The double dividend and environmental tax reforms in Europe

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THE DOUBLE DIVIDEND AND ENVIRONMENTAL TAX REFORMS IN THE EUROPEAN UNION
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INTERNATIONAL LABOUR ORGANIZATION
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Abstract

This paper is part of a series of discussion papers that have been prepared by the International Institute for Labour Studies (IILS) within the framework of the joint project “Addressing European labour market and social challenges for a sustainable globalization”, which has been carried out by the European Commission (EC) and the International Labour Organization (ILO). The discussion paper series provides background information and in-depth analysis for two concluding synthesis reports that summarize the main findings of the project. This paper relates to the second part of the project “Preparing European labour markets to adapt to the long-run challenge of ensuring the joint social and environmental sustainability of globalization” and the concluding synthesis report “Towards a Greener Economy: The Social Dimensions”. The purpose of this discussion paper is to explore how environmental policies and labour market policies can complement each other to achieve both objectives simultaneously. The paper examines the double-dividend hypothesis, from which ETRs were inspired. It further reviews ETRs, which were implemented across a range of EU Member States in the 1990s and which were often inspired by the theoretical considerations of the double-dividend hypothesis. Additionally, the paper discusses the effectiveness of these reforms and policy considerations with the aim of improving the role of ETRs in realizing the double dividend.
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Main findings

- Theoretical and empirical findings indicate that a double dividend, i.e. both a reduction in CO₂ emissions (environmental sustainability) and improvements in the labour market (job growth and improved equity) are possible if policies are well-designed. The first dividend refers to an increase in environmental quality, e.g. a stable global climate, and the second dividend refers to reduced unemployment.

- Several EU Member States undertook Environmental Tax Reforms (ETRs) in the 1990s aiming at shifting taxation from labour to energy.
  - Formal ETRs have been implemented by Denmark, Finland, Germany, the Netherlands, Sweden and the United Kingdom.
  - On average, environmental tax revenue in the EU has amounted to 2.5 per cent to 3 per cent of GDP, with a declining trend. Environmental taxes account for between 7 and to 8.25 per cent of total tax revenue on average, also with a declining trend.
  - Environmental tax revenue is higher in EU Member States which implemented ETRs than across other EU Member States. CO₂ intensity
has fallen faster – though more work is needed to investigate this relationship.

- Denmark and the Netherlands, in particular, have continually moved towards greater implementation of ETR. Both countries lie significantly above the EU average for the ratio of environmental taxes to GDP, and maintain a rising trend. These countries also have the highest share of environmental taxes in total tax revenue.

- A positive effect on employment can be expected for green jobs and non green jobs if policies are well-designed and implemented accordingly:
  
  - Many concerns about competitiveness could be allayed if ETRs would be implemented and harmonized across EU Member States. A major shortcoming of ETRs is the unpredictability of the direction of tax reforms in the long run. The most important effect of an ETR is behavioural change, which can be achieved if reliable, long-term trends in the tax structure are communicated to the taxpayer.
  
  - A reduction in average labour costs across the entire economy would be disproportionately beneficial to the low-carbon sectors by boosting employment growth in these industries. Moreover, employment growth has been significantly higher on average in low-carbon-intensive sectors (LCIS).

- In order to fully realize the potential of the double dividend EU Member States could give further consideration to improving the delivery and scope of existing ETRs:
  
  - Broadening ETR tax base: Like other taxes on energy, the focus has been narrowly restricted to households’ energy consumption. Re-orienting ETRs to tax production would not only improve efficiency but expand the current revenue base: environmental tax revenue has been trending downward and accounts for roughly 7 per cent of all tax revenue in the EU-27.
  
  - Increased emphasis on labour market measures: A necessary condition of the double dividend is that the revenue from taxing emissions is re-channelled to the labour market in the form of lower taxes on work and increased emphases on other labour market measures, e.g. training. This, is critical to facilitating adjustments in the labour market. However, in a number of instances, the revenue collected through ETRs has been used to finance broader government expenditures. The International Institute for Labour Studies (IILS) conducted a study of the double dividend in
2009 and shows that when carbon tax revenue is used to reduce
distortionary labour taxes, employment increases in all sectors.

- Improving equity through targeted initiatives: With respect to the
  environment, introducing personal energy allowances within the tax
  structure, i.e. a certain amount of energy per household would be exempt
  from tax, based on income and family size could improve equity and
  reduce the regressive nature of the current system. In terms of
  employment, similar consideration should be given to targeting labour
  market measures in similar manner, e.g. by cutting taxes on labour for
  low-income earners as was the case in Denmark.

- The success of leveraging further ETRs in the context of the EU will require that
  efforts are harmonized among Member States and that reforms are undertaken with a
  longer-term perspective. Indeed, communication of long-term price signals to markets
  will yield lasting behavioural changes of producers and consumers.

A. Theory of the double dividend

The question of environmental policies and their impact on employment is often
discussed in the context of the so called double dividend hypothesis (DDH). In the case of
climate change mitigation policies, on which this discussion paper mainly focuses, the
environmental policy analyzed is a carbon tax – or more generally, environmental (green)
taxes. The DDH can help understand the effects of proposed climate policies on
employment in the economy. See Pearce (1991) for a discussion on the double dividend in
the context of carbon taxes. Also refer to the ILO’s World of Work Report (2009), which
models the employment effects of a reduction in CO₂ emissions.

This section reviews different notions of a double dividend on theoretical and empirical
grounds, based on the work of Samaan (2011) and Goulder (1995a). Since the DDH has
also inspired ETRs in several European countries, a discussion of ETR design and results
is offered in subsequent sections

The DDH claims that benefits to the environment and employment can be simultaneously
achieved through properly designed climate policy. This paper considers the method of
carbon taxation.

1. The first dividend is an increase in environmental quality

CO₂ emissions constitute an externality. These emissions result in damage to the
environment, which translates into reduced output, reduced profits, as well as other utility
losses. The free market process therefore arrives at an inefficient allocation, as it does with all externalities. A Pigou tax is one policy tool that can correct the externality and improve welfare and efficiency (see for example Nordhaus (2008); Goulder (1995a)).

Dealing with this kind of externality (CO₂ emissions) is very complex, given its dynamic nature: First, polluters have been polluting in the present and in the past, while most of the damages will occur in the future. Second, the aggrieved parties are to a large extent unborn future generations. Third, the magnitude of future damages is highly uncertain, since the complexity of the climate system is not fully understood. In other words, the cost of the externality is difficult to quantify. Finally, the greenhouse effect is a global problem and polluters and aggrieved parties are dispersed across national borders and world regions.

The efficiency gains of the first dividend, an improvement of the environment through a reduction of global GHG emissions, already result in increased output and increased employment on a worldwide scale. However, due to the complexities mentioned, it is not clear which regions of the world can expect output and employment gains, and whether these gains occur now or in the future.

From a political point of view, internalizing the externality of CO₂ emissions is extremely difficult. Yet, when considering global population and global GDP, the current allocation (i.e. the one with unregulated CO₂ emissions) is inefficient and removing the externality leads to a Pareto improvement (see Foley (2007); Rezai et al. (2009)). This means that it is possible to shift world GDP growth to a path where no one is worse off and at least some people are better off. Internalization of the external effect produces the first dividend. From here on, this first dividend is referred to as “environmental benefits”, even though it is emphasized that these benefits can very well be translated into tangible economic terms like higher future GDP, higher profits, higher consumption or higher employment.

