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**GREENING TAX MIXES IN OECD COUNTRIES: A PRELIMINARY
ASSESSMENT**

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FOREWORD

The Committee on Fiscal Affairs and the Environment Policy Committee launched a series of Joint Meetings of Tax and Environment Experts in 1999. One part of the mandate of these meetings was to monitor green tax reform in OECD Member countries. As a contribution to this work, it was decided to undertake a study of OECD country experience with green tax reform. The issue of the environment-employment “double dividend” is of particular relevance to green tax reforms. This study is a review and assessment of simulation studies and current practice in OECD Member-countries. It will serve as an input to the final report of the Joint Meetings, which is to be published in 2001.

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EXECUTIVE SUMMARY

Environmentally related taxes have proved to be a powerful tool in environmental policy. Hence, an increasing number of OECD countries have undertaken “green tax reforms”, with the primary objective to protect the environment.

Green tax reform has usually been introduced in a revenue-neutral context: that is taxes have been shifted to pollution while distortionary taxes on labour or capital have been cut. In practice most governments that have implemented green tax reforms have reduced the tax wedge on labour in order to reduce unemployment. Will such tax shifting provide an opportunity to realise a so called “double dividend” in terms of environmental improvements and a (second) employment dividend, flowing from lower labour taxation? This report reviews the key conditions for, and obstacles to, the realisation of an environment-employment double dividend.

The existence of the second dividend is controversial and it can be realised only if a number of restrictive conditions are met. In particular, the incidence of the environmentally related tax must fall on a fixed factor with a low excess tax burden (the excess cost to society of raising an additional unit of government revenue using a particular tax) whilst the tax cut must have a high excess tax burden. For example, if the excess tax burden in an economy is lower for capital than for labour, and the burden of the tax falls onto capital and labour taxes are cut, then some double dividend is likely to result. The environmental tax should be broadly based, to avoid generating many distortions in other markets. Capital must be relatively immobile internationally, otherwise capital could avoid the tax burden by moving abroad.

Increased employment (the second dividend) depends on a number of factors:

- The degree of *substitutability between factors of production*, i.e. if firms find it easy to switch to use relatively more labour when labour taxes are cut employment would be stimulated;
- The degree of *competition in markets for goods and factors of production*, i.e. if the labour market is competitive lower labour taxes will result in lower labour costs and increased employment;
- The *time frame of the introduction of the environmentally related tax reform*, i.e. a phased-in implementation of an environmentally related tax gives firms and households time to respond to the economic incentives
- The *existence of a ‘social consensus’* for higher environmentally related taxation would reduce pressure for wage compensation above that offered by the revenue-recycling package
- *International co-ordination* of tax reforms would weaken arguments for compensation based on stated concerns for sectoral competitiveness.

Although the requirements can seem exacting in theory, a number of ex ante simulations conclude that tax shifting can result in some -- limited -- employment stimulation in practice. Furthermore,

the choice of recycling mechanism is important for the size of the employment impact. Larger employment gains can be expected if employers' social security contributions -- rather than income taxes -- are cut and if tax cuts are targeted at low-skilled workers.

Despite the uncertainties green tax shifting policies are on-going in a number of OECD Member countries, for example, Denmark, Finland, Germany, Italy, Norway, the Netherlands, Sweden, Switzerland and the UK. An example of such a green tax shift is the UK the landfill tax introduced in 1996 that was accompanied with a 0.2% reduction in employers' social security contributions. More recently, in 1999 the German government implemented its ecological tax reform package. Step-wise increases in environmentally motivated tax rates for fossil fuels and electricity tax rates have been pre-announced until 2003. In its introductory year the tax shift resulted in a 0.8% cut in total social security contributions and the objective is to reduce social security contributions by a further 1% by 2003. In the same year the Netherlands initiated a three-year policy to shift taxes to pollution and resource use (e.g. energy, wastewater, groundwater) and cut labour taxes and Italy embarked on a re-modulation of excise taxes on mineral oils according to carbon content, to be completed by 2005.

It is difficult to draw definite conclusions about the environmental and employment effects of tax shifts and *ex post* evaluations of these green tax shifts still remain to be done.

1. INTRODUCTION

Over the last decade, in particular since the mid 1980s, the “greening” of tax systems has gained significant momentum in a number of OECD countries. In some instances, this greening remains of limited scope, while in others more comprehensive reforms of tax systems are put in place. Such “green tax reforms” are usually implemented in a revenue neutral context, i.e. introducing new environment-related taxes and reducing or removing other existing distortionary taxes and tax provisions (e.g. distortionary support measures). A key issue is whether such “tax shifts” could provide double dividends in terms of both environmental improvement, increased economic efficiency and/or reduced unemployment.

The basic hypothesis is that taxes on environmentally damaging activities would not distort economic decisions, but rather would correct existing distortions. Hence, unlike taxes that depress economically beneficial activities, environmental taxes could discourage activities where the full social costs presently are not internalised. The financing of public expenditures through environmental taxation could thus provide a double dividend if the revenue was used to reduce other taxes that bring about large excess burden. In particular, an idea largely debated in several OECD countries suggests the possibility to finance a reduction of social security contributions with the revenue of new environmental taxes. A fiscal manoeuvre of this kind could provide a double dividend by promoting an environmental improvement and by creating in the meantime new jobs, thus reducing unemployment.

On policy grounds, the strength of the double dividend hypothesis (if realised) is that the introduction of a new environmental tax does increase the social welfare, even if the legislator cannot provide a precise evaluation in monetary terms of environmental benefits: if the tax shift between new environmental taxes and existing distortionary taxes entails no costs or increases the efficiency of the economy, it is sufficient to show that there are environmental benefits to provide an analytical support for the green tax reform.

A first step is to consider the main results emerging in the literature about the possibility to realise a double dividend. The evidence is not very convincing and a widespread conclusion seems to be that the requirements for getting a double dividend are rather stringent. But these theoretical results are mainly derived in the framework of general equilibrium models regarding efficiency gains. Another relevant part of the literature is more interested in a second dividend in terms of employment. If the labour market is not clearing and involuntary unemployment exists, due to wage rigidity or to a large tax wedge on labour costs, the results of the simulation of a green tax reform are more favourable, specifically in terms of new jobs opportunities.

This paper comprises four main parts: first, a definition of the concept of double dividend; second, a review of what can be learnt from recent theoretical analysis and *ex ante* simulations; third, the main requirements for the realisation of a double dividend, arising from the conceptual analysis and simulations; fourth, a preliminary review of tax shifts currently implemented in OECD countries.

2. THE ISSUE

In recent years there has been growing concern about the impact of environmental policies on the prospect of reaching other policy goals such as full employment and sustained economic growth. In particular, the negative impact on the international competitiveness of the firms that could be hurt by stringent environmental constraints has been frequently underlined. This point is very controversial in the literature and little empirical evidence seems available to support it (Jaffe [1995]); opposite conclusions have been reached by authors that have pointed to a positive relation between stringent environmental constraints and competitiveness (Porter and van der Linde [1995]). The possibility to use the revenue flowing from environmental taxes to cut down the rates of other taxes with a distortionary impact upon the economy has nevertheless been emphasised in the political debate.

The combination of ecological degradation and persistent high unemployment, in a number of OECD countries has suggested to raise the price of the factor environment and to reduce the price of labour to address simultaneously both problems. Hence, an integrated study of fiscal and environmental policy has been called for, taking into account the fact that labour taxes can entail a negative effect on labour supply – depending on labour supply elasticity –, while environmental taxes correct environmental externalities, but also confer the supplementary benefit of raising public revenues that could be used to reduce labour taxes in a revenue-neutral fashion. Accordingly, the burden of taxation could be shifted away from a “good” like labour to a “bad” like pollution. Thus, this revenue-neutral manoeuvre could yield two “dividends”: reduced pollution and increased employment.

Although it may seem self-evident that this manoeuvre, correcting a distortion in one market and reducing a distortion in another, would yield welfare benefits, the interaction between the environmental tax and existing distortionary taxes means that a double dividend does not follow automatically. Pearce (1991) noted that swapping environmental taxes for distortionary taxes may produce a double dividend by not only (1) discouraging environmentally damaging activities, but also (2) reducing the distortionary costs of the tax system. There is widespread agreement as to the ability of environmental taxes to confer the first dividend (environmental improvement), although the magnitude of this dividend is uncertain; (new evidence is now emerging in particular on market responses to energy and transport-related taxes. The price elasticities of demand for energy are generally smaller than 1: nevertheless, if the price elasticity is significantly different from zero, increases in prices can substantially reduce the demand for energy. Another relevant conclusion is that generally long-run elasticities are somewhat higher than short run elasticities.¹). On the other hand, there is much debate as to what kind of additional second dividend might be offered by environment-related taxes.

