of the determinants of environmental taxation in European economies. Using a pooled panel data I consider various groups of factors influencing environmental taxation referring to production and consumption, environmental performance and the quality of governance of European countries, taking into account their heterogeneity. I argue that to function, environmental taxation policy should rely on the virtuous interrelationship between economic development and institutional enforcement, which contributes to enhancing the process of environmental renaissance.

2.1 Introduction

In the economic literature, there has been a new wave of interest in the role of environmental taxation as an active policy of environmental protection. This interest mostly comes from the results achieved by the application of this policy in many countries, particularly in so called eco-leader European economies. Among the advantages of this policy, some factors are particularly highlighted by empirical and theoretical models. These are environmental renaissance, internalization of external costs, environmental incentives and an increase in tax revenues. These factors are part of the basis

for the Environmental Tax Reform proposed by the European Environmental Agency (2005). The aim of the reform is to shift the burden of taxation from "goods" (such as capital and labour) to "bads" (such as polluting factors) therefore, to consider environmental taxation as a tool that not only corrects negative externalities, but also reduces general taxation distortions, thus improving social welfare (Ekins et al., 2012). However, the disadvantages of environmental taxation policy are also taken into consideration when referring to the maintenance of the rights to pollute, the increase of fiscal pressure, the decrease of the competitiveness and consumption, a provision of incentives for rent-seeking activities and the uncertain effects of double dividend hypothesis (Svendsen and et al., 2001; Wier et al., 2005; Eisenack et al., 2012).

2.2 Literature review

In evaluating the application of environmental taxation policy, a better understanding of taxation itself is needed. In fact, while the effects of this policy are well discussed, the argument of the determinants of taxation is still left in the shade. In fact, the evidence on environmental taxation determinants is scarce (Anger et al., 2006; Ward and Cao, 2012). A better understanding of the main factors that influence this policy instrument is necessary for it to function effectively. Therefore, the contribution of this paper is to investigate the determinants of environmental taxation using a panel of European countries for the period from 1996 to 2012.

Environmental taxes were introduced in Europe in the beginning of the Nineties and they have become one of the most commonly used environmental policy instruments. The impact of taxes on environmental quality and on economic performance is a topic addressed by numerous studies (Ekins, 1999; Ekins and Barker, 2001; EEA, 2005; Scrimgeour et al., 2005; Kosonen, 2010 among others). These studies evidenced the positive impact of environmental taxation in European economies. The examples of positive impact can refer to the tax on carbon dioxide emissions, the tax on leaded petrol, taxes on waste and waste treatment, traffic congestion charges, vehicle excise duties among others (Vehmas, 2005; Leicester, 2006; Sartzetakis et al., 2012,). Some of the European countries have also recorded a positive impact of environmental taxation on economic performance. These are eco-leaders such as Denmark, the Netherlands, Norway and Sweden that not only have contributed to environmental progress, but have also gained in economic performance by recycling the revenues obtained from environmental taxation back into the economy, thereby reducing income taxes and increasing investments (Scrimgeour et al., 2005).

Instead of concentrating on the effects of environmental taxation, a few studies emphasize the factors responsible for the efficacy of this policy instrument (Ekins and Barker, 2001; Scrimgeour et al., 2005; Muller and Sterner, 2006, Castiglione et al., 2012). Although these studies mainly consider the applicability of environmental taxation, they also provide some hints to identify possible factors which influence this policy. Based on the existing literature, we shall attempt to identify the most likely determinants of environmental taxation.

2.3 Data and methodology

I consider environmental taxation revenues as the variable reflecting environmental taxation policy. Three categories of factors influencing environmental taxation revenues are taken into account. The first are factors regarding production and consumption processes. The second regards the environmental quality of European countries. Finally, the third category summarises factors reflecting the quality of governance. To check to determinants of the environmental taxation, I use a panel dataset of 22 European countries for the period from 1996 to 2012.

There is considerable evidence of the importance of the degree of economic development for environmental awareness (Dasgupta et al., 2001; Dinda, 2004; Galeotti et al., 2006), demonstrating that economic growth increases the demand for environmental protection. Obviously, economic growth also implies an increase in the demand of goods and services that leads to the increase of energy intensity of the economy. As a consequence, the compatibility between economic growth and the environment can be supported only by functioning environmental policies. To reflect these factors, among the determinants of environmental taxation of the first group I consider such variables as per capita income and energy saving.

When considering environmental quality, we should keep in mind both positive and negative tendencies. The first is production of pollution and emissions coming from any activity related to production and consumption processes. I approximate these factors by the indicator of municipal waste generation and the release of sulphur emissions, which is one of the

important sources of air pollution. Positive trends in environmental quality are considered through the indicator of primary energy production from renewable sources.

Finally, as underlined in the literature, the institutional context plays a crucial role in the implementation of environmental policies (Dasgupta et al., 2001; Fredriksson et al., 2003; Bhattarai and Hammig, 2004). Of particular importance for the implementation of environmental policies is governance quality. In fact, environmental protection can hardly be implemented without state intervention (Castiglione et al., 2012), while the functionality of regulation depends on the strength of the institutional context (Infante and Smirnova, 2009). Moreover, as known, institutional strength is closely related to the degree of economic development (Acemoglu et al., 2001; Giménez and Sanaú, 2007; Welsch, 2008), and so reinforces the positive impact on the environment. For these reasons, I include the governance indicator among the determinants of environmental taxation such as the index of regulatory quality, which is one of the indicators of institutional context. The indicator varies from -2.5 to +2.5, where greater values correspond to a stronger ability of government to formulate and implement policies and regulations. Finally, environmental protection expenditure, as an indicator of environmental awareness of society, is also taken into account. The description of variables used in the analysis and the sources of data are reported in Table 2.1.

Table 2.1: Variables description and sources

Variables	*Description*	*Source*
EnvTax	Total environmental tax revenues, percentage of GDP	Eurostat (2014)
GDP	GDP (constant prices), per capita	Eurostat (2014)
EnConsSav	Energy saving in primary energy consumption, thousand tons of oil equivalent	Eurostat (2014)
SO2	Sulphur oxides emissions, tons	Eurostat (2014)
Wst	Municipality waste generated, kg per capita	Eurostat (2014)
RenewEnerg	Primary renewable energy production, thousand tons of oil equivalent	Eurostat (2014)
RegQual	Regulatory quality, measured in units ranging from -2.5 to 2.5, with higher values corresponding to better regulatory quality	Kaufmann (2014)
PubExp	Environmental protection expenditure, per capita (constant prices)	Eurostat (2014)

Given the widely accepted evidence on the heterogeneous economic, environmental and institutional performance of European countries, I divide the sample into three groups. The first group (G1) includes market-economy countries with mature industrial and service sectors (Austria, Belgium, Denmark, France, Finland, the Netherlands, Sweden and United Kingdom); the second group (G2) refers to market-economy countries that present delayed development at national or regional levels (Greece, Ireland, Italy

and Portugal); former-transition economies (Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Lithuania, Poland, Romania, Slovakia and Slovenia) are included in the third group (G3). The selection of countries was conditioned by data availability.

Data analysis reveals the expected heterogeneity among the three groups of countries. Figure 2.1 shows the relation between environmental taxation revenues and per capita GDP. It can be noted that the G1 group with higher levels of income, presents greater environmental taxation revenue per capita compared to the G2 group. Former-transition countries with lower levels of income, demonstrate lower levels of environmental taxation as compared to the other two groups. This confirms that countries at the advanced stage of economic development enhance their environmental protection policies.

Figure 2.1: The relationship between environmental taxation revenues and income

Important differences also lie in all three categories of the indicators. For example, for production and consumption indicators, energy saving decreases from G1 to G3 group. The same can be said about governance quality indicators, such as regulatory quality, that are lowest for G3, which confirms a still weak institutional context of former transition economies. Taking the environmental quality indicator of environmental expenditure, a similar divergence between the groups can be noted.

In order to evaluate environmental taxation determinants, I estimate a pooled panel data model for three groups of countries:

$$EnvTax_{it} = \alpha_0 + \sum_{j=1}^{2} \alpha_j x_{jit} + \sum_{j=4}^{6} \alpha_j \gamma_{jit} + \sum_{j=7}^{8} \alpha_j z_{jit} + \varepsilon_{it} \quad (1)$$

Where $EnvTax_{it}$ is environmental taxation, x_{it} is a vector of determinants reflecting production and consumption processes: per capita income (*GDP*), primary energy consumption saving (*EnConsSav*); γ_{it} is a vector of determinants of environmental quality: sulphur emissions (*SO2*), municipal waste generation (*Wst*) and production of primary renewable energy (*RenewEnerg*); finally, z_{it} includes the indicators that belong to governance strength: regulator quality (*RegQual*) and environmental expenditure (*PubExp*). A summary of sample statistics is presented in Table 2.2.

Table 2.2: Descriptive statistics

Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
EnvTax	385	0.97886	0.24240	0.16551	1.64229
GDP	391	9.49765	0.81696	7.54960	10.62133
EnConsSav	391	3.34447	1.10266	1.33500	5.56720
SO2	368	11.97669	1.27756	8.95416	14.67756
Wst	385	-9.93222	1.04154	-11.9129	-8.00556
RenewEnerg	391	7.70778	1.105545	5.12694	9.94107
RegQual	391	1.12715	0.48928	-0.16072	2.07664
PubExp	291	4.06358	1.31747	-0.99425	6.61376

Note: variables are expressed in logs.

2.4 Results and discussion

The estimated results of the model are displayed in Table 2.3. The second and third columns report the results for the G1 group, the fourth and fifth columns report the results for the G2 group, while the last two columns show the results for the G3 group.

Table 2.3: Determinants of environmental taxation in G1, G2 and G3

	G1		*G2*		*G3*	
Variable	*Parameter*	*t-statistics*	*parameter*	*t-statistics*	*parameter*	*t-statistics*
			Production and consumption			
GDP	0.307**	2.02	0.742***	3.40	0.086	0.75
EnConsSav	-0.309*	-1.91	-0.642***	-4.42	-0.312**	-2.17
			Environmental quality			
SO2	0.183***	4.08	0.145***	2.53	-0.006	-0.14
Wst	0.005	0.04	-0.626***	-3.36	-0.291**	2.25
RenewEnerg	0.009	0.53	-0.009	-0.12	0.019	0.24
			Governance indicators			
RegQual	0.236***	3.85	0.191***	4.21	0.168*	1.68
PubExp	0.087**	2.31	-0.285***	-3.43	-0.030	-1.28
Constant	-3.889*	-1.85	-10.91***	-4.03	-1.900	-1.18

(*), (**) and (***) denote test statistic significance at the 10%, 5% and 1% levels.

Dealing with panel data, I considered the difference between random and fixed effect models (Cameron and Trivedi, 2009). To estimate equation (1), I preferred the random effects model since dividing the sample into three groups of countries according to their economic characteristics prevents potential correlation between country-specific effects and the explanatory variables.

The upper part of the table presents the estimations for the determinants reflecting production and consumption processes. The effect of per capita income (*GDP*) on environmental taxation is positive and highly significant in the G1 and G2 groups. This confirms the relationship existing between the degree of economic development and environmental awareness. Countries that are in the advanced stage of economic development invest

more on environmental protection. However, the impact of *GDP* on *EnxTax* is higher in the G2 group, since the magnitude of the parameter is 0.742, while in G1 is equal to 0.307. Interestingly, environmental taxation of the G3 group is not influenced by the income variable. This could be the result of the delayed application of environmental policies in former transition countries. In fact, while G1 and G2 economies have a mature environmental taxation system, G3 countries are still at the initial stage of this policy application, which makes it unaffected by the changes in GDP. The confirmation of this result can be found when considering the difference in the levels of environmental taxes collected in the three groups of countries, with about 15% less in G3 as compared to G1 and less than 8% as compared to G2.