The problem with this first dividend, which is alone justification for environmental taxes or other corrective instruments, is that the magnitude of the benefits is uncertain and may lie far in the future (see Goulder (1995b)). In fact, implementation of the tax imposes costs on those who currently over-emit CO₂ in the present. These costs stem from certain quantifiable behavioural changes from the status quo.¹ While the net cost of a properly designed carbon tax is negative (i.e. produces global welfare gains), there is indeed a positive gross cost in the present. This gross cost is usually expressed in terms of reductions in current GDP growth for some countries or regions, including possible losses in employment. Implementation of a carbon tax has therefore been a rather unattractive tool for policy makers.

¹ These “gross” costs are not measured as deviation from a Pareto-optimal allocation but from the status quo. “Net” costs include the benefits of a deviation from the status quo. A negative net cost of a tax indicates a welfare improvement while a negative net cost means a welfare reduction.
Given this dilemma, policy makers have developed a preference for the DDH, which claims that the gross cost of a carbon tax (or other environmental tax) is zero or even negative. This means that the implementation of the tax does not cause any welfare losses (gross cost of zero) or even generates welfare benefits (negative gross cost) besides welfare benefits arising from environmental improvements. Under these circumstances, implementation of the tax would be either costless or beneficial no matter the magnitude of the environmental benefits (as long as they are still positive). Thus, the DDH guarantees positive net benefits. If costs cannot be assured to be zero, then policy makers must support their efficiency arguments through the messy business of comparing (uncertain) environmental benefits with abatement costs (see Goulder (1995b, p.3)). The main mechanism to reduce positive gross costs of a carbon tax, according to the DDH, is revenue recycling. If the tax revenue is then used to reduce other distortionary taxes, the total cost of the tax can be reduced or even become zero or negative. Also, if environmental benefits are included in gross costs, a welfare improvement or net negative cost would always be apparent.

Goulder (1995b) distinguishes three versions of the double dividend hypothesis, based on the size of the cost reduction of the implemented carbon tax. The weak form claims that cost savings are achieved relative to the case where the tax revenues are returned to taxpayers in lump-sum fashion if the tax revenues are instead used to reduce marginal tax rates of a distortionary tax. The intermediate form claims that it is possible to find a distortionary tax such that the revenue-neutral substitution of the carbon tax (environmental tax) for this tax involves a zero or negative gross cost. The strong form claims that the revenue-neutral substitution for typical or representative distortionary taxes involves a zero or negative cost. It is important that the terms "cost reduction" and "zero or negative cost" be understood here in a general way for all kinds of welfare gains. Often these welfare gains are specified in concrete economic terms, such as reduced unemployment or increased profits (see Bovenberg & van der Ploeg (2002); Carraro et al. (1996); Nielsen et al. (1995)).

2. The second dividend is reduced unemployment

This dividend is achieved via reductions in distortionary labour taxes, financed through carbon tax revenue. Distortionary labour taxes can include many types of labour costs, such as wage taxes and social security contributions.

The welfare gain of the first dividend, the cost of the carbon tax and the implications of the double dividend can be demonstrated graphically in a simplified, static framework:

Figure 1 shows the free market solution of the production of a representative good x, say world GDP, in a case where no externality exists.
Marginal private cost (MC) and marginal private benefits (MB) coincide with social cost and social benefit. At the amount $x_{opt}$ total welfare of society is represented by the area A between MB and MC. An increase of x beyond $x_{opt}$ would trigger higher addition costs than addition benefits and therefore reduce overall welfare. One possibility to obtain the solution $x_{opt}$ could be through the free market price $p^*$. Figure 2 shows the same situation in case of an existing externality. The production of x now causes damage that is not included in private marginal cost, e.g. x entails CO2 emissions whose negative long-term costs are not taken into account by producers of x.
Marginal private cost (MC) and social cost (SC) do not coincide. The free market price $p^*$ leads to an overproduction $x_{\text{priv}}$. The optimum lies at $x_{\text{opt}}$ where marginal social cost and marginal (social) benefit intersect. Reducing $x$ from $x_{\text{priv}}$ to $x_{\text{opt}}$ causes private welfare reduction in the amount of the area of triangle A. These are the costs that are often referred to as mitigation cost or cost of a carbon tax. However, through the reduction from $x_{\text{priv}}$ to $x_{\text{opt}}$, society also avoids social costs in the amount of $(A + B)$, the total shaded area. Thus, world society experiences a net welfare gain in the amount of B since the gains of avoided social cost $(A + B)$ overcompensate the losses in A.

Figure 3 shows how the welfare gain can be realized through the implementation of a carbon tax:
Figure 3: Welfare gains of a carbon tax

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \tau )</td>
<td>Carbon tax</td>
</tr>
<tr>
<td>( p^*_\text{priv}+\tau )</td>
<td>Free market price</td>
</tr>
<tr>
<td>A</td>
<td>Lost profit due to carbon tax</td>
</tr>
<tr>
<td>B</td>
<td>Lost consumer rent due to carbon tax</td>
</tr>
<tr>
<td>C</td>
<td>Tax revenue</td>
</tr>
<tr>
<td>D</td>
<td>Net welfare gain of carbon tax</td>
</tr>
<tr>
<td>A + B</td>
<td>Gross cost of carbon tax</td>
</tr>
<tr>
<td>A + B + D + E</td>
<td>Total cost of producing ( \Delta x )</td>
</tr>
<tr>
<td>A + B + E</td>
<td>Total benefit of producing ( \Delta x )</td>
</tr>
</tbody>
</table>

The welfare losses A and B (by moving from \( x_{\text{priv}} \) to \( x_{\text{opt}} \)) also result in employment losses. However, the avoided welfare losses (area \( A + B + D \)), including avoided employment losses, over-compensate the losses A and B. Thus, a net welfare gain (D) occurs.
In the case of global CO₂ emissions, the previously described Pareto improvement, i.e. a reduction of \( x_{opt} \) to \( x_{opt} \), is practically difficult to achieve due to the global and inter-temporal dimensions of the problem. Thus, if \( x \) is understood as world output then the respective areas in the graph represent global welfare of different generations and different geographical regions. The damages \( (A + B + D) \) occur largely in the future, their exact size is highly uncertain, and they are not evenly distributed across countries in the world. The same is true for the welfare losses caused through the reduction in \( x \) \( (A + B) \). Roughly speaking, the benefits of reduced emissions \( (A + B + D) \) will mainly be realized by developing countries in the future while the welfare losses \( (A + B) \) occur mainly today in developed countries. The challenge of green growth is to find a mechanism to realize and distribute achievable welfare gains.

The DDH now claims that the areas \( (A + B) \), i.e. the gross cost of the carbon tax, can become zero or even negative if the tax revenue is used to reduce the excess burden of distortionary taxes. Basically, this means that the cost of other taxes, such as labour taxes, are greater than the area \( (A + B) \) (cannot be shown in the same diagram), so that the economy as a whole experiences efficiency gains independently of the size of gained environmental benefits \( (A + B + D + E) \).

On theoretical grounds, the claims of a weak double dividend are widely accepted and considered relatively uncontroversial (see Goulder (1995b)). Bovenberg & de Mooij (1994) develop a general equilibrium model to study the strong version of the double dividend claim in the labour market context. The only tax in their model is a labour income tax. The authors find that the strong claim is substantiated if and only if the uncompensated wage elasticity of labour supply is negative. Since empirical studies tend to find positive values for the uncompensated elasticity, the Bovenberg-de-Mooij model suggests a rejection of the strong form of the DDH.