In general terms, the impact of shifting taxes from labour to pollution may be broken down into three components:

- a positive welfare effect due to the environmental benefits of the reform;
- a revenue-recycling effect, that is positive when the revenue raised by the environmental tax is recycled into the economy *via* cuts in distortionary taxation;
- a tax interaction effect, with a negative impact, since the environmental tax is likely to be levied on a narrower basis than the taxes it (in part) replaces. Moreover, the burden of the environmental tax is

¹. A survey of the relevant price elasticities has been presented to the Joint Meeting of Tax and Environment Experts in document COM/ENV/EPOC/DAFFE/CFA(99)111

partly shifted onto other factors of production and exacerbates the distortions due to taxes which are already imposed on these factors.

Hence, the existence of a second dividend depends on the relative size of the revenue recycling and tax interaction effects.

Goulder (1995) has pointed out that existing distortionary taxes may interact with the environmental levy. If this tax interaction effect is larger than the revenue-recycling effect, a revenue-neutral environmental-labour tax swap is likely to involve net positive costs in a second best setting. Further, Goulder distinguished between three different double dividend definitions:

- a weak form: using revenues from an environmental tax to finance reductions in marginal rates of an existing distortionary tax, provides cost savings relative to the case where the tax revenues are returned to taxpayers in lump-sum fashion.
- an intermediate form: it is possible to find at least one distortionary tax which can be substituted in a revenue-neutral manner by an environmental tax at zero or negative gross costs.
- a strong form: a revenue-neutral substitution of the environmental tax for any typical or representative distortionary tax can be achieved at zero or negative gross cost.

The weak form of the double dividend is relatively uncontroversial since it is substantially equivalent to the claim that replacing, at the margin, a lump-sum tax by a distortionary tax entails a positive welfare cost. Given the nature of distortionary taxes, this claim holds by definition. But the intermediate and strong double dividend notions involve an assertion that the swapping of an environmental tax for a distortionary tax involves a negative overall net cost. The intermediate and strong double dividend notions differ since, in the first case, this assertion must only hold for at least one distortionary tax, while the strong case holds for any typical or representative existing taxes. But it should be also recalled that Goulder's definitions of the double dividend notion are not universally accepted. European authors usually define the second dividend differently, namely as an increase in employment (Bovenberg and van der Ploeg, 1994; Ligthart and van der Ploeg, 1996).

If it would be possible to show that if positive employment effects follow from switching the burden of taxation from labour to pollution, this argument could balance the widespread opposition to environmental taxes justified by their possible negative effects on the international competitiveness of domestic firms and the distribution of income. The first argument states that an energy tax levied on industrial sectors redistributes income from the energy-intensive firms onto the other sectors and makes it more difficult for the firms that are hurt by the tax measure to compete successfully on the international market. It should, however, be remembered that, at a macroeconomic level, what matters most is the development of the competitiveness position of the economy as a whole.

The second argument states that if the energy tax is levied on consumers, the distributional impact is generally considered to be regressive. Low income groups, that spend a relatively large share of their income on energy, could be particularly hurt. However, when considering the distributive impacts of a tax shift, one should also take into account the environmental improvements resulting from the shift. Low income persons often live in areas particularly affected by various types of pollution.

It is difficult to derive a definite conclusion about the effects of shifting the tax burden away from labour to pollution. It is therefore useful to survey the wide body of literature that has been evolving rapidly during the last decade, before examining the welfare and employment variations expected by tax reforms recently implemented in many OECD countries.

3. THE DOUBLE DIVIDEND: A CONCEPTUAL ANALYSIS

3.1 The theory

A simple model to evaluate the effects of a green tax swap has been elaborated by Bovenberg and de Mooij [1995]. Their conclusion is that an environmental tax reform, in which the revenues of green taxes are used to lower labour taxes, cannot yield a strong double dividend. In their general equilibrium model they assume a production technology with only one factor of production, labour. Households derive positive utility from two types of consumption goods - clean and dirty - plus environmental quality and public consumption, but disutility from working. Since private consumption and leisure are separable from environmental quality and public consumption in social welfare, changes in the supply of public consumption and environmental quality exert no feedback effects on the household's labour supply decisions, but affect the level of households welfare.

If households pay a lower tax on labour income and an increased pollution tax on dirty consumption, this green fiscal reform reduces employment if the labour supply elasticity is positive, as it is usually assumed in the literature. The reason, intuitively, is simple. The higher pollution tax erodes the pollution tax base since consumers move towards clean commodities in response to relative price changes. This erosion is larger when dirty and clean commodities are easy substitutes. If the budget constraint holds and the manoeuvre is revenue-neutral, the government is unable to lower the labour tax sufficiently to compensate for the negative effect that the pollution tax has brought about in the after-tax real wage (through an increase in the consumer price index). As a result, unless the supply curve of labour has a negative slope, households will supply less labour. Since labour is the only factor of production, and it is assumed to be immobile - implying that it always bears the full tax burden -, "intuitively, the pollution tax amounts to an implicit tax on labour that is substituted for a more efficient (and thus lower) explicit labour tax" (Ligthart, 1998, p. 14).

The conclusions of this model are therefore rather straightforward: there is no presumption of the existence of a double dividend, in the strong form as defined by Goulder. As it has been clearly stated by Chiroleu-Assouline [1999] "This result is due to the very nature of the problem: environmental quality is a public good benefiting to everyone, irrespective of his supply of labour, while the improvement in environmental quality is financed by the only immobile production factor, labour, which bears *ex post* all taxes necessary to finance public expenditures. Furthermore, environmental taxes do not tax labour efficiently since they reduce the purchasing power of salaries and distort the composition of the basket of consumption goods or the production process. The tax reduces pollution as it induces tax payers to avoid the tax, thus leading the government to impose higher tax rates to finance its expenditures. In this situation, there is an incompatibility between the environmental and the second dividend (p.9)".

From a survey of a number of models Goulder [1995] concludes that the second dividend is unlikely to result except in very restrictive circumstances. Even if he remains supportive of a well-designed switch of taxes from labour towards pollution, he argues that the double dividend discussion has largely arisen because of our inability to quantify environmental benefits in a satisfactory way.

However, the Goulder's conclusion does not seem completely adequate since an analysis of the effects of a green tax reform on welfare, but also on unemployment and growth, should take into account a number of additional issues:

1. the initial structure of the tax system;
2. the presence of factors of production other than labour;

3. the presence of households not being part of the labour force.

A second dividend could emerge only if part of the tax burden is shifted away from labour. Thus an environmental tax reform could boost employment if, for instance, the tax burden is shifted onto incomes deriving from transfer payments; but this scenario is likely to be unattractive from a distributional point of view. Hence, in designing environmental tax reforms, governments typically face a trade-off between equity and efficiency. To some extent, this could be addressed by using part of the revenues from pollution taxes to compensate those dependent on transfer incomes. In the short run, an environmental tax reform may also shift part of the tax burden to capital. However, given the large international capital mobility, taxing capital on a sustainable basis would require a wide degree of international co-ordination.

In conclusion, if the ultimate incidence of pollution taxes largely falls on labour, an environmental tax reform does not necessarily raise employment. Moreover, high distortionary labour taxes generally do not make pollution taxes more attractive, even though the revenues from pollution taxes can be employed to lower labour taxes. The reason is that pollution taxes typically exacerbate existing tax distortions.

If favourable conditions for a double dividend exist and pollution taxes raise employment, the boost in employment could come at the cost of a negative impact, e.g. a less equitable tax system. Only if the initial tax system is sub-optimal from a non-environmental point of view, may the double dividend come free. The underlying intuition is the following: the welfare gains that derive from moving towards a more efficient system from a non-environmental point of view may finance the improvement in environmental quality. But in this case, «by employing instruments directly addressing the non-environmental inefficiencies, the government can typically reap the non-environmental efficiency gains more directly than by using pollution taxes» (Bovenberg, [1994], p. 33). Hence, in this literature, mainly addressed to analyse welfare effects of tax reforms, it does not seem easy to find a real justification for employing environmental taxes to cut down other distortionary taxes.