Expected results are obtained regarding the primary energy consumption saving variable (*EnConsSav*). The contribution of this determinant for environmental taxation in all groups is negative and statistically significant. The result is straightforward given that energy saving has a positive impact on environmental quality, reducing emission levels and, therefore, decreasing environmental tax payment. Interestingly, this impact has higher magnitude in G2 group (-0.642) compared with other two groups where the impact is equal to -0.309 and -0.312 for G1 and G3 countries, respectively.

The central part of the Table 2.3 reports the estimation for environmental quality indicators. The proxy of polluting factors, such as sulphur emissions (*SO2*), being sources of environmental taxation, has a positive and statistically significant impact on environmental taxation with

similar magnitude in G1 and G2 groups, while it is not statistically significant in G3 group. Weakly enforced environmental policy of G3 group could be the reason why *SO2* has no impact on taxation. An unexpected result is achieved when waste generation (*Wst*) is considered. This variable has no influence on environmental taxation in G1 group, while it is negatively significant for G2 and G3 groups, with higher impact in G2 (-0.626) compared with G3 (-0.291). This finding could also indicate the insufficient enforcement of environmental policy, since greater amount of waste is not found to be reflected in smaller environmental taxation revenues. Primary production of energy from renewable sources (*RenewEnerg*), such as photovoltaic, biomass, wind energy and other sources, has no significant impact on environmental taxation in all groups. Clearly, the production of energy from alternative sources is expected to reduce the production of energy from consolidated polluting sources. However, it should be noted that environmental taxation revenues are often utilised to enhance the diffusion of renewable sources of energy. The non-significant impact of renewable energy production on environmental taxation can be the result of this mechanism.

The lower part of Table 2.3 takes into account the governance quality indicators. Results show that institutions matters for environmental taxation. The variable of regulatory quality (*RegQual*) that reflects perceptions of the ability of government to formulate and implement policies and regulations, is positive and statistically significant in all groups. The highest impact (0.236) is found in the G1 group, while the influence is found to be less for the other two groups (0.191 and 0.168 for G2 and G3, respectively). This

demonstrates that the reinforcement of the quality of governance is crucial for the application and the enforcement of environmental protection policy.

In turn, government environmental spending (*PubExp*) that is aimed to protect the environment has, as expected, a positive and significant role (even though with a low magnitude of 0.087) for environmental taxes in G1 group, while it is not significant for the G3 group. This is in line with our hypothesis of heterogeneity in environmental policies among European countries, where market-economy countries have access to more resources to invest into environmental protection, while former-transition countries are still lagging behind in introduction, application and enforcement of environmental taxation. An unexpected result is achieved for G2 group, where government environmental spending is found to have a negative influence on environmental taxation. This could mean that the countries of this group are not able to take an advantage of environmental protection investments on environmental taxation.

2.5 Conclusions

Progress in environmental quality can be only the consequence of effective policies of environmental protection. The aim of this work is to investigate one of the most utilized environmental policy tools, i.e. environmental taxation. In particular, I check for the determinants of environmental taxation for a panel of 22 European countries for the period from 1996 to 2012.

Environmental taxation is still considered to be a controversial policy

instrument. On the one hand, environmental taxes are proved to be a functional policy that has already given its positive contribution in terms, first of all, of pollution reduction and in terms of economic performance, especially in the most virtuous European countries. On the other hand, environmental taxation is often found to be responsible for distortions in production and consumption processes, undermining economic performance. In order to evaluate the role that environmental taxation plays for the environment and for economic development, it is crucial to understand the factors that may influence this policy instrument. The existing literature on environmental issues does not give an exhaustive explanation of environmental taxes determinants. The present work aims to open a discussion on this important issue.

I search for the environmental taxation determinants by concentrating on three groups of factors. The first group includes the variables responsible for consumption and production processes; the second group refers to the factors that reflect environmental quality; the indicators of the quality of governance are included in the third group. The countries of the sample, in turn, are also divided into three groups in order to highlight the heterogeneity existing of European economies depending on the degree of economic development, environmental awareness and quality of institutions.

The findings are in line with studies that demonstrate the interdependence of economic development and environmental quality, emphasising the role of institutional enforcement (Cole, 2007; Culas, 2007; Dutt, 2009, Leitão, 2010; Castiglione *et al.*, 2012). The model demonstrates the importance of production and consumption indicators expressed as

income per capita and of energy consumption saving for all groups. In turn, environmental quality determinants, such as pollution and waste generation may determine environmental taxation only in those countries that provide strong enforcement of their environmental policies. I find that energy production from renewable sources has an uncertain effect on environmental taxation in all the groups probably because environmental taxation revenues are often utilised to subsidise alternative fonts of energy.

Governance indicators are taken into consideration through the quality of the regulator and through expenditure on environmental protection. The former indicator is proved to be an important determinant of environmental taxation in all groups of countries. The latter indicator is correlated with environmental taxes only for countries with mature industrial and service sectors and not for countries that present delayed development or former-transition economies. This could be due to stagnant or still weakly enforced institutions that limit the application of environmental policies in these economies.

The findings suggest that in order to apply environmental taxation policy, countries should take advantage of the interrelationship between economic growth and institutional enforcement; in other words, the connection between economic development and environmental awareness inevitably requires the application and enforcement of functional environmental policies.

The Effects of the Environmental Taxation.

The First Dividend Hypothesis.

Abstract

The present work aims to add to the existing literature the analysis of the effectiveness of the environmental taxation and, then, of the Environmental Tax Reform (ETR) in European countries.

The main concern of this study is to determine whether environmental taxes and the other environmental policies and measures, such as feed in tariff, green certificates and loans, affect the level of pollution in European countries.

Using a panel dataset that covers 22 European countries over the period 2001-2012, I estimate an OLS and an Arellano–Bover's (1995) two-step dynamic panel approach. Results show that the environmental taxes and the climate change direct investments have an important role in reducing pollution levels. The fiscal and financial incentives, such as feed-in tariffs, grants, loans and subsidies, have a significantly negative effect on pollution. The introduction of the Environmental tax reform, also, has a high effect in improving environmental quality. Results also confirm the existence of an inverted U-shape relationship between the development of a country and its pollution levels.

3.1 Introduction

The first proposal of environmental taxation dates back to 1920, when A.C. Pigou outlined the fundamentals of the relationship between production negative externalities and environment. Since then, economists have devoted increasing attention to the environmental tax as the main instrument for the implementation of the "polluter pays" principle and to achieve the level of "optimal pollution".

The "polluter pays" principle (PPP) is the commonly accepted practice that those who produce pollution should bear the costs of managing it to prevent damage to the human health and to the environment. For instance, a factory that produces a potentially poisonous substance as a byproduct of its activities is usually held responsible for its safe disposal. It is regarded as a regional custom because of the strong support it has received in most OECD countries.

The principle was confirmed as a foundation of European environmental policies and the OECD Council adopted it in 1972 as the primary economic principle for allocating the costs of pollution prevention and control. Economic instruments, such as taxes, are seen as appropriate tools for implementing this principle, which has become the widely accepted framework for internalizing environmental externalities.

At the end of the 1990s the use of environmental taxes in Europe accelerated. Many countries have introduced taxes on environmentally harmful products and activities, or have expanded and refined existing tax schemes with a view to improved environmental effectiveness (EEA, 2000).

3.2 Literature review

In the economic literature, there has been a new wave of interest in the role of the environmental taxation as an active policy of environmental protection. In the last twelve years, a number of OECD countries have implemented the Environmental Tax Reform (ETR); in a series of reports, published in 2005, the EEA defined the ETR as "reform of the national tax system where there is a shift of the burden of taxes, for example on labor, to environmentally damaging activities, such as resource use or pollution". Therefore, the ETR can provide two benefits: the environmental benefit from charging the full cost of environmental resources, and the economic benefit from the reduction in other taxes. The reform is thus said to offer the possibility of a "double dividend": it would help not only the environment but also the economy as a whole.

Since then, a large number of theoretical and empirical studies has focused the attention on the impact of these taxes on the environmental quality, the economic growth and the effectiveness of the tax itself (Bosquet, 2000; Morley, 2012, Abdullah and Morley, 2014).

Bosquet (2000) review a number of studies addressing the effect of the ETR. The main conclusion is that reductions in CO2 emissions may be significant, marginal gains in employment and marginal gains or losses in activity may be recorded in the short-to medium-term, investments decrease and prices increase moderately.

Morley (2012) suggests that the recent introduction of the environmental taxes in the EU has had a significantly negative effect on pollution, but limited effect on the use of energy resources.

Abdullah and Morley (2014) analyze the causal relationship between environmental taxes and economic growth; 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.

Arbolino and Romano (2014) illustrate a methodological approach for evaluating the consequences of adopting an Environmental Tax Reform (ETR) in European countries; results show differences among countries before and after the introduction of the reform on three macro areas, environment, employment and innovation, as well as between adopting and no-adopting countries.

Pearce (1991) was the first that noted that swaps of environmental taxes for distortionary taxes may produce a double dividend by not only discouraging environmentally damaging activities but also reducing the distortionary cost of the tax system.

Bovenberg and de Mooij (1994) demonstrated that an increase in environmental taxes toward a level that fully internalizes the social costs of pollution may no longer be welfare improving if the government requires distortionary taxes to finance its spending.

The environmental effectiveness of an instrument can only be determined by estimating how well it is likely to perform. Harrington et al. (2004) distinguish between estimating how effective an environmental

instrument will be ex ante and evaluating its performance ex post. These researchers were able to find or recreate ex ante estimates of expected emissions reductions in a series of U.S. and European case studies. Their comparison of the ex-ante and ex-post observations suggests a reasonable degree of accuracy in the estimates, with those cases in which emissions reductions were greater than expected involving incentive-based instruments, while the cases in which reductions fell short of expectations involved regulatory approaches.

The main empirical work on environmental taxation has centered on the use of simulations on the impact of ETR on the environment, use of natural resources and the wider economy. Most of the studies conclude that increasing environmental taxes and the ETR can have beneficial effects on the environment (Baranzini et al., 2000).

In any case, taxes are not the only tool implemented for environmental protection. The environmentally related taxes are seldom used in complete isolation. However, taxes are often applied in combination with other environmental policies and measures. In a number of cases there can be environmental and economic benefits from combining a tax with other type of policy instruments.

Fredriksson (1997) suggest that the interaction between the subsidy, the tax rise and the pollution can in some circumstances even lead to arise in pollution. The justification for these exemptions is not just economic, but also environmental: if an industry in the EU becomes uncompetitive, it may switch production to a country outside the EU where environmental regulations and taxes are less stringent.

According to Bithas (2006), in order to prevent environmental thievery, environmental costs should be paid and any use of the environment should be charged. Therefore, even the system of standards should be accompanied by a payment rule for the use of the environment. Probably, an eloquent environmental policy should initially impose a charging system (taxes or auctioned permits) that leads to a protection level. If this protection level is not sufficient, then additional measures, standards among others, could be adopted.

According to OECD (2006), an important requirement for designing efficient and effective policies is to have a good understanding of the links with other policy areas. In addition to coordinating different environmental policies, coordination with other related policies is needed. From this point of view, a good understanding of the interaction between the different instruments is required. For example, the combination of a tax and a voluntary approach, like a negotiated environmental agreement, can increase the "political acceptability" of the former at the cost of reduced environmental effectiveness or increasing economic burden placed on other economic actors. Combining a tax and a tradable permits system can help limit compliance cost uncertainty, compared to the application of trading system in isolation (OECD, 2006). Regarding the acceptability of these instruments, Cherry at al. (2012) use a market experiment to explore the acceptability of three types of instruments: taxes, subsidies and regulatory instruments. They find that overall more than half of voters oppose efficiency-enhancing policies: voters supported subsidies significantly more than taxes while supporting quantity regulation significantly less than taxes.