Both of these conclusions crucially depend on certain assumptions about the tax system and the labour market mechanisms in place prior to the introduction of a carbon tax. Under idealized market conditions with perfect competition, a commodity tax and a wage tax can both be designed equivalently in terms of costs (see Kaplow (2008)). In other words, distortions in the commodity and labour markets are interrelated. An environmental tax on the commodity markets can therefore have distorting effects on the labour market, reducing the potential of a strong double dividend. As Goulder (1995a) points out, a main insight of the Bovenberg-de-Mooij analysis is that partial equilibrium analyses of the gross costs of environmental taxes can be highly misleading and that the question of a possible double dividend in the real world is very complex.

Nevertheless, general conclusions can be drawn on the conditions under which a strong double dividend is likely to occur. According to Goulder (1995b), the gross costs of a revenue-neutral environmental tax will be lower if:
1. In the initial tax system, the difference in the marginal efficiency costs (marginal excess burdens) is large.

2. The burden of the environmental tax falls primarily on the factor with relatively low marginal efficiency cost.

3. The base of the environmental tax is relatively broad, so that the distortions it generates in intermediate good and consumer good markets are small.

4. Revenues from the tax are devoted to reducing tax rates on the factor with relatively high marginal efficiency cost.

Other aspects of the theoretical analysis concern questions of whether capital is considered, whether involuntary unemployment exists, whether markets clear, whether the environment is treated as a capital good and whether the economy is open or closed.

The OECD has prepared several reviews of studies about the employment effects of environmental policies over the last decades (see OECD (1978); OECD (OECD 1997); OECD (2004)). OECD (2004) deals specifically with climate policies. It distinguishes between "bottom-up" approaches, in which specific policies have been implemented at the local level ("territorial initiatives"), and "top-down" approaches, in which macroeconomic policy is implemented at the "top" level by policy makers and institutions.

OECD (2004) reviews different top-down models and draws some conclusions on the DDH. Generally, the extent to which a double dividend may be realized through environmental taxes depends largely on the existing tax system of an economy and the state of the labour market. The interaction of environmental taxes with other taxes (through revenue recycling) may have an overall a positive effect on employment.

Some studies about the employment effects of environmental policies disregard economic feedback effects and simply determine the number of jobs that have been created in a particular (environmentally-related) sector. More comprehensive studies employ some kind of theoretical model that maps the economic reality into a simplified system. Different models make different assumptions about the labour markets and the economic mechanisms at work. With respect to the processes in the labour market, for example, a wage bargaining model, an efficiency wage model or a job-matching model could be utilized.

OECD (2004) roughly groups the economic models into a) econometric models that are usually demand driven and allow for disequilibrium markets; b) general equilibrium models that are based on simultaneous equilibria of all involved markets; and c) partial equilibrium models. Most models assume exogenous technical change and exogenous and fixed preferences. Due to the variety of assumptions that may still be altered, different results occur. Nevertheless, the OECD (2004) identifies general tendencies regarding the potential occurrence of a double dividend:
"A strong double dividend cannot occur if the existing tax structure is revenue-optimal. If, as is likely in practice, the existing tax structure is not revenue-optimal, a strong double dividend will occur if the environmental tax reform moves the tax structure in the direction of revenue-optimality. In a situation with involuntary unemployment, employment will only increase if the use of environmental taxes to partially replace existing taxes results in an increased demand for labour. If the labour market is in equilibrium, additional employment could only be caused by increasing labour supply."

On a general level, no necessary or sufficient conditions can be found for when an increase in environmentally related taxes combined with a reduction in e.g. payroll taxes will increase employment. Based on the study by Heady et al. (2000), OECD (2004) identifies the following factors that make the occurrence of a double dividend more likely. When there is involuntary unemployment, the prospects of increased employment are higher if:

1. The environmental tax can be passed on to factors that are inelastically supplied and relatively under-taxed.
2. Non-working households are large enough in numbers, and are significant as consumers of goods produced with the environmentally intensive inputs that are taxed.
3. Through international market power, the environmental tax can raise the price of goods produced with a relatively intensive use of the taxed environmental input.
4. Capital is relatively immobile internationally. In this case it can absorb some of the environmental tax and less of the tax burden falls on factors such as labour.
5. The elasticity of substitution between the environmental input and labour is greater than the elasticity of substitution between energy and capital.
6. The real wage rises little when unemployment falls, so that the reduction in the taxes on labour are not offset by wage rises.

When there is only voluntary unemployment, conclusions (1) to (4) still hold, but conclusions (5) and (6) are replaced by another factor: the environmental tax is levied on goods that are more complementary to leisure in consumption than the goods whose taxes are reduced.

At least as important as the above theoretical analysis are empirical studies in which the relationship between taxation and welfare costs is examined on the basis of actual economic data.

B. Empirical evidence of the double dividend
Several empirical studies have attempted to address the DDH. In the U.S., Shackleton et al. (1992) use the DRI and LINK econometric macroeconomic model, as well as the Goulder and Jorgenson-Wilcoxen intertemporal general equilibrium model. In the first two modelling frameworks, a phased-in carbon tax is accompanied by a cut in personal income tax. In the Jorgenson-Wilcoxen model, the revenue is recycled through a cut in the labour tax. In terms of welfare changes, the authors only consider the gross costs of the tax, excluding the welfare gains from environmental benefits.

In the DRI and the LINK model, Shackleton et al. (1992) find positive gross costs of the tax, i.e. welfare losses. These results do not support the strong dividend claim. However, in the Jorgensen-Wilcoxen model, they find negative gross costs of the tax if the revenue is used to reduce labour taxes, thus supporting the strong dividend claim. The reasons for the difference in these results are not entirely clear. Goulder (1995b) suspects that differences in the considerably higher marginal excess burden of capital taxation and the assumption of perfect capital mobility in the Jorgenson-Wilcoxen model may be the causes.

The studies conducted by Goulder (1995a) and Shah & Larsen (1992) introduce a constant carbon tax, or fossil fuel tax, accompanied by reductions in the personal income tax rate. All three studies for the U.S. find positive gross costs of the implemented tax, casting further doubt on the DDH in its strong form. Consensus on the issue remains elusive however, particularly because the sources of differences in the models are not entirely understood. Simulations based on data of European economies tend to be a little more optimistic about the strong double dividend.

Some EU Member States have introduced ETRs in the past years, and a number of empirical studies evaluate the employment effects of these reforms. In Germany, for example, the most comprehensive studies were carried out by Bach et al. (2001) and Frohn et al. (2003). Both studies employ simulation models. The PANTA RHEI model is an econometric simulation model of the research centre RWI (“Rheinisch-Westfälisches Institut für Wirtschaftsforschung”), for the German economy. It is a detailed multisectoral model covering 58 industrial branches. In PANTA RHEI, all parameters are estimated by econometric methods using time series data from the input-output tables of the German economy. The model has a disaggregated energy and air pollution module and is built for medium-term forecasts up to 2020. The methodology and empirical results of this model are discussed in detail by Meyer et al. (1999) and Meyer (2005). Also, Lutz & Meyer (2008) provide an overview of empirical studies about the effects of the German tax reform that have been conducted over the last years.