3.2 Ex ante simulations

These theoretical results, largely sceptical about the possibility to achieve a double dividend, are substantially contradicted by a series of studies trying to evaluate, in the framework of general equilibrium or macroeconomic models, the impact on employment and growth of a green tax reform, substituting energy taxes for labour taxes. A survey of these results has been presented in a previous OECD study (Majocchi [1996]). The conclusion that emerges from this survey is that the use of the revenue to finance a cut in employers' social security contributions is the best choice for recycling the revenue flowing from environmental taxes in order to promote employment. A cut in social contributions appears particularly efficient in promoting new employment opportunities if it is targeted to low-skilled workers. This positive result depends on many factors. An important condition that emerges from the existing literature is the assumption of wage moderation following the implementation of the tax reform and the availability of new jobs opportunities. From this point of view, policy measures targeted to the supply side of the labour market could be considered as complementary for guaranteeing a positive outcome. The impact on employment is strictly linked to the assumptions adopted with regard to the incidence of the employers' social security contributions that are assumed in the models as normally shifted forward onto prices, while a reduction of payroll taxes brings about a diminution of labour costs. Furthermore, in the models a complementarity between energy and capital as production factors is also generally assumed. Even if this outcome seems justified on econometric grounds, its validity in a long-run analysis, where an important switch in relative prices takes place, appears more disputable.

The results emerging from this survey can now be updated with some new experiments regarding the use of environmental taxes for reducing the rates of taxes levied on labour, in many cases with the main goal of curbing greenhouse gases emissions to achieve the Kyoto targets, while promoting growth and employment, in particular in European countries.

The Netherlands

In the Netherlands, the Green Tax Commission asked CPB Netherlands Bureau for Economic Policy Analysis to study possible further increases of the Dutch energy taxes, under the assumption that no comparable measures are taken in other countries. In its Report (Vermeend, W. and van der Vaart, J. [1998], first published in 1997), CPB worked out two variants, both of which increased the revenue raised by energy taxes by 3.4 billion guilders on an annual basis.

In variant 1 both the general fuel tax and the regulatory energy tax are doubled. In variant 2 the regulatory energy tax is tripled for use up to 5 000 m³ of gas and 10 000 kWh of electricity, with no changes in the general fuel tax. The main difference between the two variants is in the distribution of the tax burden. In variant 2, 75% of the tax burden is concentrated on private households, whereas this share is only 55% in variant 1. The revenues are recycled to business by reducing the employers' premiums for employee insurance, with the State taking responsibility for an indexed share of the premium. Revenues are in the simulations recycled to households via the wage and income tax route, in a revenue neutral context.

Acceptance of the tax by employees is assumed. The method for recycling revenue is considered adequate, implying that the introduction of increased energy taxes will not lead to additional wage demands.

The two variants have significant effects on households energy consumption: variant 1 shows an energy saving of around 4% on fuels, notably gas, and over 5% in electricity; in variant 2, around 7% and 10% respectively. The price elasticities vary within the range -0.14 and -0.45. By the year 2020, for both variants, CO₂ emissions are reduced by 4 to 5 megatons, approximately 2% of the emission level in the baseline scenario.

In broad terms, the two variants reflect substantially the same economic effects. There is a slight deterioration in industrial competitiveness and, due to the somewhat higher price level and the reduction in natural gas revenue as a result of induced energy saving, a slight decrease in private consumption, exports and GDP. This is reflected in a small decrease in the employment rate. On the other hand, wage costs fall as a result of the shifting of employers' premiums thus increasing the employment rate. Over time, half of the compensation represented by reduced employers' charges will be lost, because of an increase in gross wages, mainly through the functioning of the labour market. This partly cancels out the employment effect.

More positive results have emerged in a recent paper where the environmental and economic effects of energy taxes in the Netherlands have been analysed using an applied general equilibrium model (Komen and Peelings [1999]). The small-user energy tax, presently implemented in the Netherlands, and the general energy tax, (whose base is broadened to all industries and without considering exemptions) are compared, taking into account different tax recycling mechanisms. To be able to compare the two simulations, tax rates are adjusted in the general tax simulation such that exactly the same CO₂ reduction will be achieved as in the case of small user tax (- 3.5%). In both simulations, energy tax revenues are used to reduce the adverse effects of the tax by reducing pre-existing distortionary taxes on labour. Since labour taxes paid by employers are different in each industry, while there is a single rate for labour taxes paid by

employees, revenues are recycled by reducing labour taxes paid by employees in order to realise an equal distribution of the taxes over all industries

In the case of the small-user energy tax at the national level, total domestic use of natural gas, other fuels and electricity decreases by 4.1%, 7.5% and 4.6% respectively. The reduction of labour costs, by means of recycling 2,432 million guilders, results in 0.10% more employment and a redistribution of welfare towards private consumption and savings. The changing tax base reduces the excess burden due to existing tax distortions which results in a small increase in welfare (+ 0.06%). When the tax base is broadened to all industries, while the same CO₂ reduction is achieved, total domestic use of natural gas decreases more (5.4%) than in the small user tax case. Positive employment effects are larger than in the first variant (+ 0.15%), but in this case there is a small negative welfare effect (- 0.02%).

This study shows that, in the case of a small-user energy tax, both economic welfare and employment could improve. Hence a double dividend is achieved. The “literature on the double dividend suggests, however, that environmental taxes typically exacerbate, rather than alleviate, pre-existing tax distortions” (Bovenberg and de Mooj [1995], p. 1). But when more than one factor of production exists, an environmental tax can alleviate the inefficient distribution of the tax burden over factors if a redistribution from overtaxed factors towards undertaxed ones is achieved. Depending on the inefficiency of the initial tax system, the outcome of the tax interaction effect and tax recycling effect can be positive; in this case, an environmental tax reform entails a welfare increase.

Table 1. Effects of a small user energy tax and a general energy tax on energy use, welfare and employment (The Netherlands)

<i>Variable</i>	<i>Small-user energy tax</i>	<i>General</i>
Energy use		
Coal	-3.0	-2.3
Natural gas	-4.1	-5.4
Distributed gas	-6.0	-3.6
Other fuels for heating	-7.5	-5.1
Electricity	-4.6	-3.0
Welfare	0.06	-0.02
Total employment	0.10	0.15

Source: Komen and Peerlings [1999]

Different recycling mechanisms can be considered: Since labour is the only elastically supplied factor in the simulation of the effects of the small-users energy tax case, recycling tax revenues by reducing taxes on labour entails the largest positive welfare effect; on the other hand, recycling taxes on capital provides the same result as a lump-sum recycling, since a fixed supply of capital is assumed. When

the tax base is broadened to all energy users, it turns out that the tax interaction effect is negative, which is partly due to a deterioration of the international competitiveness of the large energy-using industries. This negative effect is not offset by the positive tax recycling effect, as it happens when revenues are recycled towards labour.

European Commission

Within the European Commission some preliminary simulations [Hayden, 1999] have been carried out with the Quest model of a revenue-neutral ecological tax reform consistent with meeting the Community's targets under the Kyoto protocol to reduce CO₂ emissions by 8% in the year 2010, relative to the level in 1990. Given the projected increase in energy consumption, this target requires that CO₂ emissions must be nearly 15% below the baseline emission level in 2010. The simulations are made under the assumption that member States try to reach their targets via an increase in fuel taxes. In a first variant, it is assumed that only energy taxes in the corporate sector are increased, while in a second variant only energy taxes paid directly by households are raised. The tax on fuels is increased at the same absolute rate for coal, oil and gas.

Table 2. Ecological tax reform for the EU economy: simulation results
(Variant 1: Corporate tax rise; Variant 2: Household tax rise without social consensus;
Variant 3: Household tax rise with social consensus)

	Variant 1	Variant 2	Variant 3
GDP			
2000	-0.2	-0.1	0.2
2005	-0.6	0.0	0.9
2010	-1.0	0.4	0.9
Employment			
2000	0.0	0.1	0.8
2005	0.1	0.5	1.5
2010	0.1	0.9	1.3
Inflation			
2000	0.0	-0.1	-0.1
2005	0.1	-0.1	-0.1
2010	0.1	-0.1	-0.1

Source: Hayden [1999]

In the first scenario, the GDP effect in the EU as a whole is mildly negative (- 1% in the year 2010), but with a small positive employment effect (0.1%), net real wages staying roughly constant. Investments fall by nearly 3%, reflecting a decline in capital productivity as a consequence of firms substituting away from energy-intensive modes of production. The following diminution in labour

productivity has an adverse effect on labour demand, limiting the increase in employment. The emission targets could be reached by increasing the effective level of energy taxation in the corporate sector by about 18.5 percentage points, while labour taxes are reduced by about 14 percentage points.