This is consistent with norms against coercive policy instruments. Concerning a possible trade-off between acceptability and efficiency, estimates indicate differences across instruments. Support for regulation relative to not having any policy in place increases considerably if inefficient half measures are proposed instead of efficient full measures. This is less true for taxes and subsidies. The language used to describe the policy also influences acceptability, which is particularly apparent in the case of the tax instrument.

Johnstone et al. (2010) examine the effect of environmental policies on technological innovation in the specific case of renewable energy. They find that public policy plays a significant role in determining patent applications. Different types of policy instruments are effective for different renewable energy sources.

Goulder (2013) investigates in which way the climate change policy initiatives interact with the fiscal system. The judicious combining of climate policy and tax policy instruments expands opportunities for addressing climate change while meeting other important social objectives.

An adequate development of the environmental taxes cannot be done without a vast collaboration between specialized organs in finance, vast scientific research in the field, with the positive approach of the political parties, national governments and unions that are integrated on a global scale (Cornelia and Lenuta, 2012). According to Berglann (2012), while taxation leads the firms to internalize environmental costs, the market mechanism of other policies, like tradable permits, ensures optimal distribution of damage payments.

According to Murray (2000), understanding the interaction of the environmental regulation with the tax system is so quietly necessary: alternative policy instruments to control pollution can significantly influence the fiscal system.

Aguirre and Ibikunle (2014) investigate factors influencing countries' level renewable energy growth and their results suggest that certain government-backed energy policies impede renewable energy investments, thus implying significant failures in policy design. These policies may be failing mainly because of uncertainty and the likelihood of discontinuity. Weak voluntary approaches are introduced in order to satisfy public demand for more sustainable investments and programs; they find that these may have negative influences on the growth of renewables as well.

Aigner (2013) looks at the interdependence of distributive and environmental policies from a normative perspective. Distributive goals and environmental policies are linked by the cost of public funds. On the one hand, they influence the optimal environmental tax level; on the other hand, they are a function of distribution policies. The analysis shows that if society wants more redistribution, the second-best environmental tax is lower, whereas the first-best environmental tax is higher.

Using a CGE, Allan et al. (2014) investigate the economic and environmental impact of a Scottish specific carbon tax under three alternative assumptions about the use of the revenue raised by the tax: revenues raised are not recycled within Scotland; revenues are used to increase general government expenditure or to reduce Scottish income tax. Finding highlights that, imposing a carbon tax, the pollution reduction target

is met with a very rapid adjustment in all three cases if the model incorporates forward-looking behavior. In addition, the results of the model suggest that a carbon tax might simultaneously stimulate economic activity whilst reducing emissions and thus secure a double dividend, but only for the case in which the revenue is recycled through income tax.

Asensio et al. (2013) empirically analyze a series of temporary and permanent policies (a reduction in the speed limit in highways; an increase in the biofuel content of fuels used in the transport sector and a decrease in commuting and regional train fares). Results are conflicting between the different policies: the speed limit reduction lowered gasoline consumption, while an increase in the biofuel content of gasoline increased this consumption.

Baek et al. (2009) analyze the dynamic relationships among trade, income and the environment for developed and developing countries, using a cointegration analysis. Results suggest that trade and income growth tend to increase environmental quality in developed countries, whereas they have harmful effects on environmental quality in most developing countries. It is also found that for developed countries, the causal relationship appears to run from trade and income to the environment, or rather that a change in trade and income growth causes a consequent change in environmental quality. For most developing countries, on the other hand, the causality is found to run from the environment to trade and income.

Bor and Huang (2010) utilize a CGE model to simulate the effects of a proposed energy tax regime and its complementary fiscal measures on the economy, energy consumption and CO2 emissions. They demonstrate that

all supplementary measures have effectively reduced energy consumption, which means that they have delivered the first dividend (decreasing CO2 emissions).

3.3 Methodology

The model of the effectiveness of the ETR to improve the environmental quality used in this study is partially based on the conventional approach to pollution suggested by Grossman and Krueger (1995). For this reason, the explanatory variables include the real GDP per capita in linear and nonlinear form.

Many econometric studies of the relationship between measures of economic development and pollution have been conducted since the seminal work of Grossmann and Krueger (1991, 1995). Most of the papers focus on a specific conjecture, the so-called “Environmental Kuznets Curve” (EKC) hypothesis, which postulates an inverted U-shaped relationship between the level of economic development and pollution.

According to Stern (2004), economic activity inevitably implies the use of resources and, by the laws of thermodynamics, use of resources inevitably implies the production of waste. Regressions that allow levels of indicators to become zero or negative are inappropriate. A logarithmic dependent variable will impose this restriction. Some studies, including the original Grossman and Krueger (1991) paper, used a cubic EKC in levels and found an N-shape EKC. This might just be a polynomial approximation to a logarithmic curve.

The standard EKC regression model is, therefore:

$$lnPoll_{it} = \alpha_{it} + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{it}^2 + \varepsilon_{it}$$

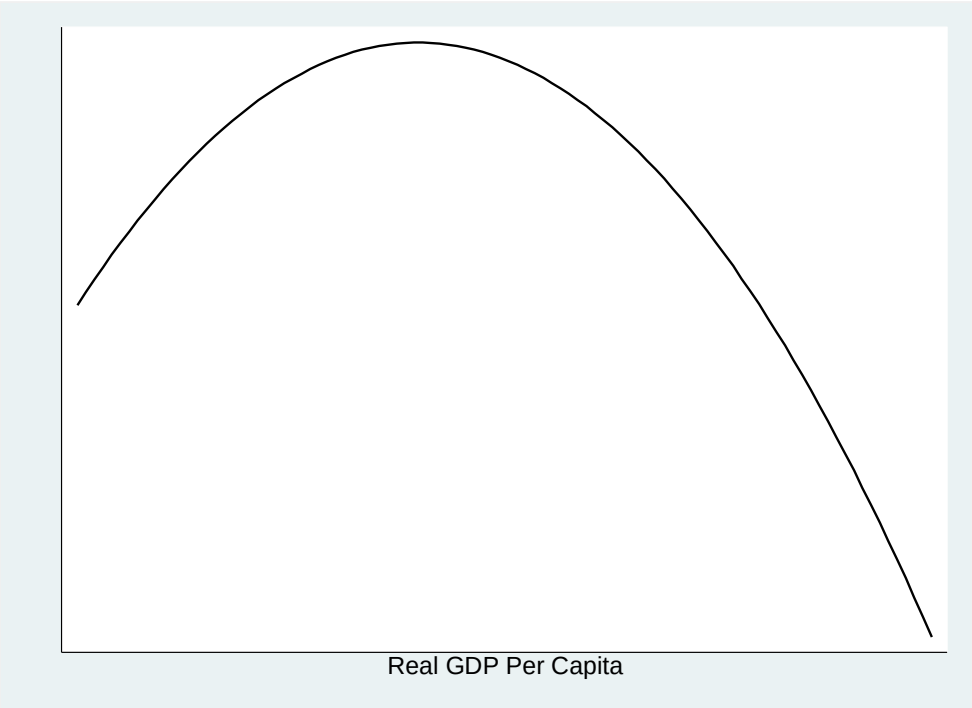
Where $Poll$ represents the Greenhouse gas emissions per capita of country i at time t; ln indicates natural logarithm; GDP is the real GDP per capita; ε_{it} is an error term.

The ‘‘turning point’’ income, where emissions or concentrations are at a maximum, is given by:

$$\tau = \exp -\frac{\beta_1}{\beta_2}$$

Figure 3.1 shows the relationship between the greenhouse gas emissions per capita and the real GDP (EKC).

Figure 3.1: Environmental Kuznets Curve



Source: Author's estimation on 22 countries data over the 2001-2012 period.

Figure 3.1 shows how the environmental degradation increases in the early stage of the economic development, and after per capita income exceeds a certain level, the turning point, it turns to decrease as income increases.

It is interesting to note the different stage of this relationship of the European countries. I estimate the EKC for six countries: Belgium, Germany, Greece, Spain, Estonia and Poland. The first two countries are in an advanced stage of economic development and they could be defined "eco-leader"; Greece and Spain are heavily indebted countries; the latter two are former-transition economies.

Figure 3.2: Belgium EKC

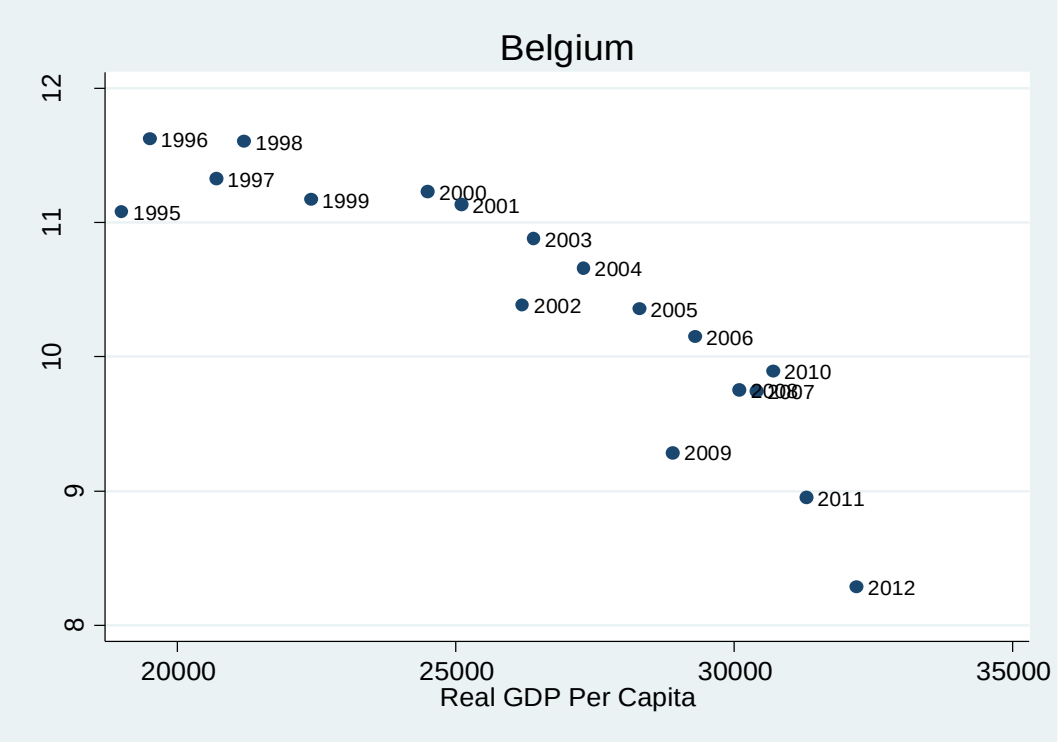


Figure 3.3: Germany EKC

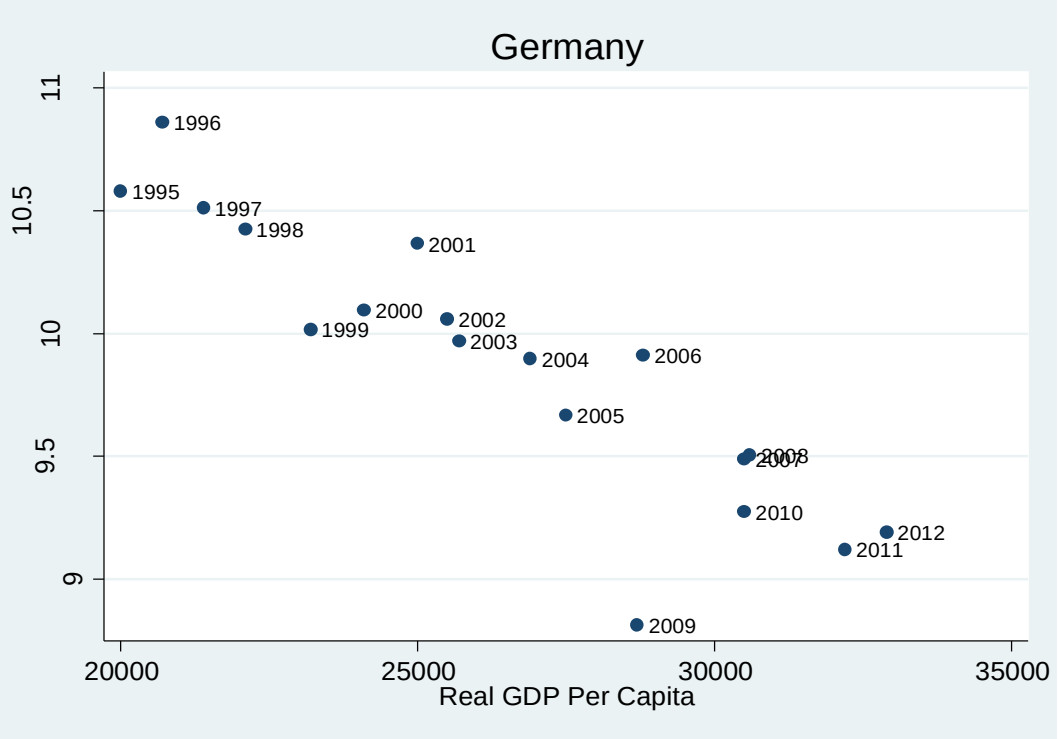


Figure 3.2 and Figure 3.3 show the relationship between the real GDP per capita and the greenhouse gas emissions, respectively, of Belgium and Germany (developed and environmental conscious countries). For both countries, GHG emissions are decreasing, current with an increase in income. It is also interesting to note that the turning point, both for Belgium and for Germany, is approximately when the real GDP reaches the 20.000 € per capita.