Germany’s ecological tax reform boiled down to introduction of energy taxes and a continued increase of the existing petroleum tax. The tax revenue has been used to subsidize social security contributions levied on labour, thereby reducing the effective

\[^2\] Studies by Bach et al. (2001) were conducted by the German Institute for Economic Research (DIW) on behalf of the German Federal Ministry of Finance.
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wage cost (there are large exceptions from the energy tax for energy-intensive industries and air traffic.) Bach et al. (2001) conclude that the eco tax will reduce Germany’s growth only slightly (-0.1 per cent), but will increase employment and reduce CO₂ emissions. However, the latter two effects are rather small and by no means sufficient to solve either the problem of climate change or the problem of high unemployment in Germany. Due to these relatively small effects, some economists have called the German reform an "eco-political fig leaf" (see Boehringer & Schwager (2003)).

Frohn et al. (2003) confirm the results of Bach et al. (2001). All scenarios resulted in slightly positive employment effects and a small reduction of emissions. While the employment increase did not react very strongly to an increase in the tax rates and the abolishing of eco tax exemptions, CO₂ emissions fell more sharply in scenarios with higher tax rates and no exemptions from the eco tax. The highest reduction in CO₂ emissions was achieved in a scenario with a hypothetical CO₂ tax (as opposed to an energy tax). However in this scenario, the (still) positive employment effect was the weakest and the decelerating effect on macroeconomic activity was the strongest. A switch from the current energy taxation to a CO₂ tax is endorsed by most authors. Besides different findings and criticism about the size of the “double dividend” in the case of the German experiment, we can at least conclude that no cumulative negative effects on employment were found.

Some studies concluded that imposing the ecological tax is one of the most effective green policy instruments because it has positive impacts on energy efficiency, climate protection and employment. According to the Research Project commissioned by the German Federal Environmental Agency (UBA), by undertaking the ecological tax reform created 250,000 jobs particularly in labour-intensive sectors during 1999-2003. Moreover, fuel consumption and CO₂ emissions have been reduced by 7 per cent and by 2-2.5 per cent respectively (see Robins et al. (2009)).

Significant research on climate change has been done by the MIT Joint Program on the Science and Policy of Global Change. The Program integrates multidisciplinary expertise from the Center for Energy and Environmental Policy Research and the Center for Global Change Science and collaborates with other major research groups within and outside MIT. At the heart of the Joint Program's work lies the MIT Integrated Global System Model (IGSM). This comprehensive tool analyzes interactions among humans and the climate system.

The Emissions Prediction and Policy Analysis (EPPA) model is a component of MIT’s Integrated Global System Model (IGSM) (see Babiker et al. (2001)). EPPA, which is also designed to evaluate the economic impacts of policies for limiting GHG emissions, belongs to a class of economic simulation models known as computable general equilibrium (CGE) models. Babiker & Eckaus (2007) use the EPPA model to study the theoretical unemployment effects of restrictions on GHG emissions. A variety of research
papers focusing on different economic aspects of climate change have been produced by the MIT Joint Program on the Science and Policy of Global Change.³,⁴

Babiker & Eckaus (2007) allow for labour market rigidities – for example limited mobility of labour among sectors – and thus include scenarios in which involuntary unemployment occurs. The authors simulate three different scenarios for the following labour market environments: (1) mobile labour and flexible wages; (2) sector-specific labour but flexible wages; (3) mobile labour but rigid wages; (4) sector-specific labour and rigid wages. The three climate policy scenarios are: (1) no GHG policy restrictions (reference solution); (2) Kyoto-like emission restrictions imposed without any offsetting policies; (3) Kyoto emissions restrictions but with labour subsidies to offset the unemployment and the economically depressing effects of those restrictions.

Babiker & Eckaus (2007) are hesitant to give exact measures of the effects due to the limits of data and of the EPPA model. However, they find results similar to ours. Their analysis indicates that "there would be a real, direct depressing effect from the imposition of emissions restrictions". The employment effects they anticipate are expected to be only small but negative caused by a reduction in GDP growth under the implemented climate policies. Thus, in their modelling framework they cannot find support for the DDH. They recommend that other policy measures, such as wage subsidies, be implemented to mitigate negative employment effects of climate policies.

The IILS also conducted a study of the double dividend of carbon taxation. In the World of Work Report (2009), the IILS models the employment effects of a carbon tax for nine countries, including France, Germany, Hungary, Sweden and the UK from the EU.

When tax revenue is used to address distortionary labour taxes by cutting social security contributions, employment rises in all sectors. The increase in employment in low-carbon-intensive industries (LCII) is three times larger than that in the high-carbon-intensive sector (HCIS). Overall, the IILS estimates that more than 1.7 million jobs would be created in the nine countries studied. A final scenario considers subsidizing green sectors and results show the best employment growth. In LCIS, employment increases more than 1.8 per cent and in HCIS, it increases by 0.5 per cent. Overall, the IILS estimates that 3.9 million jobs could be created in the nine countries.

The IILS also reviewed a study by Bossier et al. (1993) that utilizes the HERMES model, which analyzes eight sectors across the EU. The results show that a carbon tax would both reduce CO₂ emissions and increase employment, driven by factor substitution between labour and capital. Another, similar model used by Hayden (1999), called QUEST, shows that when the carbon tax burden falls on industries, a small, positive employment effect of 0.1 per cent is observed and GDP is reduced by 1 per cent. When the tax burden falls on

³ see http://globalchange.mit.edu/pubs/reports.php
⁴ see http://globalchange.mit.edu/pubs/reports.php
consumers, employment increases by 0.9 per cent, due to the substitution of capital for labour. And when a certain degree of wage moderation is present, employment increases the most, by 1.3 per cent.

C. Environmental tax reforms in the EU

Many green policies have been implemented by EU Member States to reduce GHG emissions. However, some of the instruments did not originally have this intention (e.g. motor vehicle tax) and may have served other political goals, such as raising revenue. Still, their existence may well be justified by climate goals, placing these instruments in line with the definition of green policies (definition 2 in the INST-EC Discussion Paper No. 10. Several instruments were inspired by the EU Energy Tax Directive (2003/96), a market harmonization instrument for taxation of carbon that introduced minimum tax rates for coal, electricity and oil fuel.

The instruments observed are taxes and fees or charges, subsidies or tax expenditures, trading systems and voluntary agreements. The ones most widely used in the EU are taxes and fees. Typically these tax instruments target energy efficiency by either taxing the use of energy directly, or by taxing the use of transport vehicles or roads. Almost all taxes are levied on transportation activities or heating. Considering the many tax exemptions for industries, it is striking that taxes are relatively strongly focused on direct private energy consumption and less on production activities.

This is interesting because only 20 per cent of annual CO₂ emissions arise from direct energy consumption of households. About 80 per cent of total CO₂ emissions stem from production processes. Most policy instruments introduced by EU Member States attempt to increase overall energy efficiency. Thus, CO₂ emissions shall be reduced indirectly through the use of less energy per unit of output.

The ratio C/E, CO₂ emissions per unit of energy, would be affected if energy taxes were only levied on fossil fuels and non-fossil fuels were exempt. Under such circumstances, the tax is not on energy itself, but rather on the emission of CO₂. Since CO₂ emissions are the externality, and energy is not, this approach would be more efficient. Some countries have followed this idea and tax energy based on the carbon content of the fuels. The most consequent approach would be to totally refrain from general energy taxation and to switch to a pure CO₂ tax. Energy taxation is, however, much easier to implement and to administer.

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5 Refer to Appendix 1 in the INST-EC Discussion Paper No. 14 for a list of all green policies that have been implemented by EU Member States. In accordance with the main focus of this paper, the table only considers green policies that target the reduction of GHGs.