With a revenue-neutral tax reform shifting taxes from labour to households consumption of energy, that is shifting the tax burden from wage earners to recipients of profits and interest, there is no efficiency loss in production. Since the taxation of labour is effectively falling, while all other taxes on factor inputs remain constant, the efficiency of production is enhanced in this scenario and an increase in employment should generally be expected. A drawback of this approach is that reaching the emission targets would require an increase of about 64 percentage points in households energy taxes over the simulation period. If wage moderation is assumed, GDP is about 0.9% above baseline and employment increases by 1.3% in the year 2010. Due to the overall positive effects of this policy and the additional revenues generated, even without social consensus, labour taxes could be lowered by 3.7 percentage points by the year 2010. Hence, *inter alia*, these simulations show the importance of a broad tax base for the realisation of a double dividend.

Another paper (Scaglioni and Sgarra[1999]) tries to evaluate the possibility to realise a double dividend in the European countries where a carbon tax has already been implemented. The basic idea is to estimate, in different European countries, a regression function linking the level of employment during the period (1986-1990) preceding the introduction of the carbon taxes to different economic variables, including real wages, nominal interest rate, real GDP, number of workers enrolled in trade unions and social security contributions. During a second time period (1991-1995) an additional variable is included – the revenue flowing from the carbon tax. The estimate of the regression model is either cross section and time series and the method adopted is OLS. The sign for the carbon tax results is positive, meaning that the introduction of the environmental tax plays a role in explaining the level of employment.

Sweden

In Sweden, the Government Green Tax Commission analysed the effects of a theoretical revenue-neutral green tax shift where distortionary taxes were replaced by taxes on goods and services which have negative effects on the environment when produced or consumed. A tax swap involving higher carbon dioxide taxes and lower taxes on labour was evaluated with the help of a general equilibrium model.

The Commission's conclusions suggest that there is a welfare loss in the sense of a reduced real income unevenly distributed across different households. According to the model, there are different winners and losers among the firms. Winners of the simulated reform are in sectors such as telecommunications, drugs and medicines. Companies within the pulp and paper, transportation and retail sectors may be negatively affected by carbon dioxide/labour tax swaps.

A targeted reduction of the labour tax may be a better option, as compared to a general cut of labour taxes, in terms of the effects on employment. The results are sensitive to different assumptions about the labour market. If wages are fixed at a too high level and if lowered labour taxes are fully absorbed into lower labour costs, then the probability of welfare gains, exclusive of environmental benefits, are higher. The Commission recalls that similar results have been obtained in other countries using similar models: the probability of a double dividend is not high for a general tax swap between environmental and labour taxes, but the results are sensitive to assumptions about the functioning of labour markets and the weight assigned to environmental improvements. The Commission suggests that, since revenues from higher energy and environmental taxes currently do not allow substantial general reductions of the labour tax, one should primarily consider some kind of selective tax cut on labour. In addition,

priority should be given to tax reductions giving the largest possibility for increased employment, not the least in view of the positive distributional impacts that could follow from this achievement.

Norway

In Norway, a Green Tax Commission appointed by the government in 1994 presented its final report in August 1996 (Norwegian Green Tax Commission [1996]). The main purpose of the Commission's work was to make recommendations related to a green tax reform which may contribute to a better environment combined with higher employment.

In the Norwegian literature, the opinion is widespread that reductions in taxes on wage incomes and employers' social security contributions could lower the overall efficiency loss in the economy, while higher environmental taxes could create positive efficiency effects through their effects on pollution emissions and other environmental harmful activities. Taken together, this opinion suggests that there may be double dividends associated with increased environmental taxes and using the tax revenue to reduce taxes on labour, in the sense that these measures could generate a better environment and a lower efficiency loss of taxation.

The Commission carried out simulations regarding environmental and employment effects of proposals considered in its report. The main conclusions of these simulations are as follows:

- in the very short run, a revenue neutral tax reform with greater emphasis on CO₂ taxes does not generate significant employment effects. In all the variants including such a shift, environmental effects are positive since emissions in Norway will decline;
- in the somewhat longer run, the simulations suggest that a tax reform may generate positive effect on employment under certain conditions related to wage formation and to the extent that higher CO₂ taxes contribute to a wage decline in the manufacturing industry;
- even though the employment effects seem to be moderate, a tax reform may be considered as favourable due to the environmental improvements it provides;
- the macroeconomic effects are relatively moderate, but the effects on individual industries and regions may well be important.

In a first alternative considered by the Commission, a CO₂ tax of NOK 50 per ton CO₂ was imposed on emissions in sectors presently exempt from the tax, while the tax on other sectors was not changed. The increase in the CO₂ tax corresponds to a reduction in employers' social security contributions of 0.2 percentage points, so that the tax reform is revenue neutral. Macroeconomic and environmental effects are relatively small. An escalation alternative assumed an increase of the CO₂ tax over a 7 years period, so that, at the end of the period, all sectors faced a tax of NOK 360 per ton, i.e. the same level as the existing petrol tax. In this alternative, employers' social security contributions were also reduced to 2 percentage points lower in 2010 than in the reference scenario. In this scenario, the macroeconomic effects were somewhat larger: employment increases by 0.4 percentage points while CO₂ emissions were estimated to be reduced by 4.8 points and SO₂ by 11.8 points.

A third simulation concerned the effects of applying the consumption tax on electricity, paid by households and other business sectors, to the manufacturing industry. The resulting increase in government revenue was assumed to be used to reduce employers' social security contributions by 1 percentage point. As a result, profitability declined in energy intensive industries, but rose in other, more labour intensive,

industries. The overall estimated effects on production (+0.3%) and employment (+0.4%) in 2010 were relatively favourable.

In conclusion, the Commission recommended a large number of changes and increases over a broad range of green taxes, a main motive being to transfer well established principles of cost efficiency into practical policies for a better environment and higher employment. The revenue from green taxes should be used to reduce taxation of labour or for other measures that will ease adjustment and structural changes in the labour market.

3.3 Conclusions

Today, a variety of sophisticated and complex models are available for the analysis of ecological tax reforms. The inherent disadvantage of these models are the different restrictive assumptions which they are bound to make with regard to the real world complexity. These assumptions, differing from model to model, have been the main reason for the contradictory results that emerge in the literature. But, as it appears in a recent study promoted by the European Commission (Infras [1996]), some convergent results eventually come out:

- in general, a tax shift from the relative abundant factor labour to the scarce factor environment leads to positive effects on employment (substitution effect) and negative effects on GDP (nominal income effect). Theoretical studies show that negative employment effects have to be expected if negative income effects of the tax dominate over the substitution effect due to the change in the relative factor input prices. However, simulation studies, based on traditional assumptions with regard to substitution elasticities, show a dominance of the substitution effect;
- positive employment effects can be expected if the revenues are used for lowering taxes on labour in general and social security contributions of employers and employees in particular. Using the revenue for lump sum payments to households or for lowering VAT leads to less significant or negative employment effects;
- for most European countries, larger employment effects can be expected if the cut in social security contributions are targeted on the unskilled labour force;
- positive effects on GDP can be expected if the revenues are used for a cut in capital taxes, (thus favouring investment), and gradually implemented;
- both GDP and employment effects depend on the size of the tax reform. Generally, the results of the simulations show positive effects on GDP and employment when the energy tax is introduced stepwise and the energy price increase does not exceed 4-5% per year. Higher tax rates lead to negative effects on employment and GDP;
- the effects in the labour market are larger if unemployment is linked with wage rigidity that is, if the level of wages does not decrease with unemployment, lower social security contributions are more likely to induce positive employment effects. On the other hand, simulations turn out to be quite insensitive to changes in the structure of the production functions;
- negative impacts on international competitiveness can be controlled effectively by introducing offsetting methods, such as border tax adjustments, sectoral recycling of the revenue or a rebate scheme for buffering the negative short term effects on energy intensive industries.

4. THE MAIN ISSUES AND REQUIREMENTS FOR THE REALISATION OF A DOUBLE DIVIDEND

This overview of the literature and *ex-ante* simulations of green tax reforms clearly indicate that the realisation of a double dividend involves several requirements (Goulder 1995).

4.1 General requirements

First, the tax system would have to be initially sub-optimal. This would be the case if efficiency losses (excess burden) related to existing taxes differ widely; in this case, there is a greater potential to reap a double dividend. But a double dividend does not follow if the environmental tax falls largely on the factor with an existing high excess burden.

Hence, a second requirement is that the incidence of the environmental tax falls on a fixed factor with a relatively low excess burden. If, for instance, the burden of the pollution tax falls primarily on capital, and the excess burden of a capital tax is much lower than that of a labour tax, a green tax reform, shifting the tax burden from labour to pollution in a revenue-neutral way, could yield positive welfare effects.

The third requirement is that the environmental tax should be broadly based, otherwise it would tend to generate many distortions in other markets thus reducing social welfare.