Figure 3.4 and Figure 3.5 show the relationship between the real GDP per capita and the greenhouse gas emissions, respectively, of Greece and Spain. These countries reached the turning point approximately in 2005, later than the two previous ones. These are heavily indebted countries, with lower level of income per capita; in any case, it interesting to note that the turning point, also in this case, is around the 20.000 € of GDP per capita.

Figure 3.4: Greece EKC

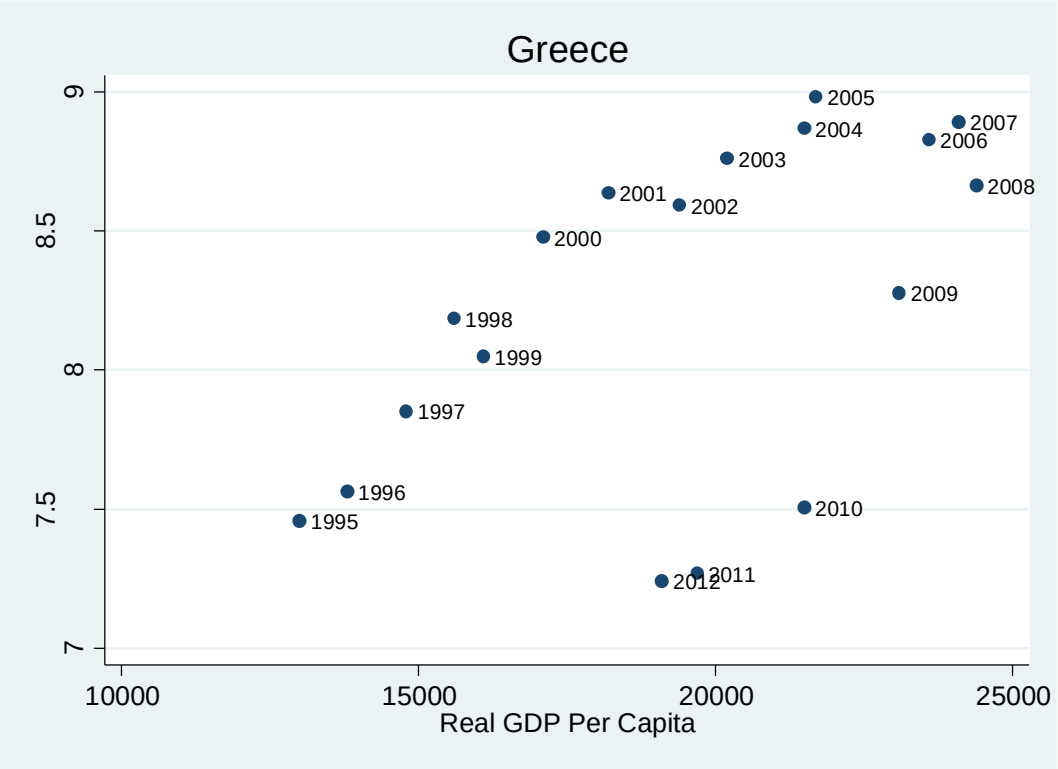
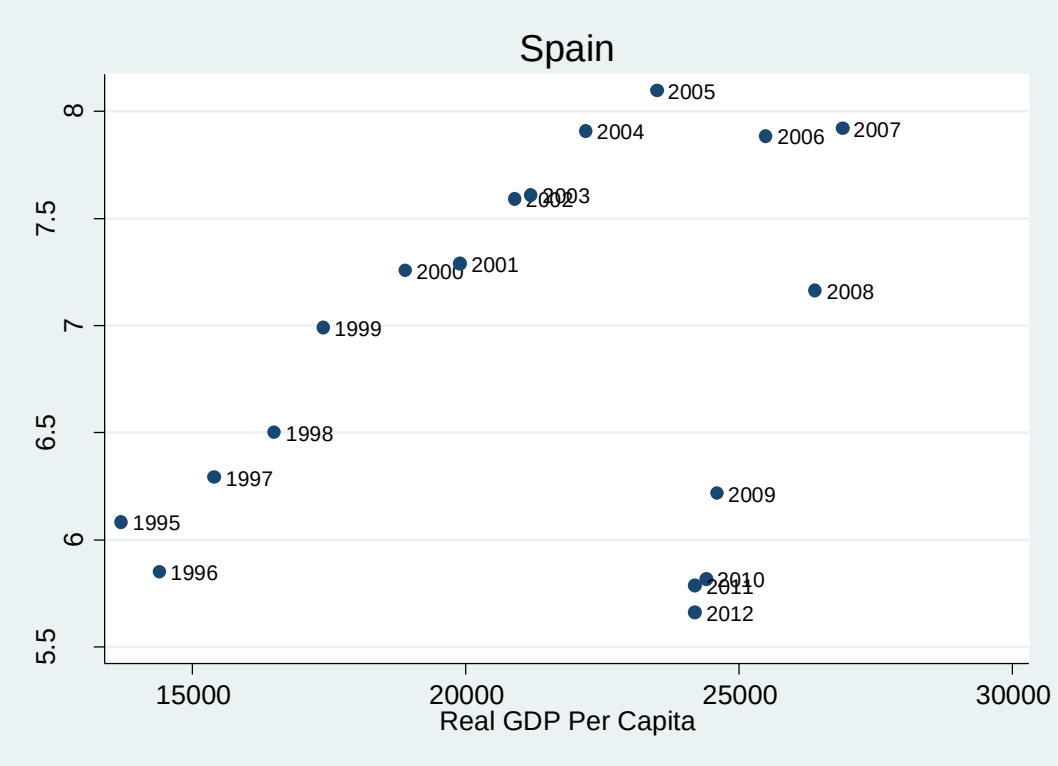


Figure 3.5: Spain EKC



Figures 3.6 and 3.7 show the relationship between the real GDP per capita and the greenhouse gas emissions, respectively, of Estonia and Poland.

These countries, that present delayed development, not reached yet the turning point, even better Estonia and Poland, being in a phase of economic growth, have increasing pollution.

Figure 3.6: Estonia EKC

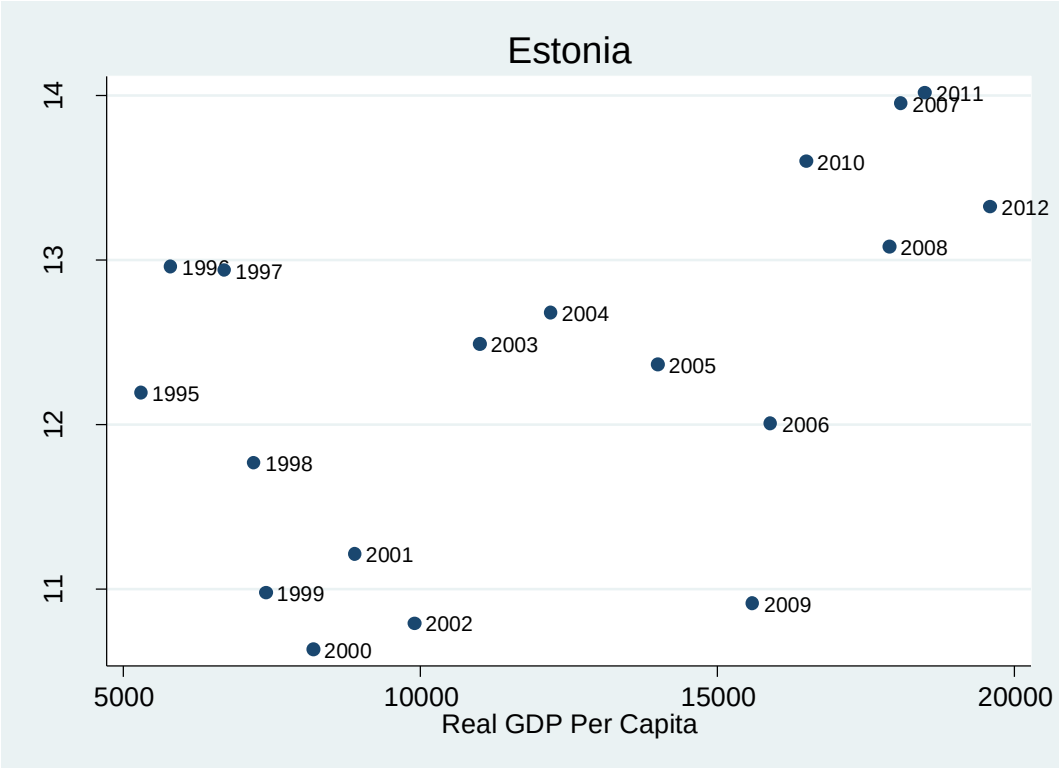
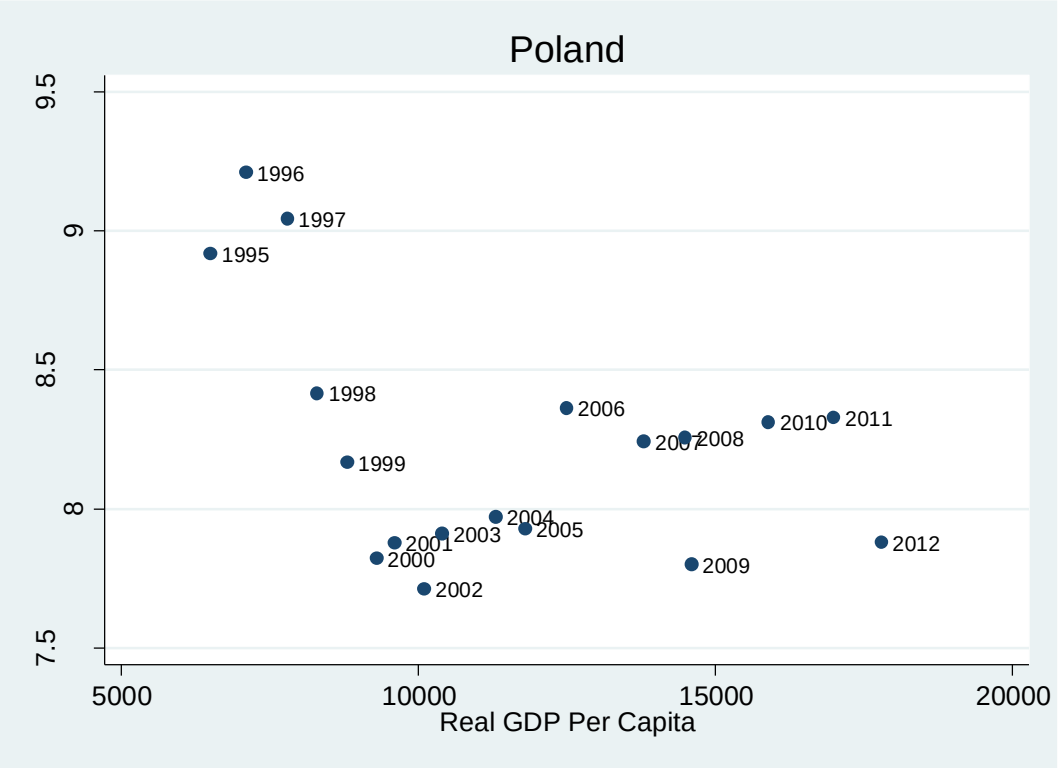


Figure 3.7: Poland EKC



In the model, I speculate also a non-linear relationship between the pollution levels of a country and the respective environmental taxation.