6 On a theoretical level, these instruments are discussed in the INST-EC Discussion Paper No. 12.

7 IILS calculations
The efficiency and effectiveness of tax instruments depend on the existing system of instruments. For example, an implemented tax may be useless if introduced with opposing tax exemptions. It is therefore important to look at the whole tax structure of a country in evaluating any one instrument. In the following report, tax instruments are reviewed for selected European countries that have generally implemented ETRs during the 1990’s.

1. Tax instruments and environmental tax reforms (ETRs)

Several countries in Europe moved beyond individual environmental taxes and undertook ETRs during the 1990s. ETRs, often referred to as “eco taxes” or “green taxes”, may have been inspired by the theoretical discussion on the double dividend. The survey of ETR in the EU that follows is based on the work of Speck & Jilkova (2010) and Eurostat & European Commission (2010).

The main idea of ETRs is to broaden the overall tax base and to shift taxation on income to consumption. In particular, taxes on energy consumption and CO2 emissions should be increased while taxes and social security contributions levied on labour should be decreased. It is often argued that environment tax reform should be revenue neutral (see Weiszäcker (2010)). The theory of the double dividend asserts that a shift in the tax system can increase efficiency without creating additional deadweight loss through higher taxes. Political acceptance of green taxes would, in this case, increase since these dues are not seen as merely an attempt to raise additional revenue for the government.

ETRs were first implemented by Finland, Denmark and Sweden, followed by the Netherlands, the UK and Germany in the late 1990s. The theoretical ideal of ETR has been achieved in varying degrees in the six countries. In their practical implementation, most ETRs concentrate on energy taxes, often through intensified taxation of transport fuels. The most common scheme is to levy quantity taxes or ad valorem taxes on the consumption of energy by households and producers. Denmark and Finland also introduced CO2 taxes. The remaining revenue is derived principally from taxes on transportation of goods and people and the use or extraction of resources.

2. Challenges in ETRs: Resource allocation and distribution

The special provisions and exemptions under ETRs highlight some important challenges in resource allocation and distribution. First, quantity taxes (or ad valorem taxes) on energy are regressive and place a greater burden on low-income households. ETRs should include mechanisms to mitigate such effects, especially if they are implemented on larger scales in the future. One possible improvement to ETR is the inclusion of personal energy allowances within the tax structure (see also von Weizsaecker et al. (2010)). Under these allowances, a certain amount of energy per household is exempt from tax, but energy used beyond the threshold is taxed, possibly with a progressive rate. The threshold amount of energy and the tax rate can also be crafted to the personal characteristics of households,
like family size or income. Such a mechanism would improve distributional justice within an ETR scheme while creating an incentive to reduce energy consumption.

Second, it is striking that all countries created special provisions for certain industries that were usually energy-intensive, while no exceptions exist for households. However, the largest potential for CO₂ emissions reduction is in the production sector and mainly in those industries that have been granted special tax provisions. Indeed, approximately 80 per cent of the CO₂ emissions of industrialized economies are emitted through production activities and only about 20 per cent result from direct household consumption (heat, petrol etc.). It is important to note that special provisions for industries allow them to impose externalities on the public, even if the public is represented by a future generation. The provisions are then nothing more than a hidden subsidy and result in an inefficient allocation.

Somewhat tempering these arguments against special provisions is the fact that ETRs have been launched in several phases to avoid any abrupt shocks to the economy, with energy tax rates increasing gradually over time. A careful, predictable policy intervention is laudable so that temporary exemptions for this purpose are justified. Furthermore, several countries have planned to adjust special provisions and reduce exemptions during the different phases of the ETR. Nevertheless, many special provisions have not been entirely based on economic arguments, but were instead created through the political process. This process granted tax exemptions to certain industries. From a political perspective, these exemptions can also be interpreted as a prerequisite to the implementation of the ETR in the first place (see also Speck & Jilkova (2010)).

ETRs also contain at least some elements of re-distributional policies. After taxation of externalities, ETRs also aim to reduce other, distortive taxes, primarily taxes on labour and income. As explained in the discussion about the double dividend, the idea is to re-inject the collected tax revenue into the system. Some of this revenue recycling is accomplished by decreasing tax rates.

In Denmark, for example, tax rates were decreased for low- and medium-income earners, and revenue was also distributed to retirees. Another way that ETRs redistribute cash directly to wage earners is through the reduction of employees’ portion of social security contributions. A reduction in the employer’s portion of social security contributions is also used to benefit wage earners, even though no direct cash is transferred to employees. Even with these types of redistributions, it remains hard to determine the net tax effect of an ETR for an average household, since employees who benefit from revenue recycling are at the same time fully taxed on energy consumption.

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8 Calculations made by the IILS.
9 One has to distinguish the payer of a tax from the bearer of a tax. Under quite general conditions the largest or even the full amount of social security contributions is borne by employees, even if paid by employers.
It can be expected that the effects for households will differ considerably depending on marginal tax rates, employment status, energy consumption and other specific features of the household. No redistribution is provided for people who do not participate in the labour market, unless direct payments are made: students, retirees and other people outside the workforce do not directly benefit from a reduction in labour cost but still bear the costs of higher energy taxation. The unemployed, however, do benefit, since the chance of being hired will increase ceteris paribus if gross labour costs for employers fall.

In accordance with the idea of the double dividend, ETRs are often targeted to be more or less revenue-neutral, since the revenue collected from environmental taxation is supposed to finance the reduction of other taxes. In practice, there have been considerable differences among the six countries in this regard. The Finnish ETR, for example, was never designed to be revenue-neutral. The German ETR was planned to be revenue-neutral, but some of the revenues were later used to consolidate the federal budget.

3. Analysis of ETR in the EU

The key aspects of the ETR are summarized below for the six countries which implemented an ETR, and for Slovenia which introduced an interesting environmental scheme (see Speck & Jilkova (2010)):

**Denmark**
- CO₂ tax on energy products consumed by households (1992) and businesses (1993)
- Special tax provisions for industry with possibility of refunds
- Reduction of marginal tax rates on personal income
- Other environmental taxes: tax on tap water, wastewater tax, tax on plastic and paper bags, sulphur tax, energy tax on natural gas
- Provision of investment grants for energy-saving measures
- Reduction of employers’ contribution to social security contributions
- Establishment of special fund for small and medium-sized enterprises that would only marginally benefit from reduction of social security contributions
- Adjustment of tax rates over the three phases
- No shift of taxes between industry and household sector

**Finland**
- Two phases: 1997 and 1998
- Not intended to be revenue neutral (deficit)
- CO₂ tax on energy products except for transport fuels
- Landfill tax

10 Transport fuels were already subject to energy taxes in Finland
The double dividend and environmental tax reforms in Europe

- Reduction in state and local personal income taxation
- Reduction in employers’ social security contributions
- Almost no special tax provisions

**Germany**

- Two phases: 1999 (covers 1999-2003) and 2004
- Increase of mineral oil taxes in transport fuels
- Gas tax, tax on heavy fuel oil, tax on light heating fuels, electricity tax
- Reduction of employers’ and employees’ social security contributions
- Promotion of renewable energy (very small fraction)
- Intended to be revenue neutral but temporary also used for budget consolidation
- Many special tax provisions in particular for manufacturing industry, agriculture, forestry and fishery sectors

**The Netherlands**

- Several phases and revisions starting in 1991, “formal” ETR in 1998
- ETR intended to be revenue neutral
- Taxes on energy and CO₂
- Tax free allowance (natural gas and electricity)
- Reduction of personal and corporate income taxation
- Special tax provisions for industry