According to Ligthart (1998) all these requirements mean that the key condition to reap a double dividend is the presence of production factors on which the burden of taxation can be shifted. Three different types of tax burden recipients can be sorted out for illustrative purposes:

- fixed factors of production;
- households that consume out of transfer incomes, such as retirees or unemployed workers;
- foreign countries that are unable to influence the terms of trade.

Fixed factors of production

Bovenberg and van der Ploeg [1996] and Ligthart and van der Ploeg [1996] evaluate the double dividend hypothesis within a model with three factors of production – labour, energy and a fixed factor, capital -, where the level of wages is too high to clear the labour market, hence, the existence of involuntary unemployment. A double dividend could emerge if the share of capital within the value added is sufficiently high and labour is a better substitute for energy than capital. In this case, the improvement of environmental conditions is due to the adoption of more labour intensive production techniques, and not to a diminution of the level of output, and the burden of taxation is shifted from labour to capital owners. This result holds only if capital is relatively immobile internationally, otherwise capital could simply avoid the burden of the tax by moving abroad; this explains why a double dividend is particularly unlikely within models where the existence of a small open economy is assumed.

Tax burden on income transfers

A second possibility is the introduction of a tax on polluting goods when some households derive their income from transfer payments made by the public administration. Taxes are initially paid by all consumers – workers and transfer income recipients. But while workers get a benefit through lower labour taxes, (using the revenue of the environmental tax), this does not happen for the other transfer recipients, and their real income is consequently reduced. The tax burden is partly shifted from workers to the other income recipients, since the tax base of the environmental tax, involving every kind of income, is larger than the tax base of the labour tax, that is limited to wages. If this second effect is larger than the first one, a double dividend could result, but this would have a regressive impact, as the tax burden is partly shifted on to the unemployed and the retirees, whose levels of income are normally lower.

Marsiliani and Renström [2000] are more positive concerning the idea that shifting the burden of taxation away from labour towards the environment could either boost employment and increase welfare. In the framework of a general equilibrium model where the economy is distorted by labour taxes, monopolistic product market competition and union-wage bargaining, if the revenue from the introduction of a Pigouvian tax, imposed on firms and households, is fully recycled to cut the rate of the pre-existing labour tax, employment and welfare increase due to the presence of non-wage income, i.e. unemployment benefits and profits, towards which the burden of the environmental tax can be shifted. Both employed and unemployed workers together with shareholders bear the burden of the pollution tax, while only employed workers benefit from the reduction of the labour tax. Therefore, the base of the environmental tax is relatively larger than the base of the labour tax, which mitigates the tax base erosion effect. Under these circumstances a double dividend is more likely.

Terms of trade changes

A third possibility arises if a country is able to export its tax burden through a change in the terms of trade. If a country levies a tax on an imported good for which it has significant market power – energy, for instance – the import price of the good could be reduced. A part of the burden of the tax would be shifted abroad, while the benefits of the tax reductions funded by the revenue of the environmental tax would be exploited domestically. This could be the case, for instance, if the oil-importing countries are able, following the introduction of a new tax on energy products, to cut down the rents of the oil-producing countries (Hourcade [1999]).

4.2 Requirements for increased employment

Alternative definitions of the second dividend should be considered when stressing the requirements for achieving a successful green tax shift. While American authors normally define the second dividend in terms of a reduction in the distortionary cost of the tax system, European authors usually consider the second dividend in terms of an increase of employment. The possibility of obtaining an increase in employment is linked to a number of issues.

The first issue is the *degree of substitutability between factors of production*. When the revenue of the environmental tax is used to lower labour taxes, firms face incentives to switch to different production techniques. They may both use less polluting energy sources and more labour instead of energy and capital. Increased employment is most likely to be achieved if, in general, it is easy to substitute between different production factors (Hourcade [1999], p. 7). A pressure for change can derive also from the demand for goods and services, since changes in the relative prices of energy-intensive and labour-intensive goods will result in increased demand of labour intensive goods.

The second issue is the *degree of competition in the markets for goods and factors of production*. If the market for labour is competitive, a lower labour tax will result in reduced labour costs. If the labour market shows strong monopsonistic powers of the trade unions, the benefits of lower labour taxes will be enjoyed by insiders, that is workers already employed, through higher wages. On the other hand, if the goods markets are not competitive, the tax reduction will be probably captured by the firms through increased profits.

A third issue is the *time frame of the introduction of the tax reform*. A phased introduction can enable firms to adapt through a defined time span to new market conditions and introduce new, more labour intensive and less energy intensive technologies, induced by the switch in taxation. This would reduce the possibility of negative effects on output in the short run, without impairing the possibility to exploit the positive environmental effects of the reform.

A fourth issue is the *existence of a "social consensus"*. If industries, particularly the more energy-intensive ones, would accept the reform as useful for the overall economy, one could avoid exemptions for the sectors involved; if trade unions adopt a policy of wage moderation, the reduction in labour taxes will entail positive effects on employment since it will not be immediately balanced by an increase of nominal wages.

A fifth issue is *international co-ordination of tax reforms*. If, for example, a country decides to introduce an energy tax to reduce greenhouse gases emissions, and to use the revenue to lower the rates of taxes on labour, the possibility to achieve a double dividend is higher if competing countries are following a similar path. The risk of reduced competitiveness of domestic firms through an ecological tax reform would be significantly lower if the major producing countries take similar measures simultaneously.

5. TAX SHIFTS IN PRACTICE

This section provides a preliminary survey of the implementation of green tax shifts in OECD countries. In particular, this section considers the likely impact on growth and employment of a revenue-neutral tax reform, where the revenue of environmental taxes has been targeted to lowering the fiscal wedge on labour costs.

5.1 Denmark

In 1995 the Danish Parliament adopted the "Energy Package". The main purpose of this policy was to increase the CO₂ tax, to extend the energy taxes to energy sources used in trade and industry and finally to introduce a new tax on SO₂ emissions. Energy intensive firms could make voluntary agreements with the government on reductions in CO₂ emissions and thereby obtain a tax rebate. When the Energy Package was adopted, it was promised that the effects of the new legislation should be evaluated in 1998. The evaluation has been carried out by a working group under the Danish Minister of Finance. The Committee's Report remarks that green taxation for trade and industry is instrumental for regulating the environmental load. The taxation system under evaluation ensures that the environment is affected in an economically efficient manner, which also takes companies' international competitiveness into account.

Generally, the environmental effects of the Energy Package is found to live up to the expectations held at the time it was introduced. The package will contribute to about a 4% reduction in CO₂ emissions in 2005, thereby covering a significant part of the effort required to comply with the Danish commitments. The macroeconomic impact of the energy package is limited. This is partly due to the fact that the increased revenue from the tax changes is recycled back to trade and industry. The energy package brings in revenue of approximately DKK 2 billion annually in additional CO₂ tax, SO₂ tax and energy taxes on trade and industry. Similarly, approximately DKK 2 billion are transferred back via investment subsidies to promote energy savings up to 30% of the initial expenditure, the reduction of labour contributions and other fees. However, the impact on individual firms can be substantial.

5.2 Finland

In Finland, energy tax levels were raised once again on 1 September 1998. However, the general structure of energy taxation remained unchanged. The environment-related tax component, i.e. the surtax on heat and traffic fuels, which is based on the carbon content of the fuel, was raised 24% to FIM 102 per ton of CO₂ (FIM 374 per ton of carbon). Electricity faces the same tax increase. Total taxation of traffic fuels remains unchanged; basic tax components of petrol and diesel oil experienced a cut equal to the increase in the environment-related component.

In addition to increases in tax rates, changes were made to favour combined heat and power production and wind power. Refunding was introduced for energy intensive industry (and also to escape the tax on electricity produced with waste gas from metallurgical processes, supplementing the refunding already in place on electricity produced with wood or wood-based fuels).

Finally, the suggestion of a comprehensive green tax reform is included in the programme presented by the Prime Minister Paavo Lipponen on 15 April 1999, where it is stated that “the tax structure will clearly be changed to favour work and employment. The lower taxation of labour will be compensated to a considerable extent by new environmental taxes. The tax model will favour those that save energy and reduce the emissions that are detrimental to the environment and it will support the development of labour intensive and new technology branches, without creating obstacles to the Finnish exports”.

5.3 Germany

In Germany, a law to phase in a green tax reform has been adopted in the framework of the coalition agreement between the SPD and Alliance90/the Greens and came into effect as from 1 April 1999. The goal is to make energy consumption more expensive, while the extra tax revenue will be used to lower statutory contributions to pensions insurance, hence easing the tax burden on labour as a production factor, and promoting the use of renewable energy sources. The double dividend expected is a positive effect on the environment and a reduction of the cost of labour to the firms, thus stimulating the labour market while raising net labour incomes. The ecological tax reform is also seen as a step towards the envisaged 25% reduction of CO₂ emissions in Germany in the year 2005 compared to 1990 levels. Furthermore, the introduction of an electricity tax has been seen as contribution towards a common energy taxation policy within the European Union.