Following Castiglione et al. (2014), I hypothesize the existence of an Environmental Taxation Kuznets curve. The intuition behind the model is the following. With the growth of income, environmental taxation is expected to rise together with emissions until high income and strong institutions contribute to achieving the goals of environmental protection policy to decrease pollution. After this, emissions declines with the further increase of income and environmental taxation. The level of "sustainability" of a country is strictly related to its level of development. It means that more developed countries have high environmental taxation burden, to achieve the ETR goal: a shift of the burden of taxes, for example on labor, to

environmentally damaging activities, such as resource use or pollution. Therefore, while the other taxes fall, the environmental taxation burden rises.

In any case, environmental taxation is not the only instrument planned for environmental protection. In fact, the environmentally related taxes are seldom used in complete isolation. Taxes are often applied in combination with regulatory instruments; in a number of cases there can be environmental and economic benefits from combining a tax with other type of policy instruments.

The "acceptance" of an economic instrument among a public at large seems to be related to the degree of the environmental problem the instrument is to address, and whether this instrument is considered to contribute significantly to reducing the environmental problem. For this reason, it is advisable to "prepare the ground" for later instruments implementation by providing correct and targeted information to the public on the causes and impacts of relevant environmental problems.

According to OECD (2011), an important requirement for designing efficient and effective policies is to have a good understanding of the links with other policy areas. In addition to coordinating different environmental policies, coordination with other related policies is needed. According to Aguirre and Ibikunle (2014), as important as the type and number of policies implemented, so is the need to evaluate how effective and significant they are.

Based on this background, my specific econometric panel specification is:

$$lnPoll_{it} = \alpha_{it} + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{it}^2 + \beta_3 lnEnv\_Tax_{it} + \beta_4 lnEnv\_Tax_{it}^2 + \beta_5 lnX_{it} + \varepsilon_{it}$$

Where $Poll$ represents the Greenhouse gas emissions per capita in country i at time t; ln indicates natural logarithm. GDP is the real GDP per capita; Env_Tax_{it} is the environmental taxation revenue per capita. X_{it} is a vector of other climate change policies and measures taken to reduce greenhouse gas emissions; ε_{it} is an error term.

3.4 Data, variable definitions and descriptive statistics

To illustrate the impact on pollution levels of the environmental taxation and the other climate change policies and measures, I used a panel dataset that covers 22 European countries over the period 2000-2012.

Countries included in the dataset are Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Luxembourg, Netherland, Norway, Poland, Portugal, Slovakia, Spain, Sweden and United Kingdom.

The dataset consists of the following variables:

- Greenhouse gas emissions per capita, in CO2 equivalent;
- GDP real per capita;
- Environmental taxes revenue per capita;

- Direct investments, that represents the cumulated number of funds of sub-national governments, procurement rules and funding;
- Fiscal and Financial incentives, that represents the cumulated number of Feed-in Tariff/Premiums, grants, loans and subsidies;
- Research, Development &Deployment (RD&D): that represents the cumulated number of policies and measures aimed at supporting technological advancement, through direct government investment, or facilitation of investment, in technology research, development, demonstration and deployment activities.
- ETR, that is dummy variable for each year that indicates the introduction of the Environmental Tax Reform since 2005.

Table 3.1 shows label variables, a short description and source.

Table 3.1: Variables, definition and source

Variables	Definition	Source
lnPoll	Total of greenhouse gas emission in CO2 equivalent, thousand tonnes per capita	Eurostat (2016)
lnGDP	Real GDP per capita	Eurostat (2016)
lnEnv_Tax	Environmental taxes revenue per capita	Eurostat (2016)
Dir_Inv	Direct investments, cumulated number	IEA CC Policies and Measures (2016)
Fisc_Inc	Fiscal and financial incentives, cumulated number	IEA CC Policies and Measures (2016)
RDeD	Research, Development &Deployment policies, cumulated number	IEA CC Policies and Measures (2016)
ETR	Dummy=0 if year<2004; =1 if year>=2005	

In Table 3.2, some descriptive statistics are reported.

Table 3.2: Descriptive statistics

	Mean	Sd	Min	Max
lnPoll	0.0777536	0.3347786	-0.8274661	1.039711
lnGDP	10.07759	0.4172094	8.853665	11.13896
lnEnv_Tax	6.308558	0.7911836	4.310769	7.619894
Dir_Inv	0.6526772	0.7611348	0	2.484907
Fisc_Inc	2.236411	1.105176	0	4.26268
RDeD	1.071355	0.9382549	0	2.995732
ETR	0.6153846	0.487357	0	1
N	286			

Next section shows the empirical results using Random and Fixed effects estimates.

3.5 Empirical results and discussion

Table 3.3 shows the results about the impact of environmental taxation and other climate change policies and measures on pollution, using RE and FE estimates.

Table 3.3: OLS estimates

	Random effects	Fixed effects (1)	Fixed effects (2)
lnGDP	3.653***	3.640***	2.279*
	(3.57)	(3.44)	(2.06)
lnGDP2	-0.170***	-0.170***	-0.0990*
	(-3.49)	(-3.38)	(-1.81)
lnEnv_Tax	-0.716**	-0.623*	-0.548*
	(-2.06)	(-1.69)	(-1.80)
lnEnv_Tax2	0.0607**	0.0514*	0.0549**
	(2.07)	(1.63)	(2.15)
Dir_Inv	-0.0497***	-0.0498**	-0.0116
	(-2.80)	(-2.76)	(-0.91)
Fisc_Inc	-0.0858***	-0.0862***	-0.0446**
	(-4.23)	(-4.10)	(-2.11)
RDeD	-0.0164	-0.0185	-0.0101
	(-0.77)	(-0.87)	(-0.65)
ETR	-0.0385***	-0.0279**	
	(-3.69)	(-2.42)	
N	286	286	286
R-squared		0.571	0.775
Country dummies	-	-	Yes
Year dummies	-	-	Yes

In both model, random and fixed effects, SE are robust and corrected for heteroscedasticity; the third column reports the FE regression without the

dummy variable that represents the introduction of the ETR and with the country and year dummies (not reported).

Results are approximately the same in all three cases.

The estimates show that there is an evidence of the existence of the EKC. Therefore, results confirm the inverse U-shape relationship between environmental quality and economic development.

In the model, I hypothesize also a non-linear relationship between environmental taxation and pollution. Results confirm the existence of a quadratic relationship between pollution and environmental taxation. In any case, the evidence does not confirm the ETKC (Castiglione et al, 2014).

The findings show a U-shape relationship between pollution and environmental taxation: it imply that the environmental taxes may be valid tools to reduce pollution, but when they reach too high levels, the environmental taxes have to be combining with other environmental protection measures to improve the environmental quality.

Regarding the other policies and measures, the fiscal and financial incentives only have a significant impact on pollution in all different specification model. Feed-in tariffs, grants, loans and subsidies tend to reduce pollution levels.

Direct investments have a negative and significant impact on pollution both in RE and FE estimations. In any case, when we do not consider the introduction of the ETR, these policies lose their significance.

The RD&D policies do not have any impact on pollution; the motivation might lie in the fact that this type of policy is still not too diffuse in all the countries considered.

The dummy that represents the introduction of the ETR is significant in both model, and this means that the introduction of the Environmental Tax Reform has had a very high impact on pollution, improving the environmental quality.

3.5.1 Robustness check

There are any types of endogeneity problems that plague regressions of environmental quality on institutional and income variables that it should be considered.

One type is the simultaneity bias introduced by the reverse causality of GDP and environmental degradation. While the increases in economic activity that come along with increases in GDP may increase pollution, increases in pollution may, at the same time, harm people's health, for example, thereby reducing GDP. Output and pollution may also be jointly produced in the production process, causing GDP and pollution to be simultaneously determined (Liscow, 2013).

Another problem that should be that in to the account is the endogeneity between pollution and environmental taxation. There is a reverse causality, also in this case, between these two variables: pollution is the most important basis of the environmental taxation and, at the same time, environmental taxation is introduced with the aim of improving the environmental quality.

Finally, an endogeneity problem arises from omitted variable bias. While including policy variables helps reduce the problem of the

endogeneity of GDP, it is still quite plausible that a third variable jointly causes both economic growth and environmental degradation, perhaps cultural or geographic factors not now in the regression formula (Liscow, 2013).

Table 3.4 is the correlation matrix between variables.

Table 3.4: Correlation matrix

	lnPoll	*lnGDP*	*lnEnv_Tax*	*Dir_Inv*	*Fisc_Inc*	*RDeD*	*ETR*
lnPoll	1						
lnGDP	0.543***	1					
lnEnv_Tax	0.482***	0.934***	1				
Dir_Inv	-0.319***	0.222***	0.209***	1			
Fisc_Inc	0.0580	0.651***	0.607***	0.677***	1		
RDeD	0.0223	0.532***	0.499***	0.724***	0.762***	1	
ETR	-0.104	0.276***	0.165**	0.294***	0.324***	0.285***	1

To avoid the endogeneity problem between the variables, I estimate the model using also the Arellano–Bover's (1995) two-step dynamic panel approach.

The DPD (Dynamic Panel Data) is based on the notion that the instrumental variables approach noted above does not exploit all of the information available in the sample. By doing so in a Generalized Method of

Moments (GMM) context, it is possible to construct more efficient estimates of the dynamic panel data model (Roodman, 2009).

The econometric specification of the model is the following:

$$lnPoll_{it} = \alpha_{it} + \beta_1 lnPoll_{it-1} + \beta_2 lnGDP_{it} + \beta_3 lnGDP_{it}^2 + \beta_4 lnEnv\_Tax_{it} + \beta_5 lnEnv\_Tax_{it}^2 + \beta_6 lnX_{it} + \varepsilon_{it}$$

Where $Poll$ represents the Greenhouse gas emissions per capita in country i at time t; ln indicates natural logarithm. $Poll_{it-1}$ is the lagged dependent variable to account for inertia in adjustment to desired or targeted pollution levels. GDP is the real GDP per capita; Env_Tax_{it} is the environmental taxation revenue per capita. X_{it} is a vector of the other climate change policies and measures taken to reduce greenhouse gas emissions; ε_{it} is an error term.

Table 3.5 shows the results from the Arellano–Bover's (1995) two-step dynamic panel approach, using lags of the environmental taxation and GDP in the model as instruments, with Sargan and Hansen's test accepting the null that the over identifying restrictions are valid in all cases. In the second stage of estimation, any heteroscedasticity is accounted using robust SE.