**Sweden**

- Intended to be budget neutral in the long run but deficits accepted in the short run
- CO₂ tax, SO₂ tax, NOx charge, VAT on energy purchases
- Energy taxes\(^{11}\) are indexed for inflation and linked to CPI
- Reduction of personal income tax rates for all income earners
- Until 1992: No special tax provisions for companies but tax ceiling of 1.7 per cent of sales values for energy taxes
- After 1992: special tax provisions for industry

**UK**

- Intended to be revenue neutral
- Landfill tax
- Reduction of employers’ national insurance contributions
- Taxation of energy mainly through heavy taxation of transport fuels

\(^{11}\) Energy taxes existed already before the reform.
• Revenue from Fossil Fuel Levy\textsuperscript{12} are redirected from subsidization of nuclear power to renewables (1998)
• Introduction of Climate Change Levy (CCL)
• Subsidies of investment in energy and research activities
• Special tax provisions for industry

\textbf{Slovenia (no formal ETR)}

• Interesting system of energy taxation
• Until 1997, ad valorem tax on energy products
• After 1997, all ad valorem taxes abandoned (except for transport fuels that were abolished in 1999) and Value Added Tax Act and the Excise Duty Act adopted by government
• Increase in the number of taxable energy products
• Excise taxes have been ad quantum in nature
• First country in Eastern and Central Europe to introduce a CO\textsubscript{2} tax in 1997
• Tax revenue not recycled, although plans were created in 2004 for one-third of revenue to co-finance investments in energy efficiency and emissions reduction. Revenue from other environmental taxes are generally earmarked for specific environmental investments
• Businesses may be eligible for tax reductions up to 100 per cent, decreasing by 8 per cent per annum until 2009

Most ETRs focus on taxing the use of energy (figure 4). Indeed, it is estimated that about three-quarters of environmental tax revenue in the EU arises from energy taxation (see Eurostat and European Commission 2010). The total tax revenue generated by environmental taxes varies between about EUR 5 billion (Finland) and EUR 55 billion (Germany).

\textbf{Figure 4: Environmental tax revenue in 2008 (EUR million)}

\textsuperscript{12}The Fossil Fuel Levy (FFL) is an ad valorem tax on electricity that had already been introduced in 1990.
The double dividend and environmental tax reforms in Europe

Figure 5 depicts environmental taxes as shares of GDP for the countries that have introduced ETR and the (arithmetic) averages for EU Member States as a whole. The figures include all kinds of environmental taxes. Thus, the share of environmental taxes that are imposed as potential climate change measures is expected to be slightly smaller. Most environmental taxes, however, also qualify as green policies according to definition 2\(^1\), developed in the INST-EC Discussion Paper No. 10, since they also have the purpose and the potential to reduce CO\(_2\) emissions. About three-quarters of environmental taxes\(^2\) in the EU represent taxes on energy (see Eurostat & European Commission (2010)). The remaining 25 per cent are taxes on transport, pollution and resources, which often (but not always) qualify as green policies in the sense of definition 2.

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\(^1\) Definition 2 states: Green policies are all measures implemented by the government or other governmental institution that have the purpose and the potential to reduce CO\(_2\) emissions.

\(^2\) In terms of tax revenue.
Figure 5: Environmental tax trends in the EU, 1995-2008

Panel A: Environmental taxes (as % of GDP)
Panel B: Environmental taxes (as % of total tax revenue)

Source: IILS estimates based on Eurostat

The ratios in Figure 5 of environmental tax revenues to GDP or total tax revenue are common indicators used to illustrate the significance of environmental policy in a country. Speck & Jilkova (2010) advise interpreting these types of measures with care, as the numbers alone cannot determine whether the quality and magnitude of environmental policy in a country are appropriate. Similarly, it is not possible to determine the environmental quality (“greenness”) of a country without incorporating additional information. In fact, high environmental tax revenues could indicate intense use of the
environment. Nevertheless, the numbers may help describe changes over time and can help put environmental taxes in context with other ratios, like the share of labour taxation to GDP.

On average, environmental tax revenue in the EU has amounted to 2.5-3 per cent of GDP, with a declining trend. In terms of total tax revenue, environmental taxes account for 7 per cent to 8.25 on average, also with a declining trend. These declining shares may be due to the fact that many environmental taxes are essentially quantity taxes, and therefore tend to fall over time if not adjusted for inflation. Eurostat & European Commission (2010) identify three other possible causes for the declining trends.

First, energy demand has a tendency to grow more slowly than income, so that the share of taxes paid on energy decreases as the economy expands. Second, energy tax increases in recent years may have had an effect on energy consumption. Depending on the price elasticities of the energy markets, increasing taxes may result in a reduction of the tax base. Third, governments may be unwilling to continually raise tax rates on products that could affect energy costs of households and industry.

With regard to the ratio of environmental taxes to GDP, Denmark and the Netherlands lie significantly above the EU average and Finland and Sweden are at the upper end among the remaining four countries in this study. Denmark and the Netherlands also maintain a rising trend of green taxes. Despite ETRs in Germany and the UK, neither country is higher than the EU average. In Germany, the share of green taxes has remained relatively stable over time, which may reflect the constant increase in tax rates provided in the 1999 ETR. In the UK, the environmental tax-to-GDP ratio has significantly declined over the past years and is now at the lower end of the EU average.

Similar tendencies can be observed for the environmental tax/total tax revenue ratio (Figure 5). Denmark and the Netherlands are well above the EU average and belong to those countries with the highest shares of environmental taxes. Other EU Member States with similarly high ratios – but which have not implemented ETRs – are Bulgaria, Cyprus and Malta. Germany, Sweden and the UK fall below the EU average, with Germany and Sweden maintaining a stable ratio while the UK’s ratio has been declining. Finland’s ratio is at the lower end of the EU average but has remained stable over time.

Overall, Denmark and the Netherlands have continually moved towards greater implementation of the ideas of an ETR, making the significance of environmental taxes high for both countries. However, a better assessment can be made if labour taxes over the same time period are considered. The following Figure 6 depicts the ratios of environmental taxes to GDP and total tax revenue as well as the ratios of labour taxes to GDP and total tax revenue for each of the six countries.
Figure 6: Environmental versus labour taxes by country

Denmark

Taxes on labour vs. environmental taxes (as % of GDP)

Taxes on labour vs. environmental taxes (as % of total tax revenue)

Finland

Taxes on labour vs. environmental taxes (as % of GDP)

Taxes on labour vs. environmental taxes (as % of total tax revenue)

Germany

Taxes on labour vs. environmental taxes (as % of GDP)

Taxes on labour vs. environmental taxes (as % of total tax revenue)
The double dividend and environmental tax reforms in Europe

Netherlands

Taxes on labour vs. environmental taxes (as % of GDP)

Taxes on labour vs. environmental taxes (as % of total tax revenue)

Sweden

Taxes on labour vs. environmental taxes (as % of GDP)

Taxes on labour vs. environmental taxes (as % of total tax revenue)

UK

Taxes on labour vs. environmental taxes (as % of GDP)

Taxes on labour vs. environmental taxes (as % of total tax revenue)
There is a long-term tendency in the EU-27 and the EA-16 countries for taxes on labour to decline in terms of GDP/total tax revenue. Post-2007 one can observe a sharp increase in labour taxation although this process started as early as 2005 in countries like Denmark and the Netherlands. That increase occurs at the end of the time series, and may be the result of the economic crisis rather than a break in the trend in European tax laws to decrease labour taxes. It is also possible that GDP decreased more quickly than revenues from labour taxes. In general, revenues from taxes on profits or consumption tend to be more volatile (and procyclical) than revenues from labour taxes, making the economic crisis an obvious reason for the trends.