The idea behind the increase in energy taxation is that the price of energy in Germany is still too low and, as it does not reflect completely the external costs of energy consumption, it does not provide a sufficient incentive to promote the use of renewable resources and to exploit the potential for energy conservation. The German reform makes also an explicit reference to what has already been done in others EU countries, such as Denmark, the Netherlands, Austria and recently Italy. As a first step, the German government has increased the duty on mineral oil and has introduced an electricity tax, with an expected additional revenue for the fiscal year 1999 of DM 8.4 billion for the federal budget.

This extra revenue was used to reduce pensions insurance contributions by 0.8 percentage points, thus easing the tax burden on labour, with a 0.4 percentage points reduction either for employees or employers contributions. The pensions insurance contribution level will thus come down from 20.3 to 19.5% and that of total social security contributions from 42.3 to 41.5%, with the aim of bringing down this level below 40% in three successive stages.

The Law on Continuing the Ecological Tax reform, which was adopted by the Bundestag on 11 November 1999, provides for a second phase of the ecological tax reform, with a further four-steps increase in taxation from 2000 to 2003. The rate of the tax on mineral oil will be increased every year by 6 pfennig, while the rate of the tax on electricity will be raised by 0.5 pfennig per kWh. The pensions insurance contributions rates will be correspondingly decreased by 0.1 percentage point in the year 2000 and by a further 0.3 percentage point every year, thus reaching a accumulated reduction of 1 percentage point in 2003. Half the reduction will be made in employers contributions and half in employees contributions. In some estimates, provided by the Bundesministerium der Finanzen, a representative household (a family with an average monthly income of 4 700 DM), taking into account the increase in energy taxation and the reduction of the rates of pensions insurance contributions, will face a monthly increase in tax payments equal to 2.90 DM in 2000, 1.10 DM in 2001, but a reduction of 0.70 DM will appear in 2002, that will increase to 3.36 DM in the year 2003.

Box 1. New environment-related taxes in Germany

A new tax of DM 0.02 per kWh has been introduced on electricity. The tax is levied on electricity generators or utilities, and the structure of the tax assumes that the burden will be shifted, or passed on to, the end-user in the electricity bill. Imported electricity is also subject to the tax, that has been designed as a consumption tax. Electricity generated by renewable sources (wind power; solar energy; geothermal energy; water power, landfill gas and biomass in power stations with an output not exceeding 2 MW or 10 MW in the case of hydro-power) is exempted from the tax if consumed directly from the generator, or if the electricity is taken for consumption from a grid or a line carrying power generated exclusively from renewable sources.

The mineral oil duty has been increased by DM 0.06 per litre on motor fuels; by DM 0.04 per litre on heating oil and by DM 0.0032 per kWh on gas. Heating oil or gas used as inputs for generating electricity are exempted from the increase in the mineral oil duty. The goal is to avoid an advantage for coal in electricity production. In order to give efficient technologies a competitive boost, combined heat and power plants (cogeneration of electricity and heat) with a monthly utilisation rate of at least 70% will be completely exempt from the existing mineral oil tax. Highly efficient combined cycle gas turbine power plants with an electric efficiency factor of at least 57.5% which are completed and begin operating after 31 December 1999, will have full exemption from the existing mineral oil tax for ten years after the first generation. This measure will remove the competitive disadvantage of gas-steam power plants that can play an essential role in providing replacement capacity for nuclear power plants.

To keep the external competitiveness of the producing sector, electricity used by enterprises for operating purposes is taxed at a reduced rate of DM 0.004 per kWh, corresponding to 20% of the standard rate, insofar as annual consumption exceeds 50 MWh. In addition to this reduced rate on electricity, the producing sector is also exempted in part from the tax increase on heating oil and gas. This limits the extra charge in this sector to 20% of the increase in mineral oil duty presently implemented. But energy intensive firms are entitled to additional claims. A further refund will be granted if the tax burden imposed by the increased rates is 1.2 times greater than the relief provided by the reduction in pensions insurance contributions. Companies will, on application, be refunded the full amount. This provision impacts the competitive situation of energy intensive firms, thus lowering the incentives to delocalise productive activities towards countries which do not have at present high energy taxes. The refund is paid only if the burden imposed by the added taxation exceeds DM 1,000 a year respectively for the additional taxation of heating oil and gas and of electricity.

The same reduced rate of DM 0.004 per kWh is applied to electricity used by agriculture and forestry undertakings for operating purposes, provided that consumption exceeds 50 MWh per year. The same firms are entitled to a refund of 80% of the mineral oil duty increase if the refund due exceeds DM 1,000 per year. Electricity used for rail transport and trolley buses is subject to a reduced rate of DM 0.01 per kWh. The same rate applies to electricity used for domestic space heating installed before 1 April 1999, since the accommodations equipped with this type of heating are now occupied predominantly by socially disadvantaged tenants. Since this group of persons does not generally benefit from reductions in the pensions insurance contribution rates, this provision helps to ensure that the burden imposed by the ecological tax reform is kept within socially acceptable limits.

The provision of a reduced tax on the use of natural gas or LPG for the operation of vehicles has been extended to 31 December 2009 and the restriction of this provision to vehicles operating in public transport has been lifted. This is intended to give an extra, long term incentive for manufacturers to put environmental friendly gas driven vehicles on the market and for consumers to buy them, and to provide an important contribution towards resolving traffic-related environmental problems in inner city areas and conurbations.

5.4 Italy

A similar reform has been implemented in Italy with the approval of the Financial Law for 1999 (L. 23/12/1999, n. 448, article 8). A new taxation on CO₂ emissions and related compensation measures have been introduced, providing a revision of the existing excise duty rates on mineral oil. These provisions came into force as of the year 1999. The new green tax is based on two main components:

- a re-modulation of excises on mineral oils, according to their carbon content and to their use, so that their potential effects on climate change is taken into consideration, to be realised with a smooth transition from 1999 to 2005;
- the introduction of a consumption tax on coal, petrol-coke and natural bitumen used in the combustion plants as defined by EC Directive 88/609.

In order to modify the present structure, a target vector of energy products tax rates has been identified, that satisfies on the one hand the requirements of the EU harmonisation process of excise rates on energy products by complying with the minimum rates set out in the proposal for a EU Directive actually under examination; and, on the other hand, a criterion has been introduced to tax the potential pollution capacity of each fossil fuel according to its specific CO₂ emissions, so that an environment-friendly consumption could be encouraged. The new taxation system fosters a progressive reduction in greenhouse gas emissions in line with the fulfilment of the Kyoto commitments, by modifying in a significant way the relevant prices in order to encourage the replacement of fossil fuels with other fuels having a lower carbon content, to foster energy efficiency and to promote non-fossil fuel alternatives.

Box 2. The new energy excise taxes in Italy

The new excise rate system is determined on the basis of a structure similar to the following:

$$A = C \cdot A_M + B_K$$

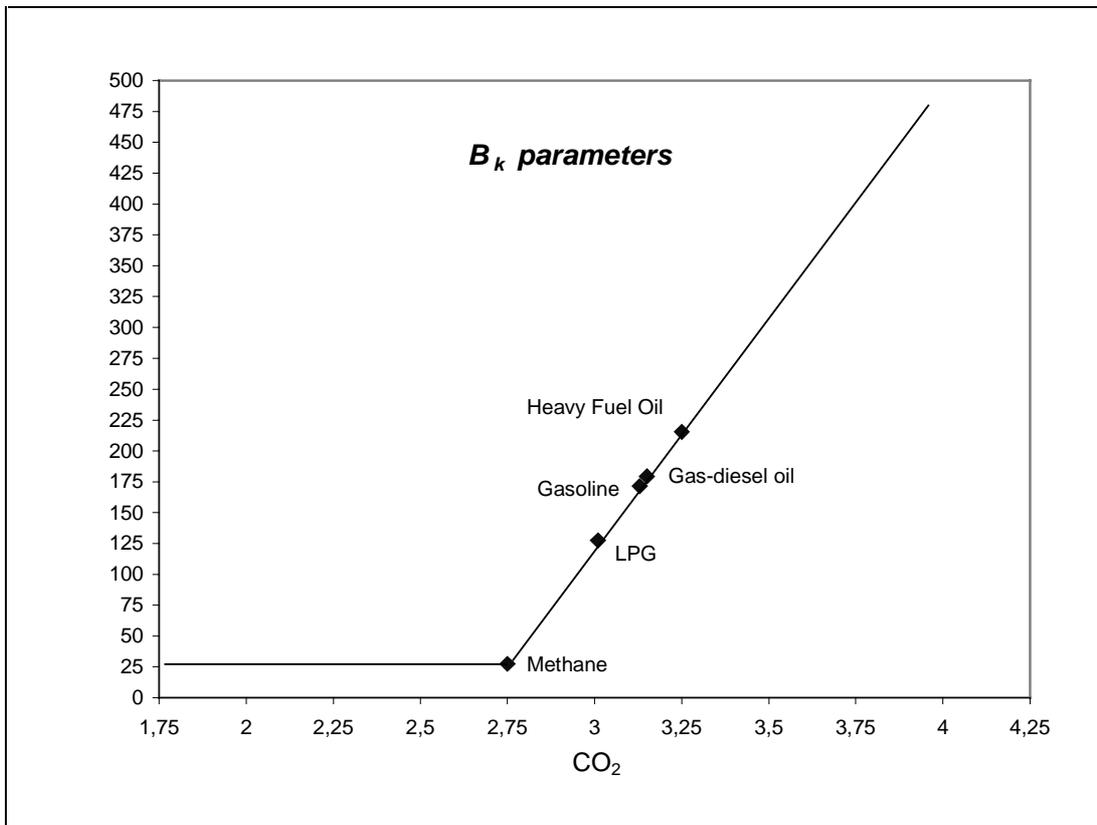
where:

A_M is the tax component proportional to the tax levied on energy products as currently proposed at the European level

B_K is the tax component proportional to the environmental impact due to the greenhouse effect

C is a correction coefficient taking into account the comparison between the European tax levels and the Italian one, as to ensure a sound stability of the revenue flowing from this source.

In accordance with a well established view in the international debate on curbing the negative environmental impacts of energy products, **B_K** can include values proportional to the CO₂ quantities released in the combustion of 1 kg of energy products. Given the specific CO₂ emission values for each energy products, in the Italian tax provisions the burden unit values per kg of CO₂ released have been scaled on a line to derive the **B_K** component of the environmental tax, to which the relevant energy tax values should be added. In more details, starting from an environmental impact rate of Lit. 10 per kg of CO₂ released in the combustion of 1 kg of fuel, up to a value of 2.75 kg CO₂ – that is, the value of the least polluting product, methane – in the emission range that is considered by the law provisions (2.75 – 4 kg CO₂) a linear increase by Lit. 400 per each additional kg of emissions is assumed. While such structure is also applied to energy products used in the industrial sector, the rates are reduced when applied to the production of electric power since in Italy electricity is already taxed as output. In this area the tax rate is calculated by applying the component proportional to the environmental impact only with a very limited increase coefficient.

Figure 1. The rates of the Italian carbon tax

In this way the excise duty rates on mineral oils to be applied as of 1 January 2005 have been set out. In the next years the rates will be progressively raised within a pre-defined range, so that the increase will not be lower than 10% and not higher than 30% of the difference between present and target rates and will be basically established according to the total CO₂ emission values recorded in the previous year. Starting from 1 January 1999 a new consumption tax equal to Lit. 1,000 per each ton of coal, petrol-coke and natural bitumen used in the combustion plants has also been introduced.

The new revenue flowing from these sources will not add to the overall tax burden. It will be compensated through a reduction in the compulsory contributions on labour. The explicit goal of the reform is to exploit a double dividend; to promote an environmental policy linked to the growth of employment through a lowering of the tax wedge in labour costs. While the largest share (60.5%) of the expected revenue will be used for the reduction of social contributions, 31.1% will be targeted on compensation measures and 8.4% for interventions improving environmental efficiency of energy use. The estimated new revenue is about 1 125 mill Euro in 1999 and about 5 420 mill Euro in 2005.

In 1999 the revenue of the carbon tax (2 180 billion lire) will be distributed in the following way (in billion lire):

• reduction of the labour costs	1,319
• tax reductions	683
• expenditures for environmental projects	300
• other expenditures	31

for a total of 2 310 billion lire (1.2 billion Euro), larger than the expected revenue of the carbon tax. This difference will be covered through the revenue increase provided by the excise on unleaded petrol. The new environmental expenditures will be targeted to promote the reduction of polluting emissions, energy efficiency and renewable energy sources, while the tax reductions will concern compensations for some social groups more severely hurt by the new environmental levy.

More specifically, the following measures are targeted to lowering labour costs or promoting entrepreneurial activity:

- (a) removal of some contributions that hit labour costs;
- (b) transfer on the account of the state budget for three years of the social contributions due by the firms for the labour force recruited before the end of 2001 in the Southern regions;
- (c) halving the social contributions due by young entrepreneurs in the handcraft and commercial sector.

This first stage of this tax reform has been postponed at least until the end of September 2000. The reason for this delay has been the significant rise in oil prices experienced in 1999 and the first three quarters of 2000. Oil price rises have boosted associated VAT revenue and the Italian government has used this additional revenue to cut the excise on oil products from between 30 and 50 lire per litre. In addition the government has offered relief on fuel costs to lorry hauliers. The intention is that carbon tax increases will still be progressively increased to the final target rate set for January 2005, but the Ministry of Finance is keen to avoid a situation where tax increases exacerbate already high world oil prices.

5.5 The Netherlands

The Netherlands currently applies two energy taxes, the general fuel tax and the regulatory small-user energy tax. The first covers all energy inputs and the rates are set on a 50% carbon content and a 50% energy value basis. The rates of the general fuel tax are fairly low but are applied with practically no reductions or exemptions. The only important exception is natural gas use in excess of 10 million m³ per year, which is taxed at a lower rate. The regulatory energy tax covers primarily gas and electricity. The first 800 m³ of gas and the first 800 of electricity per user per year are not taxed, nor is the gas use above the threshold of 170 000 m³ of electricity use in excess of 50 000 per year. The rates are quite a bit higher than those of the general fuel tax.

In the White Paper “Taxes in the 21st Century” the possibility is outlined of a Dfl. 5.1 billion tax raise in environmental taxes that can be used for reducing income tax (3.7 billion), while a part (0.5 billion) could be utilised to provide positive incentives for investment in energy saving by households and industry and the remaining 0.9 billion for compensations to industry. Energy taxes are proposed to be raised by 3.7 billion, while the other revenue will come from different environmental taxes and by indexing environmental taxes for inflation.

The overall impact on CO₂ is estimated to compensate the growth of these emissions, otherwise to be expected, in about 4 years. According to the White Paper, no significant effects on employment should be expected. Positive employment effects could result only if the shift is made in such a way that

the net income from labour benefits more than income from social security payments. According to the Ministry of Finance, changes in the tax system along these lines will be implemented in the years 1999-2001. The first part of the greening measures was introduced on 1 January 1999. This part consists of a rise in the regulatory small-user energy tax – by 1.1 billion Dfl, which is about one third of the intended total rise -, a higher VAT rate on water and the indexation of the existing environmental taxes on energy, groundwater and waste. The revenues of these tax measures are mainly used for lowering the income tax and partly for raising positive tax incentives for environment-friendly investments and behaviour by industries and households.

5.6 UK

In July 1997, the UK government issued a "Statement of Intent" on environmental taxation. This statement committed the government to exploring the scope for environmental taxation, while taking account of the dead-weight, compliance costs, distributional impact and international competitiveness. Accordingly, where appropriate, mitigation measures were to be put in place such as the recycling of tax revenues - for example, through lower National Insurance Contributions or schemes aimed at helping adjustment - or a gradual phasing in of tax increases providing in advance a clear signal to the market and allowing time to adjust.

An evaluation of the potential effects of each tax is presented in the Government's Economic and Fiscal Strategy Report which accompanies the annual Budget. In the March 1999 Budget the Government announced that it would introduce a climate change levy on energy use by business with effect from April 2001. Further details on the design of the levy were finalised in the March 2000 Budget, including the overall size of the levy (£1 billion) and the levy rates (0.07 p/kWh for LPG, 0.15 p/kWh for gas and coal and 0.43 p/kWh for electricity). New renewable electricity (excludes large-scale hydro) and 'good quality' CHP will be exempted from the tax. The projected environmental benefit of the levy 'package' is a 5 million tonne reduction in carbon emissions by 2010 (price effect of the levy: 2MtC, energy efficiency measures: 0.5MtC, and negotiated agreements: 2.5 MtC). The Government has given special consideration to the treatment of energy intensive sectors -- all the revenues raised -- will be recycled back to business through a 0.3 percentage point reduction in employers' National Insurance Contributions. In addition the government will provide £50 million per annum additional support for measures improving energy efficiency and the development of renewable energy. A further £100 million will be available in the first year of the tax (2001-02) for 100% enhanced capital allowances for specific energy saving technologies. Furthermore, an 80 per cent discount on the levy will be offered to energy intensive sectors that agree targets that meet the Government's criteria.