Table 3.5: Two-step dynamic panel model results

	GMM
lnPoll_1	-0.305*
	(-1.77)
lnGDP	20.75***
	(2.75)
lnGDP2	-1.052***
	(-3.01)
lnEnv_Tax	-5.352***
	(-3.37)
lnEnv_Tax2	0.492***
	(3.61)
Dir_Inv	-0.364
	(-1.29)
Fisc_Inc	-0.134
	(-0.80)
RDeD	0.148
	(0.75)
ETR	0.0213
	(0.22)
N	264

The estimation of this model confirms the previous results obtained using RE and FE OLS estimates.

There is a significant impact of the GDP per capita in both the linear and nonlinear forms, supporting the early literature that found the inverted U-shaped relationship between GDP and pollution as suggested by the Environmental Kuznets Curve approach.

The GMM estimates also confirm the quadratic relationship between environmental taxation and pollution. The other climate change policies and measure, in this case, result not significant to improve environmental quality.

3.6 Conclusions

The aim of thr analysis is to verify the effectiveness of the environmental taxation and the other climate change policies and measures taken to reduce pollution, so improve environmental quality.

This study suggests that the recent introduction of environmental taxes and climate change policies and measures in the European countries has had a significantly negative effect on pollution. Findings show an U-shaped relationship between pollution and environmental taxation: it implies that the environmental taxes may be valid tools to reduce pollution, but when they reach too high levels, the environmental taxes should be combined with other environmental protection measures to improve the environmental quality.

Results also confirm the existence of an inverse U-shaped relationship between pollution and the real GDP per capita: there is an evidence on the existence of the EKC.

Finally, the fiscal and financial incentives, such as feed-in tariffs, grants, loans and subsidies, have a significantly negative effect on pollution.

The introduction of the Environmental Tax Reform (ETR), also, has a high effect in improving environmental quality, although its implementation was coinciding with the economic crisis that after the 2007 have hit the European Countries.

Given the results, it is possible to conclude that the ETR has played an important role in reducing pollution levels, reaching the first “goal” that represents the basis of the reform.

Environmental Taxes, Labour Tax and Unemployment: Is there any evidence about the "Second Dividend"? An empirical analysis.

Abstract

Since the introduction of the Environmental Tax Reform, European countries have increased their use of environmental taxes. These instruments may offer the possibility of a double dividend. The first dividend is an improvement of the environmental quality; the second dividend is the possibility of a tax-shifting mechanism of the burden of taxes, for example on labour, to environmentally damaging activities, such as resource use or pollution.

The aim of this paper is to verify the existence of the "second dividend", exploring the relationship between environmental taxation and labour market (labour tax and unemployment). I use a panel dataset that covers 22 European countries over the period 2000-2012 to investigate whether the environmental tax affects the labour tax burden and, consequently, the unemployment rate. I handle endogeneity problems through an instrumental variable approach. Results show that environmental taxation has a significant impact on labor tax, but no impact on unemployment levels.

4.1 Introduction

In the last ten years, a number of OECD countries have implemented the Environmental Tax Reform (ETR); in a series of reports, published in 2005, the EEA defined the ETR as "a reform of the national tax system where there is a shift of the burden of taxes, for example on labor, to environmentally damaging activities, such as resource use or pollution".

A double dividend may arise from the ETR fiscal reform, in terms of more effective environmental protection (first dividend), and in terms of a more efficient economy when it replaces existing distortional taxes, such as labour tax rates (second dividend) that could lead to an increasing employment. In this paper, I focus the analysis to verify the existence of the second dividend.

4.2 Literature review

There is now a considerable empirical and theoretical literature that has attempted to assess the existence of the double dividend. Some papers offer support for the existence of a double dividend (e.g. Bento and Jacobsen, 2007; Taheripour et al., 2008), others provide mixed support (Takeda, 2007) and others no support (Bovenberg et al., 2008; Williams, 2002). Three reasons that have emerged to explain these contradictory results are: 1) the role of specific factors; 2) labor supply and the tax interaction effect; 3) the choice of the instrument used to recycle the environmental tax revenue (Frases and Waschik, 2013).

The notion of double dividend was first proposed by Pearce (1991), who noted that "swaps of the environmental taxes for the distortionary taxes may produce a double dividend by discouraging environmentally damaging activities and reducing the distortionary cost of the tax system". The idea was that the governments should adopt a revenue neutrality approach to levying carbon taxes and use such revenues to reduce other distortionary taxes, maintaining a constant level of the total revenue and expenditure.

Goulder (1995a) analyzes two different notions of double dividend, weak and strong, examining the theoretical and empirical evidence for each. Goulder states that a weak double-dividend claim - returning tax revenues through cuts in distortionary taxes leads to cost savings relative to the case where revenues are returned lump sum - is easily defended on theoretical grounds and receives support from numerical simulations. The stronger versions contend that revenue-neutral swaps of environmental taxes for ordinary distortionary taxes involve zero or negative gross costs; theoretical analyses and numerical results tend to cast doubt on the strong double-dividend claim.

Bovenberg and de Mooij (1994) initially provided a refutation of the double dividend hypothesis: by employing a general equilibrium model, they find that environmental taxes typically render the overall tax system a less efficient instrument to finance public spending.

The double dividend hypothesis is rejected when the economy is made up of one productive sector, using only one productive factor (labour), and one representative consumer (Bosello et al., 2006). But, when there are several productive factors and several consumer groups, the double dividend

can be obtained (Bovenberg and van der Ploeg, 1996; Proost and Van Regemorter, 1995).

According to Oates (1995), pollution taxes can play a significant and constructive role in the revenue system; such taxes not only reduce levels of polluting activities, but they also provide important incentives for research efforts into new and improved abatement technologies.

Bovenberg and Goulder (1996) employed analytical and numerical models to examine the general equilibrium interactions between environmentally related taxes and distortionary taxes. The analytical model shows that in the presence of distortionary taxes, optimal environmental tax rates are generally below the rates suggested by the Pigouvian principle, even when revenues from environmental taxes are used to cut distortionary taxes; the numerical simulations support this result.

Goulder (1995b) pointed out that although substitution between taxes might be able to reduce the social cost of the environmental tax, it would not be effective in improving the overall economic efficiency: the environmental tax as an indirect tax for intermediate goods has a stronger distortionary effect on the market. In a following analysis, Goulder et al. (1998) maintain that the second dividend was decomposed into three effects: the revenue recycling effect, the tax interaction effect, and the tax shifting effect. The second dividend might exist if the benefit to employment generated by the tax shifting effect is higher than the negative effect of the revenue recycling effect and tax interaction effect combined.

According to Repetto et al. (1992), the environmental taxes could be an opportunity for governments to raise revenues in ways that improve

economic productivity while strengthening environmental protection. In their point of view, these revenue options are far more attractive than conventional taxes on payrolls, incomes, profits, and savings that destroy needed economic incentives and reduce the competitiveness.

Parry (1995) identify the ‘‘interdependency effect’’ out of the second dividend effect to emphasize that the benefit derived from replacing the environmental tax with the labor income tax was no match for the deteriorating effect of the environmental tax on the current distortion.

According to Parry and Oates (1998), the double dividend hypothesis should be rejected since their model indicated that the distortionary effect of environmental taxes exceeded the tax reduction effect of labor income taxes. According to Parry et al. (1999), the double dividend effect disappears when the welfare decreases due to the tax interaction effect exceeding the benefit created through the revenue cycling effect.

Fullerton and Metcalf (1997) suggest that the validity of the double dividend hypothesis can not be settled as a general matters: under certain circumstances, a shift to environmental taxes may improve the environment and reduce the overall tax burden; under other circumstances, such a shift may increase the burden of the tax system. They also demonstrate that other types of policies (non-revenue-raising type of command-and-control regulation and a revenue-losing environmental subsidy) can have equivalent impact on the environment and on labour supply.

Chiroleu-Assouline and Fodha (2006) have shown that a balanced environmental fiscal reform may result either in an increase or a decrease of the labour tax rate, depending on the elasticity of consumption and on the

initial tax rates. In both cases, the existence conditions of a double dividend rely on the initial per capita capital stock and on the intertemporal elasticity of substitution. In a recent study (Chiroleu-Assouline and Fodha, 2014), it was shown in a general framework that a budget-neutral environmental tax reform may result in a double dividend, when the economy is characterized by heterogeneous agents (old and young), many classes of employees (heterogeneous labour) and productivity affected by pollution.

Arbolino and Romano (2014) illustrate a methodological approach for evaluating the consequences of adopting an Environmental Tax Reform (ETR) in European countries; results show differences among countries before and after the introduction of the reform on three macro areas, environment, employment and innovation, as well as between adopting and no-adopting countries.

Oueslati (2015) examines the macroeconomic effects of the Environmental Tax Reform in a growing economy, using a model of endogenous growth based on human capital accumulation to simulate numerically the growth effects of different environmental tax reforms and calculate their impact on welfare in the short and the long-term. Results suggest that the magnitude of these effects depends on the type of tax reform and the presence of a convex adjustment cost for investment. Although, the green tax reform that aims to use the revenue from environmental tax in order to reduce tax on wages is always growth improving, its long term welfare effects depend on the capital adjustment cost.

Using a CGE, Allan et al. (2014) investigate the economic and environmental impact of a Scottish specific carbon tax under three

alternative assumptions about the use of the revenue raised by the tax: revenues raised are not recycled within Scotland; revenues are used to increase general government expenditure or to reduce Scottish income tax. Finding highlights that, imposing a carbon tax, the pollution reduction target is met with a very rapid adjustment in all three cases if the model incorporates forward-looking behavior. In addition, the results of the model suggest that a carbon tax might simultaneously stimulate economic activity whilst reducing emissions and thus secure a double dividend, but only for the case in which the revenue is recycled through income tax.

Fraser and Waschik (2013) use a Computable General Equilibrium model to empirically examine the double dividend hypothesis; their results provide support for the existence of a strong double dividend in Australia when revenue is recycled through reductions in consumption taxes.

Bor and Huang (2010) utilize a CGE model to simulate the effects of a proposed energy tax regime and its complementary fiscal measures on the economy, energy consumption and CO2 emissions. Under the assumption of tax revenue neutrality, the use of energy tax revenue generated for reducing income will effectively stimulate domestic consumption and investment, and, consequently, mitigate the negative impacts of the distortionary tax regime (achievement of the second dividend). The double dividend effect is less significant, however, when the supplementary measures being used are for government expenditure. Nevertheless, all supplementary measures have effectively reduced energy consumption, which means they have delivered at least the first dividend (decreasing CO2 emissions).

Due this background, the aim of the present analysis is to verify the existence of the "second dividend" in the European countries. Section 4.3 contains a description of the variables used to conduct the analysis. Section 4.4 show the results about the relationship between environmental taxation and the labour market. Specifically, Section 4.4.1 shows the results regarding the impact of the environmental taxation on the labour tax rate using OLS estimates. In Section 4.4.2 I estimate the relationship using an Instrumental Variable approach. Section 4.4.3 shows the results regarding the impact of the environmental taxation on the unemployment rate. Section 4.5 concludes.

4.3 Data, variable definitions and descriptive statistics

To illustrate the impact of the environmental taxation in the labour market, I used a panel dataset that covers 22 European countries over the period 2000-2012.

The countries included in the dataset are Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Luxembourg, Netherland, Norway, Poland, Portugal, Slovakia, Spain, Sweden and United Kingdom.