A general shift away from labour taxation towards green taxation can be observed only for Denmark, Germany and (to some extent) the Netherlands. In all cases, however, the magnitudes of these tax shifts are relatively small. The figures show the most consistent and forceful implementation of the ETR concept in Denmark, where increasing environmental taxation is accompanied by decreasing labour taxes. Moreover, in the case of Denmark, tax rates were decreased for low- and medium-income earners, and revenue was also distributed to retirees. In Germany, stable environmental taxation goes along with a sharp decline in labour taxation. In the Netherlands a pattern is not clear over the
period, but if current data are compared to 1995 rates, the opposing trends in labour and environmental taxes are visible. For Finland and Sweden, no opposing trends can be detected and in the UK the trends have reversed themselves, as labour taxation has increased while environmental taxation has declined.

4. Improving ETRs: Sending clear market signals

There is clearly no evidence of major shifts in tax systems so far. Thus, the fundamental, structural break towards a new tax system has not yet occurred. Implemented ETRs are only the initial steps in the process of a structural change in tax systems. In their current form, they are too insignificant to address climate change or other environmental challenges.

Even though several countries have attempted to increase the importance of their ETRs over time, the developments have been rather slow given the fact that already about 20 years passed since the first ETRs have been implemented. Comparisons with the EU average and those EU Member States without ETRs underscore the small overall impact of ETRs. Many ETRs started with a lot of verve in the 1990s but seem to have lost momentum over time.

For example, special tax provisions have undermined the original purposes of many ETRs. One of the main theoretical arguments in favour of these provisions is the concern that ETRs will hurt the competiveness of certain energy-intensive industries. This same argument is often used to support political claims of special interest groups. Policy makers should be mainly concerned about the impact of ETRs and other green policies on the economy as a whole. Negative short-term impacts on certain sectors may be mitigated and should not determine overall economic strategy. In fact, the impact of green taxes on competitiveness has been widely debated and it is unclear whether the effect on competitiveness has to be negative (see for example, Enevoldsen et al. (2010)).

Many concerns about competitiveness could be allayed if ETRs would be implemented and harmonized across EU Member States. First, a common understanding among EU Member States about the revenue-recycling potential of taxes on environmental externalities would calm these fears. An understanding that revenue from environmental taxes could decrease taxes on labour would reduce incentives to move production abroad, because an economy with a cheaper labour force is favourable. If a common environmental tax structure existed (for example a tax on the consumption of CO₂-intensive goods), the EU could apply the same tax rules on imported goods, ensuring that imported goods and components do not receive a competitive advantage.

A major shortcoming of ETRs in the EU is the unpredictability of the direction of tax reforms in the long run. It is important that plans for the development of long-term ETRs be created and that these details are communicated to both consumers and producers (see Weizsäcker (2010)). The most important effect of an ETR is behavioural change, which
can be achieved if reliable, long-term trends in the tax structure are communicated to the taxpayer.

A structural change is only possible if governments modify the long-term parameters of the system. In the context of ETRs, this means that plans for development of long-term green tax reforms have to be devised and to be effectively communicated to consumers and producers (see also von Weizsaecker et al. (2010)). In particular, enterprises must change their production plans and make expensive and large investments in the process of structural change. These investments in research or equipment have to pay-off over periods of 20-30, or more, years. When short-term tax-reforms change within political cycles, the government is unable to send strong signals to investors that are considering multi-billion dollar investments.

The ability for firms to plan long-term is essential for technological innovation. In many developed countries, governments have recognized that the free market does not effectively foster this sense of security for firms and subsequently grant patents to research-intensive industries, with durations of approximately 20 years. These temporary monopolies provide greater planning capacity and reliability in the market in order to encourage enterprises to make long-term investments. Similarly, the profitability of environmental technology, such as CO\textsubscript{2} emission free technology, depends crucially on this type of government action, since the free market fails to price externalities. Thus, the reliability that is often created through patents needs to be incorporated into ETR’s, so that large investments in new technologies and products are viewed more favourable by industry.

For example, a long-term (20-50 years) plan for increased taxation of fossil fuel energy and environmental pollutants, possibly combined with a long-term reduction in labour taxes, should first be clearly communicated to taxpayers. In the short run, detailed adjustments and specifications in the tax structure may be necessary to account for short-term economic circumstances or equity considerations. Such a scheme would send a clear signal to entrepreneurs in the EU that investments into energy and resource productivity have high profit potential, while investments into labour productivity may become less essential. The long-term reliability of ETR also extends benefits to consumer decision making, such as for homeowners who might choose to install energy saving technology, like heaters or isolations.
D. Environmental Effects of ETRs

Measuring the environmental impact of green policies can be a challenging task, due to their complex interactions with the economy. In the climate change context, a common indicator used to measure the degree of “greenness” of an economy is (aggregate) CO₂ intensity (CO₂/GDP). This indicator expresses how much CO₂ is emitted per produced value. The lower this ratio, the more efficient is the economy in terms of its environmental impact.

Table 1 allows comparison of CO₂ intensity across the world. From 1990 to 2005, the EU-27 has seen a decline in the CO₂ intensity of production, by 28 per cent. This decrease is relatively greater than decreases in the rest of the developed world. Green policies implemented in the EU over this time period may have encouraged the reduction in emissions.

<table>
<thead>
<tr>
<th></th>
<th>1990</th>
<th>2005</th>
<th>2005 (% change)</th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>0.87</td>
<td>0.74</td>
<td>- 14.9</td>
</tr>
<tr>
<td>EU-27</td>
<td>0.60</td>
<td>0.43</td>
<td>- 28.3</td>
</tr>
<tr>
<td>U.S.</td>
<td>0.69</td>
<td>0.53</td>
<td>- 23.2</td>
</tr>
<tr>
<td>Japan</td>
<td>0.26</td>
<td>0.24</td>
<td>- 7.7</td>
</tr>
<tr>
<td>China*</td>
<td>4.01</td>
<td>2.43</td>
<td>- 39.4</td>
</tr>
</tbody>
</table>

* Including Hong Kong
Source: EIA

Within the EU, however, it is more difficult to show a relationship between ETRs and declining CO₂ intensity. In Table 2, countries that implemented ETRs have all shown reductions in CO₂ intensity since 1990, and are highlighted in the table. In comparison to other developed Western European countries, like Spain, France and Italy, these reductions are relatively greater. Other EU Member States that did not undertake ETR, but still show large reductions in CO₂ intensity include Luxembourg, Ireland, Estonia, Lithuania, Latvia, Bulgaria, Czech Republic and Hungary. These countries highlight the difficulty in making comparisons across nations that differ in stage of development or industrialization. Greater efficiency gains may be possible in countries that have recently entered the EU, for example, leading to relatively larger reductions in CO₂ intensity.