Only those companies whose sites are covered by the EU's Integrated Pollution Prevention and Control (IPPC) legislation are eligible to enter a negotiated agreement. However, some smaller sites that fall beneath the set size threshold, may nonetheless join such agreements. This will effectively mean that around 60% of the energy used in manufacturing will be covered by energy or emissions agreements. Ten of the largest energy intensive trade associations have already signed Memoranda of Understanding with the Government on such targets, with arrangements for monitoring, review and variation over the period to 2010. As a result of all of these measures, the levy package is expected to be revenue neutral for the private sector; entail no net financial gain for the public finances; and be broadly neutral between manufacturing and service sectors.

A series of economic instruments are used to address the environmental problems associated with road transport. The duty on road fuels - petrol and diesel - are set every year in the Budget at a level which takes into account economic and social objectives as well as environmental commitments to reduce carbon dioxide emissions. However the road fuel duty escalator (introduced in 1996) which raised real fuel prices

by 6% per annum was abandoned in 2000. In future, the revenue from any real term increases in duty will be allocated to improving public transport and modernising the road network. On average, households spend £7 a week on road fuel duty. This is equivalent to approximately 2% of net household income. The road fuel duty is not regressive across the whole income spectrum. Although expenditure on road fuel duty as a percentage of net household income across all households is lowest for the households in the top decile (1.4% of net income), it is highest for those in the fifth and sixth decile (2.3% of net income). Those in the lowest income decile spend a similar proportion of their household income on road fuel duty as those in the seventh decile. Within the lowest decile, a large proportion of households (65% compared with an average of 37%) do not purchase any road fuel, thus reducing average expenditure on road fuel for that group. But among those households which purchase road fuel, the tax is more regressive, with the lowest income decile spending 5.6% of net household income on duty, over three times more than the richest decile, and more than twice as much as the average.

A *landfill* tax was also introduced in October 1996 and a corresponding cut in employers' social security contributions of 0.2 percentage points. The main goal of the tax is to discourage the use of landfilling as a way of disposal for wastes and to promote other more environment-friendly waste treatments by firms and households. The level of the tax was fixed at a basic rate of £7/tonne, with a reduced rate of £2/tonne for inactive waste. The tax rates were based on the results of a study on the external costs of landfill. Subsequently, the government has increased the basic rate of landfill tax to £10 per tonne, with effect from 1 April 1999, and announced its intention to further increase the rate by £1 per tonne per year until at least 2004. This marks a shift away from a tax based purely on internalising estimated external costs. One driver for this change is the need to meet EU targets for reducing landfilling of biodegradable municipal waste.² Setting out rate increases in advance, over a five-year period, is intended to enhance behavioural effects by giving a degree of planning certainty to waste producers and waste managers. Rebates on the landfill tax apply (the landfill tax credit scheme): operators can claim a tax credit of 90% of any contribution they make to an environmental body for spending on an approved environmental project, subject to a maximum credit of 20% of landfill tax liability.

5.7 Switzerland

In October 1999 the Swiss Parliament approved a law permitting the introduction of a subsidiary CO₂ tax from 2004 onwards at a maximum rate of CHF 210 per ton of CO₂, in case the reduction target of 10% by 2010 compared to 1990 seems unlikely to be met by voluntary agreements only. The actual tax rates will be set accordingly to close the potential gap in order to reduce CO₂ emissions from heating oils by 15% and from motor fuels by 8%.

- The manoeuvre should be revenue-neutral, hence all the revenue will be redistributed to the general population and the business community in proportion to their original payments. The proportion returned to the business community will be distributed to employers via the compensation funds of the Old Age and Survivors' Insurance Fund on the basis of the salary of the employees. The transition to a green tax reform will be strengthened if a constitutional article will be approved through a referendum in September 2000. This article states that a maximum of 2 Rp. per kWh can be levied on all non-renewable energy sources. The revenue will be used to reduce overall labour taxes by 1% (0.5% for employers and 0.5% for employees) as well as to promote renewable energy and enhance energy efficiency. As a consequence of the rejection of the referendum, the only instrument available now to meet Kyoto commitments is the subsidiary CO₂ law, which has, been in force since 1st May 2000. However, an incentive tax on fossil fuels will only be implemented on a subsidiary basis, if the Kyoto

² The current tax design has not reduced waste from this waste stream because households are not directly subject to the price incentives.

CO₂ reduction targets can not be met by voluntary action and programmes in the industrial sector. The incentive tax will be introduced in 2004 at the earliest and the tax rates on the different fuels will be set to close the gap between forecast and target greenhouse gas emission levels.

6. Conclusions

Drawing definite conclusions on the efficiency and employment effects of tax shifts in terms of double dividend is quite difficult. From the point of view of economic policy, the main question seems to be the possibility to exploit a second dividend by using the revenue flowing from an environmental tax to lower labour costs and to promote employment. This opportunity has emerged first in the literature as a political response to the double-faced challenge that many industrialised countries were confronted with, i.e. an increasing level of pollution and a declining level of employment. But, despite the conceptual uncertainties, a number of countries have decided to move in the direction of the environment-employment double dividend. Following the way paved by Denmark, Finland and the Netherlands, the same target is now pursued by the British government and, more recently in Italy and Germany. In France, a report on environmental taxation, prepared by the Conseil d'analyse économique [Bureau *et al.* [1998]) presents the base for an ecological tax reform. In a recent White Paper (Livre blanc [1999], p. 9) it is stated that "The Government is committed to further develop environmental taxes in the context of future budgets. In particular, the revenue of the re-adjusted General Tax on Polluting Activities (excluding energy) will be entirely affected to the reduction of social security contributions."

Up to now it is practically impossible to use *ex-post* evaluations of existing experiences in the field of green tax reforms to derive clear rules for achieving in reality a double dividend. The only possibility is to review the literature and to scrutinise different *ex-ante* simulations of the economic effects of greening the tax system and check the validity of the conclusions reached in the more theory-oriented studies. The literature frequently indicates a deep contradiction between the theoretical papers showing the difficulty in achieving a strong double dividend in the Goulder's sense, and some empirical work concluding that shifting the tax burden from distortionary taxes on labour towards taxes levied on pollution could actually increase employment. This survey underlines that many requirements should be satisfied to achieve a double dividend à la Goulder, that is an increase in social welfare. But taking into account the most important experiences within OECD countries and the few available empirical studies about their effects on employment, it seems possible to reach the conclusion that an employment-related double dividend is more likely to be achieved.

In the original Bovenberg model, the burden of the environmental taxes falls necessarily on labour and this is a less efficient means for funding public expenditure than an explicit tax on labour. But Bovenberg successively modified his original assumptions, including other production factors in the model and assuming that the labour market does not clear, since there is rigidity in wages and then involuntary unemployment. In this case, Bovenberg concludes that an increase in employment is possible since the tax wedge on labour costs is lowered. Another possible condition for getting a double dividend is that in the labour market wages are endogenously determined and that the level of real wages is linked to the contractual power of trade unions vis-à-vis firms and to the willingness of workers to eventually accept a wage reduction, instead of being unemployed, while the lowering of social security contributions reduces the labour costs for the firms. Under these assumptions, that seem more realistic in market conditions similar to those prevailing in Europe where a large unemployment exists, Bovenberg accepts the idea that a double dividend in terms of more employment and positive efficiency effects could result from an ecological tax reform.

Another important assumption regards the structure of the environmental tax. It should be designed in such a way as to be possibly shifted to other economic agents and not only on labour. In

Germany and Italy, the additional environmental tax is paid either by firms or by households, while the reduction of social security contributions is divided half on employers and half on employee. The distribution of the fiscal burden finally depends on the incidence of the different taxes. But if firms are able to shift, at least in part, the environmental taxes on product prices, while lower social contributions do reduce labour costs, positive employment effects are likely to follow.

A side condition for getting a double dividend is linked to the assumption that the implementation of a green tax reform happens in an economy that plays a significant role in the world market. In the case of a small open economy, it is quite difficult to foresee positive economic effects, since the country concerned is fully constrained by international competition. But if the switch from taxes on labour towards taxes on pollution is pursued by an economy of continental size, the result will be probably different. This involves international co-operation and in Europe such a policy would only be effective if designed at the European level.

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