The dataset consist of the following variables:

- Tax rate on labour, defined as the income tax on gross wage earnings plus the employee's social security contributions less universal cash benefits, expressed as a percentage of gross wage earnings;

- Wages: average annual wages per full-time and full-year equivalent employee in the total economy;
- Unemployment rate: annual average of unemployed people as a percentage of active population;
- Environmental tax: environmental taxation revenue as a percentage of total tax revenue and social contribution;
- Real GDP per capita;
- Unemployment benefits: amount of unemployment insurance and unemployment assistance as a share of GPD per capita. The unemployment insurance refers to benefits payable to workers satisfying criteria for membership in an unemployment insurance scheme; these are often paid only for a limited period. The unemployment assistance refers to benefits payable to workers either failing to satisfy criteria for membership in an unemployment insurance scheme or who have exceeded the period for entitlement to unemployment insurance benefit;
- Employment protection: a measure of strictness of employment protection; the indicator incorporates 8 data items concerning regulations for individual dismissals;
- Duration of working life: it measures the number of years a person aged 15 is expected to be active in the labour market throughout his life. This indicator has been developed and produced for analysis and monitoring under the Europe 2020 employment strategy.

- Young employed: it is the ratio of the population employed aged 15-24 and total population.
- Primary production of energy.

Table 4.1 shows label variables, a short description and source.

Table 4.1: Variables, definition and source

Variables	Definition	Source
Lab_Tax	Income tax on gross wage earnings plus the employee's social security contributions less universal cash benefits, expressed as a percentage of gross wage earnings	Eurostat (2016)
Env_tax	Environmental taxes revenue as a percentage of total tax revenue and social contribution	Eurostat (2016)
Wage	Average annual wages, 2015 USD PPS	OECD (2016)
Unempl	Annual average of unemployed people as a percentage of active population	Eurostat (2016)
lnGDP	Real GDP per capita, 2015 USD PPS	Eurostat (2016)
Unempl_Ben	Unemployment insurance and unemployment assistance as a share of GPD per capita	OECD (2016)
Empl_Prot	Strictness of employment protection	OECD (2016)
Work_Life	Duration working life, years	Eurostat (2016)
Young	Share of people employed aged 15-24 as a percentage of population	OECD (2016)
En_Prod	Primary production of energy, thousands of tons of oil equivalent	Eurostat (2016)

In Table 4.2, some descriptive statistics are reported.

Table 4.2: Descriptive statistics

	Mean	*Sd*	*Min*	*Max*
Lab_Tax	20.60367	6.90918	2.81	39.26
Env_Tax	6.910629	1.341255	4.16	10.64
Wage	34248.28	11873	10173	58704
Unempl	8.413636	4.172473	1.9	24.8
lnGDP	10.07759	0.4172094	8.853665	11.13896
Unempl_Ben	0.8369084	0.5729657	0.06	2.88
Empl_Prot	2.416085	0.6477352	1.26	4.58
Work_Life	34.28042	3.239499	27.5	40.6
Young	37.69161	13.66111	13	70
En_prod	47764.96	63756.48	63.6	268188.8
N	286			

As it is possible to see in Table 4.2, the average tax on labour is 21%, with a minimum of 2% and a maximum of 39.26%. The unemployment rate swings between a minimum of 1.9% and a maximum of 24.8%, with a mean about 8.41%.

The average working life duration is 35 years, e the average share of young people participation in labour force is the 37%.

For more detailed information, Table 4.6 in Appendix reports the correlation matrix of main variables. The correlation matrix for all the coefficients in the models shows that there is a strong correlation between some variables. Anyway, to avoid this problem, I included in the model one variable at a time, but the results do not change.

4.4 Environmental and labour market

In this section, I analyze whether environmental taxation provide any benefits in the labour market. The purpose is to analyze the relationship between environmental tax and labour tax and, therefore, the unemployment rate.

Section 4.4.1 shows the results regarding the impact of the environmental taxation on the labour tax rate using OLS estimates. In Section 4.4.2 I estimate the relationship using an Instrumental Variable approach. Section 4.4.3 shows the results regarding the impact of the environmental taxation on the unemployment rate.

4.4.1 Environmental and labour taxation

To investigate the impact of the environmental taxation on the labour taxation burden, I estimate the following model:

$$LT_{it} = \beta_0 + \beta_1 Env\_Tax + \beta_2 X_{it} + \varepsilon_{it} \qquad (1)$$

Where, LT_{it} is a variable measuring the tax rate on labour in country i in year t; Env_Tax represents the environmental tax as a share total taxation and social contribution revenue; X_{it} is a vector of economic and institutional variables that represents the labour market characteristics. These variables are: the average wages, the unemployment rate, the real GDP per capita (expressed in logarithmic form), the average duration of the working life, the

unemployment benefits as share of GDP, the strictness of employment protection and the share of "young people" employed as share of total population; ε_{it} is an error term.

The OLS estimated results of equation (1) are reported in Table 4.3 with labor taxation rate as dependent variable.

Table 4.3: OLS estimation results of equation (1)

	Random effects	Fixed effects
Env_Tax	-0.968***	-1.025***
	(-2.81)	(-2.91)
Wage	-0.000561***	-0.000693***
	(-2.63)	(-2.89)
Unempl	0.431*	0.462*
	(1.72)	(1.73)
lnGDP	8.024	8.499
	(1.27)	(1.15)
Unempl_Ben	1.211	1.094
	(1.15)	(1.12)
Empl_Prot	1.480	2.758
	(0.85)	(1.08)
Work_Life	-0.717**	-1.015**
	(-2.52)	(-2.17)
Young	0.259**	0.281**
	(2.42)	(2.15)
N	240	240
R-squared		0.391
Country dummies	-	Yes
Year dummies	-	Yes

In both models (random and fixed effects with SE robust corrected for heteroscedasticity) the environmental taxation is significant and has a negative impact on labour tax rate ; it could represents an empirical evidence about the existence of the mechanism of tax shifting that represents the main target of the Environmental Tax Reform.

Wages are significant, even though a very low impact on the dependent variable. As expected, the unemployment rate affects positively

the labor tax burden: countries that have an high level of unemployment have higher tax rate on labour.

The real GDP per capita, the unemployment benefits and the strictness of employment protection result to be not significant in both models.

The duration working life and the share of young people employed have contrasting effects on labor tax rate, as expected. In fact, a country that has a long duration working life will certainly have higher retirement age; this means more revenue from social contribution and lower expenditure for pensions. At the same time, if there is a high share of young people employed, the labour tax rate will rise.

However, there are some reasons for not interpreting the OLS results as causal. It is well know that there is a strictly correlation between the labour tax and the GDP of a country. In addition, the environmental tax rate, for itself definition is related to GDP and, then, to the total taxes revenue and it means that it is strictly related to the labour tax. This situation can determine a bias in the OLS estimator. The inconsistency of OLS estimator is due to endogeneity of X, meaning that changes in X are associated not only with changes in Y but also changes in the error term. In the next section, I tackle this problem using an instrumental variable approach.

4.4.2 Using IV regression to deal with endogeneity

Equation (1) describes the relationship between labour taxation and environmental taxation. To take into account the fact that there is an endogeneity problem between environmental tax rate and the tax rate on

labour, I estimate the model using the Instrumental Variable estimation strategy, searching for a new variable that is associated with environmental taxation but not with the error term. I use the Energy production as instrumental variable for environmental tax.

The environmental taxation variable, Env_Tax, is treated as endogenous and modeled as the following:

$$Env\_Tax = \gamma_0 + \gamma_1 EP_{it} + \gamma_2 X_{it} + v_{2it} \qquad (2)$$

Where the variable EP_{it} represents the Energy Production in country i in year t. The exclusion restriction put this variable out of equation (1). The coefficient β_1 in equation (1) is the effect of interest.

I suppose, that the two conditions (relevance and exogeneity) for the validity of the instrument are met since the instrument influences the environmental tax (since it represents the basis of the tax) but it is not correlated with the labour tax and, therefore, with the error term ε_{1it}.

I estimate the equation (1) using a Two-Stage Least Squares (TSLS) procedure. Results are reported in Table 4.4.

Table 4.4: TSLS result estimates

Panel A: Two Stage Least Square	
Env_tax	-3.035**
	(-2.14)
Wage	-0.000709***
	(-5.49)
Unempl	0.488***
	(3.42)
lnGDP	5.798
	(1.29)
Unempl_Ben	1.745**
	(2.36)
Empl_Prot	2.273
	(1.19)
Work_Life	-1.009***
	(-3.64)
Young	0.291***
	(3.69)
N	240
Country dummies	Yes
Year dummies	Yes
Panel A: First stage	
En_Prod	0.00000552***
	(2.88)
Wage	-0.0000122
	(-0.75)
Unempl	0.0178
	(0.78)
lnGDP	-1.480***
	(-3.05)
Unempl_Ben	0.213*
	(1.83)
Empl_Prot	-0.0944
	(-0.49)
Work_Life	-0.00839
	(-0.21)
Young	-0.00959
	(-0.82)
N	240

The instrumental variable significantly influence the environmental tax rate. I am reassured that the instrument is not weak, since the F-statistic for

the test of whether the coefficient instrument is equal to zero is 23.08, well above the threshold value of 10 suggested by Staiger and Stock (1997).

For additional information, I tried also other variables to use as instruments. I checked also as instruments the greenhouse gas emissions, the total waste generated per capita and the domestic extraction of resources. However, these instruments, either individually or in combination, reduced the F-test of the First stage.

The obtained TSLS results confirm previously findings: the environmental taxation has a significant impact on labour tax rate. This mean that trough an increase in environmental tax rate, it is possible to obtain the "second dividend" that derives from the Environmental Tax Reform. The aim of this reform is a shift of the burden of taxes on "goods", for example on labor, to "bads", that is environmentally damaging activities, such as resource use or pollution.

Results shows that this mechanism of tax-shifting is obtained, since that there is a negative relationship between environmental tax and labour tax, that means that a rise in environmental taxes causes a fall in labour tax.

In addition, in examining the OLS and TSLS results it is important to highlight that a change in the labor tax may only reflect a taxation policy change in the European countries after the 2008 to contrast the effects of the financial crisis of 2007-2008. To verify this, I take into the account also the Financial Crisis using a dummy, with a value of 0 until 2007 and a value of 1 since 2008. Results are exactly the same of previous estimations and are shown in Appendix in Table 4.7.

Overall, the results in Tables 4.3 and 4.4 document a strong effect of environmental taxation on labour tax rate. However, it is to verify the indirect effect of the ETR on employment we need to study the relationship between the change in the overall tax shifting and the unemployment rate. That is what I do in the next paragraph.

4.4.3 Environmental taxation and unemployment rate

Previous results highlight that the environmental taxation causes a decrease in labour tax rate. It is interesting, now, analyze if this tax-shifting phenomena has any impact on the unemployment rate level.

To represent the tax shifting I use the following definition:

$$Tax\ Shifting = \frac{ET_{it} - LT_{it}}{Total\ Tax\ Revenue_{it}}$$

Where ET_{it} represents the environmental taxation revenue of county i in year t; LT_{it} represent the income tax revenue of county i in year t. this difference is divided by the total of tax revenue in county i in year t.

I think that this variable can be a good proxy to represent the tax-shifting between environmental and labour taxation. In fact, a rise of this variable imply a rise in environmental taxation or a fall in labour taxation, or both. It means that a change in this variable could represent a change in the taxation system of a country. For this reason I decide to use this variable to investigate if the environmental taxation has an indirect and additional impact on the unemployment rate.

To investigate the impact of the environmental taxation on the unemployment, I estimate the following model:

$$Unempl\_rate_{it} = \beta_0 + \beta_1 LT_{it} + \beta_2 Tax\ shift_{it} + \beta_3 X_{it} + \varepsilon_{it} \qquad (3)$$

Where, $Unempl\_rate_{it}$ indicates the unemployment rate of country i in year t. LT_{it} represents the labour tax rate; $Tax\ shift_{it}$ is the difference between the environmental and labour tax revenue as a share of total taxation revenue of country i in year t. X_{it} is a vector of economic and institutional variables represents the labour market characteristics. These variables are: the average wages, the real GDP per capita (expressed in logarithmic form), the average duration of the working life, the unemployment benefits as share of GDP, the strictness of employment protection and the share of "young people" employed as share of total population; ε_{it} is an error term.

Table 4.5 includes the results of OLS regression estimation of equation (3) with the unemployment rate as the dependent variable.