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15 The relatively low starting CO₂ intensity in 1990 in France, and subsequent relatively small decline through 2005, may be due to the country’s reliance on nuclear energy.
### Table 2: CO₂/GDP, kg/USD (2000 prices), 1990 and 2005

<table>
<thead>
<tr>
<th>EU Member States</th>
<th>1990</th>
<th>2005</th>
<th>2005 (% change)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Belgium</td>
<td>0.58</td>
<td>0.45</td>
<td>-0.22</td>
</tr>
<tr>
<td>2 Denmark</td>
<td>0.41</td>
<td>0.28</td>
<td>-0.32</td>
</tr>
<tr>
<td>3 Germany</td>
<td>0.62</td>
<td>0.41</td>
<td>-0.33</td>
</tr>
<tr>
<td>4 Netherlands</td>
<td>0.56</td>
<td>0.44</td>
<td>-0.20</td>
</tr>
<tr>
<td>5 Austria</td>
<td>0.38</td>
<td>0.36</td>
<td>-0.05</td>
</tr>
<tr>
<td>6 Luxembourg</td>
<td>0.84</td>
<td>0.46</td>
<td>-0.45</td>
</tr>
<tr>
<td>7 Portugal</td>
<td>0.46</td>
<td>0.53</td>
<td>0.15</td>
</tr>
<tr>
<td>8 Finland</td>
<td>0.54</td>
<td>0.40</td>
<td>-0.26</td>
</tr>
<tr>
<td>9 Sweden</td>
<td>0.26</td>
<td>0.18</td>
<td>-0.31</td>
</tr>
<tr>
<td>10 UK</td>
<td>0.48</td>
<td>0.32</td>
<td>-0.33</td>
</tr>
<tr>
<td>11 Ireland</td>
<td>0.63</td>
<td>0.35</td>
<td>-0.45</td>
</tr>
<tr>
<td>12 Greece</td>
<td>0.70</td>
<td>0.61</td>
<td>-0.12</td>
</tr>
<tr>
<td>13 Spain</td>
<td>0.47</td>
<td>0.50</td>
<td>0.07</td>
</tr>
<tr>
<td>14 France</td>
<td>0.32</td>
<td>0.27</td>
<td>-0.16</td>
</tr>
<tr>
<td>15 Italy</td>
<td>0.42</td>
<td>0.40</td>
<td>-0.07</td>
</tr>
<tr>
<td>16 Estonia</td>
<td>6.09</td>
<td>1.97</td>
<td>-0.68</td>
</tr>
<tr>
<td>17 Cyprus</td>
<td>0.62</td>
<td>0.64</td>
<td>0.03</td>
</tr>
<tr>
<td>18 Lithuania</td>
<td>2.06</td>
<td>0.81</td>
<td>-0.60</td>
</tr>
<tr>
<td>19 Latvia</td>
<td>1.76</td>
<td>0.65</td>
<td>-0.63</td>
</tr>
<tr>
<td>20 Bulgaria</td>
<td>5.00</td>
<td>2.81</td>
<td>-0.44</td>
</tr>
<tr>
<td>21 Czech Republic</td>
<td>2.81</td>
<td>1.76</td>
<td>-0.37</td>
</tr>
<tr>
<td>22 Hungary</td>
<td>1.50</td>
<td>0.95</td>
<td>-0.37</td>
</tr>
<tr>
<td>23 Malta</td>
<td>0.96</td>
<td>0.67</td>
<td>-0.30</td>
</tr>
<tr>
<td>24 Poland</td>
<td>2.91</td>
<td>1.47</td>
<td>-0.49</td>
</tr>
<tr>
<td>25 Romania</td>
<td>3.80</td>
<td>1.88</td>
<td>-0.51</td>
</tr>
<tr>
<td>26 Slovenia</td>
<td>0.79</td>
<td>0.66</td>
<td>-0.17</td>
</tr>
<tr>
<td>27 Slovak Republic</td>
<td>3.00</td>
<td>1.47</td>
<td>-0.51</td>
</tr>
</tbody>
</table>

Source: IEA

A new way to evaluate the success of green policies may be to use the CO₂ intensity of labour as indicator of the level of “greenness” of an economy. The CO₂ intensity of labour represents the average amount of CO₂ emitted per worker engaged in an economy. It shows the direct connection between CO₂ emissions and employment. Table 3 shows the change in this indicator from 1990 to 2005 in the EU.
The possible effects of ETRs may be more apparent in this table, as the relative reductions in CO₂ intensity of labour are greatest for the six countries that undertook ETR, which are highlighted in the table. Lithuania, Latvia and Poland also created reductions of 10 per cent, which are the same for the lowest reductions in ETR countries (the Netherlands and the UK). As mentioned above, however, these countries are largely in different stages of development and comparison with Western Europe is complicated. The greatest reductions remain in Denmark, Finland, Sweden and Germany.

Table 3: CO₂ per number of persons engaged, EU-25 Member States (kilo t/person), 1995 and 2005

<table>
<thead>
<tr>
<th>EU States</th>
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*For some countries data is available only from 1995
Source: IILS estimates based on European Environment Agency (EEA) and EU Klems
E. Employment effects of ETRs

The different components of ETRs support employment growth in the four categories of Figure 7 to varying degrees. Reduction of labour taxes, like social security contributions, affects labour in all four categories. A positive effect on employment can therefore be expected for green jobs (I-III) and non-green jobs (IV). The magnitude of a potential increase in employment depends on the level of unemployment at implementation of the policy, the growth potential of the respective sectors, and the relative size of these sectors. A recent empirical study by Mittnik et al. (2010) indicates that low-carbon sectors (I and III) have a higher growth potential in terms of output and employment growth. In all nine countries surveyed, output and employment growth have been significantly higher on average in LCIS. Based on these findings, it is expected that a reduction in average labour costs across the entire economy would be disproportionally beneficial to the low-carbon sectors (I and III) by boosting employment growth in these industries.

Figure 7: Green employment effects

The employment effects of a reduction in income taxes and a combined increase on energy taxes are more difficult to estimate. On the producer side, higher factor input prices on energy may result in reduced output and possibly reduced employment, if substitution from fossil fuels to other factor inputs like labour or renewable energy is limited. Under these circumstances, a reduction of jobs in high-carbon-intensive industries (categories III and IV) is likely. Such negative employment effects should be less severe in category III since all companies have an incentive to employ abatement technologies, e.g.

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16 Figure 7 refers to the INST-EC Discussion Paper No. 10.
17 Australia, France, Germany, Hungary, Japan, South Korea, Sweden, the UK and the U.S.
to use solar technology or environmental technology to reduce their tax burden. These technologies are provided by sectors I and III. Output and employment in these sectors would therefore benefit from higher demand in abatement or backstop technologies.

On the consumer side, the impacts of ETRs are even harder to predict, especially for changes in consumer behaviour and employment effects from changing consumption patterns. If many households experience a net impact on their income through the tax shift, a change in consumption patterns is likely. Rising prices for energy and energy-intensive products do not necessarily imply reduced demand for these products. Since the effects depend on individual household preferences, the total effect on consumer demand cannot be predicted.

Based on these theoretical considerations, ETRs on average support industries in category I the most and industries in category IV the least. Accordingly, employment growth could be highest in category I (green jobs) and the lowest in category IV (brown jobs).

The overall employment effects for the economy, however, can only be determined empirically. Mittnik et al. (2010) employ a vector autoregression and impulse response analysis to estimate the effects of a revenue-neutral tax shock on output and employment in nine countries. They find consistent, positive effects on low-carbon-intensive industries. The impact on high-carbon-intensive industries varies but tends to be negative. And, the overall impact on employment is country-specific – positive for some countries and slightly negative for others.

Empirical studies of this kind usually ignore possible behavioural changes triggered by ETRs, like increased innovation and other adjustments as predicted by Porter (1990) and Porter & van der Linde (1995) in the “Porter Hypothesis”. Such behavioural responses would mitigate negative effects on output and employment even further.
References


Institute for Labour Studies (IILS).