Table 4.5: OLS regression results of equation (3)

	No Lab_Tax	No GDP	No Lab_tax and GDP	All variables
Lab_Tax		0.113**		0.102*
		(2.18)		(1.91)
lnGDP	-6.978*			-6.578*
	(-1.72)			(-1.76)
Tax_shift	-2.647	-1.434	-1.082	-2.875
	(-0.32)	(-0.22)	(-0.14)	(-0.44)
Wage	0.264**	0.258**	0.232**	0.286**
	(2.36)	(2.83)	(2.38)	(2.75)
Unempl_Ben	1.839***	1.946***	2.009***	1.793***
	(3.14)	(3.16)	(3.35)	(2.99)
Empl_Prot	-2.567**	-2.576***	-2.454**	-2.671***
	(-2.64)	(-2.94)	(-2.41)	(-3.19)
Work_Life	0.992***	1.036***	1.030***	1.000***
	(3.80)	(4.27)	(4.26)	(3.79)
Young	-0.413***	-0.448***	-0.442***	-0.420***
	(-6.15)	(-5.86)	(-5.66)	(-6.23)
N	240	240	240	240
R-squared	0.846	0.841	0.833	0.852
Country dummies	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes

I estimate several models, omitting some variables that can cause endogenous problems, but in any case the results are the same.

Results show that the tax shifting phenomena has not a significant impact on the unemployment rate, suggesting that, even if the environmental taxes can reduce the labour tax burden, this cannot necessarily result in a rising of the employment level.

But a decreasing labour tax rate does not necessarily means the creation of new jobs vacancies. According to Fullerton and Metcalf (1997), Environmental taxes raise the cost of production and thus the break-even price of output. This effect reduces the real net wage, which offsets the increase in the real net wage made possible by using the revenue to reduce the labour tax rate. Under certain simplifying assumption that represent a reasonable approximation, the two effects exactly offset.

The labour tax rate is significant and has a positive impact on the unemployment level: higher labour taxes implies higher unemployment rate.

The result about the wages confirm the labour market demand curve: there is an inverse relationship between the wages and the number of people employed.

As expected, the unemployment benefits have a positive and high-significant impact on the level on unemployment; this represents the so-called unemployment trap.

The strictness of employment protection generate, obviously, a decrease in the unemployment rate.

The duration of working life and the share of young people employed have a significant effect on employment level. Exactly specular to labor tax rate analysis, a country that has a longer duration of the working life, will certainly have higher retirement age; this means less job vacancies creation.

4.5 Conclusions

In the last ten years, a number of OECD countries have implemented the Environmental Tax Reform (ETR); in a series of reports, published in 2005, the EEA defined ETR as "reform of the national tax system where there is a shift of the burden of taxes, for example on labor, to environmentally damaging activities, such as resource use or pollution". Therefore, ETR can provide two benefits: the environmental benefit from charging the full cost of environmental resources, and the economic benefit from the reduction in other taxes. The reform is thus said to offer the possibility of a "double dividend": it would help not only the environment but also the economy as a whole.

Depending on which taxes rates are cut and the specific country considered, the second dividend could generate cuts in labor taxes and, therefore, employment gains. Generally, the extent to which double dividend may be earned through environmental taxes depends largely on the already existing tax system of an economy. The interaction of environmentally related taxes with other taxes may then in total have a positive effect on employment. The OECD also point out that the current state of the labor market has to be considered before a meaningful evaluation of the double dividend hypothesis can be undertaken.

I conducted my analysis to verify whether increasing Environmental taxes can reduce the labour tax burden. Results, using OLS and IV estimates, have shown that environmental taxation has a significative and negative

impact on the labor tax rate; it means that, in a tax revenue neutrality system, if environmental taxes rise, labor tax falls.

The analysis also shows that the Environmental tax reform has not impact on unemployment. A decreasing labour tax rate does not necessarily implies the creation of new jobs vacancies: if environmental taxes raise, the cost of production and thus the break-even price of output raise too. This effect reduces the real net wage, which offsets the increase in the real net wage made possible by using the revenue to reduce the labour tax rate and this may be the reason why the analysis shows that environmental taxation has effects on the labour taxation but no effect on employment.

Appendix

Table 4.6: Correlation matrix

	Lab_Tax	*Env_tax*	*Wage*	*Unempl*	*lnGDP*	*Unempl_Ben*	*Empl_Prot*	*Work_Life*	*Young*
Lab_Tax	1								
Env_tax	0.00727	1							
Wage	0.112	-0.463***	1						
Unempl	-0.184**	0.259***	-0.532***	1					
lnGDP	-0.0173	-0.381***	0.916***	-0.593***	1				
Unempl_Ben	0.0840	-0.332***	0.394***	0.268***	0.196**	1			
Empl_Prot	-0.0394	0.164**	-0.304***	0.00550	-0.175**	0.0336	1		
Work_Life	0.232***	-0.208***	0.318***	-0.290***	0.352***	0.204***	0.0813	1	
Young	0.329***	-0.276***	0.503***	-0.580***	0.401***	0.228***	-0.113	0.764***	1

Table 4.7: OLS regression results, accounting Financial crisis. Dependent variable: Labour tax

	Random effects	Fixed effects
Env_tax	-0.957***	-0.977**
	(-2.75)	(-2.75)
Wage	-0.000590**	-0.000695***
	(-2.55)	(-2.84)
Unempl	0.472*	0.468*
	(1.76)	(1.81)
lnGDP	8.391	8.870
	(1.31)	(1.41)
Unempl_Ben	1.226	0.946
	(1.19)	(0.96)
Empl_Prot	1.633	2.290
	(0.90)	(0.98)
Work_Life	-0.865**	-0.907**
	(-2.39)	(-2.49)
Young	0.295**	0.241*
	(2.40)	(2.04)
Crisis	0.462	0.590
	(0.85)	(1.09)
N	240	240
R-squared		0.365

Conclusion

The main concern of this thesis has been the analysis of the determinants and the effects of the environmental taxation in European countries.

The thesis is introduced in Chapter 1, which outlines the context, motivation and aim of this research.

Chapter 2 has focused the analysis on the environmental taxation determinants by concentrating on three groups of factors. The first group includes the variables responsible for consumption and production processes; the second group refers to the factors that reflect environmental quality; the indicators of the quality of governance are included in the third group. The countries of the sample, in turn, are also divided into three groups in order to highlight the heterogeneity existing of European economies depending on the degree of economic development, environmental awareness and quality of institutions.

The model demonstrates the importance of production and consumption indicators expressed as income per capita and of energy consumption saving for all groups. In turn, environmental quality determinants, such as pollution and waste generation may determine environmental taxation only in those countries that provide strong enforcement of their environmental policies. We find that energy production from renewable sources has an uncertain effect on environmental taxation in all the groups probably because environmental taxation revenues are often utilised to subsidise alternative fonts of energy.

Governance indicators are taken into consideration through the

quality of the regulator and through expenditure on environmental protection. The former indicator is proved to be an important determinant of environmental taxation in all groups of countries. The latter indicator is correlated with environmental taxes only for countries with mature industrial and service sectors and not for countries that present delayed development or former-transition economies. This could be due to stagnant or still weakly enforced institutions that limit the application of environmental policies in these economies.

The findings suggest that in order to apply environmental taxation policy, countries should take advantage of the interrelationship between economic growth and institutional enforcement; in other words the connection between economic development and environmental awareness inevitably requires the application and enforcement of functional environmental policies.

The second step of my analysis is to verify the existence of the double dividend hypothesis, which is the main target of the Environmental Tax Reform taken in European countries since 2005.

Chapter 3 verifies the effectiveness of the environmental taxation and the other climate change policies and measures taken to reduce pollution, so to improve environmental quality. This study suggests that the recent introduction of environmental taxes and climate change policies and measures in the European countries has had a significantly negative effect on pollution. Findings show a U relationship between pollution and environmental taxation: it imply that the environmental taxes may be valid tools to reduce pollution, but when they reach too high levels, the

environmental taxes have to be combining with other environmental protection measures to improve the environmental quality.

The introduction of the Environmental tax reform, also, has a high effect in improving environmental quality. Results also confirm the existence of an U-shaped relationship between pollution and the GDP of a country: there is an evidence on the existence of the EKC. Given the results, it is possible to conclude that the ETR has played an important role in reducing pollution levels, reaching the first "goal" that represents the basis of the reform.

The final step of my analysis is to verify if increasing environmental taxes can reduce other distortionary taxes, in particular labor tax. Depending on which taxes rates are cut and the specific country considered, the second dividend could generate cuts in labor taxes and, therefore, employment gains.

In Chapter 4, I conducted my analysis to verify whether increasing Environmental taxes can reduce the labor tax burden. Results have shown that environmental taxation has a significant and negative impact on the labor tax rate; it means that, in a tax revenue-neutrality system, if environmental taxes rise, labor tax falls.

The analysis also demonstrate that the Environmental tax reform has not impact on unemployment. A decreasing labor tax rate does not necessarily implies the creation of new jobs vacancies: if environmental taxes raise, the cost of production and thus the break-even price of output raise too. This effect reduces the real net wage, which offsets the increase in the real net wage made possible by using the revenue to reduce the labor tax

rate and this may be the reason why the analysis shows that environmental taxation has effects on the labor taxation but no effect on employment.

Policy implication

The analysis shows that environmental taxes are an efficient tool to achieve the double dividend that represent the basis of the Environmental Tax Reform. This imply that governments should and could apply an increasing use of environmental taxes not only to improve the environmental quality but also to cut other distortionary taxes.

It is also important to highlight that environmental taxes should do not be used as the only tool to reach the environmental protection. In a number of cases there can be environmental and economic benefits from combining a tax with other type of policy instruments.

The “acceptance” of an economic instrument among a public at large seems to be related to the degree of the environmental problem the instrument is to address, and whether this instrument is considered to contribute significantly to reducing the environmental problem. For this reason, it is advisable to “prepare the ground” for later instruments implementation by providing correct and targeted information to the public on the causes and impacts of relevant environmental problems.

According to OECD (2006), an important requirement for designing efficient and effective policies is to have a good understanding of the links with other policy areas. In addition to coordinating different environmental policies, coordination with other related policies is needed. The combination of a tax and voluntary approach, like a negotiated environmental agreement,

can increase the "political acceptability" of the former at the cost of reduced environmental effectiveness or increasing economic burden placed on other economic actors. Combining a tax and a tradable permits system can help limit compliance cost uncertainty, compared to the application of trading system in isolation.

However, the overall benefit of the ETR for the economy, environment and society are potentially significant. ETR should, therefore, be regarded as a key element in the policymaking toolkit for shifting to a green economy.

The overall benefit of the ETR for the economy, environment and society are potentially significant. ETR should, therefore, be regarded as a key element in the policymaking toolkit for shifting to a green economy.

However, a word of caution should be spent on the conclusion of the impact of ETR in European countries if we consider the economic and technological context in which the ETR has been applied in European countries. From this point of view it is no correct to isolate the labor market from the rest of the economy, ignoring the fact that it is affected by what happens in other markets (Carraro et al., 1996). The 2007-2008 global economic crisis had a differentiated impact on the level of income and unemployment across European countries, introducing a divergent growth path between Northern and Southern European countries, with former countries having shortly recovered after the 2007-2008 global recession, whilst the latter entered in a heavy period of recession that has worsened their rate of growth and, consequently, their rates of unemployment. The introduction of the ETR had a positive impact on the level of taxation on

labour but this positive impact was not sufficient to offset 1) the negative effects of low or negative rates of growth that many European countries registered after the 2007 and 2) the related labour-saving technological innovations and the industrial delocalization in extra-European countries that many European countries have introduced to compete at global level. In this context European policy makers to sustain the level of employment should introduce additional labour policy instruments besides tax shifting from goods to environmental bads.

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