By the turn of 2010, one of the controversial policy issues in France was the choice of the most suited economic instrument to yield the desired GHG\textsuperscript{1} abatement effort in all fossil fuels consumptions which are not yet regulated. In fact, the implementation of the European Emissions Trading System (EU ETS) has given rise to a number of criticisms. The most prominent of them addresses the successful lobbying of the biggest firms in the covered industries (energy production, automobile or cement) about the amount of the freely allowed emission permits. During the first phase of the EU-ETS (2005-2007), permits were allocated in excess which has led to an insufficient carbon price in regards to the needs of innovation and the target levels of emission expected by the Kyoto protocol. This market failure has given new arguments to the tax advocates.

Even in the United States are there now warm advocates of the tax against the cap and trade approach, like James Hansen\textsuperscript{2}, an American scientist, who claims “A rising price on carbon emissions is the essential underlying support needed to make all other climate policies work. [...] A rising carbon price is essential to “decarbonize” the economy, i.e., to move the nation toward the era beyond fossil fuels. The most effective way to achieve this is a carbon tax (on oil, gas, and coal) at the well-head or port of entry. [...] The public will support the tax if it is returned to them [...]”. This quite surprising attitude corresponds to a larger movement in favour of the price instrument. This movement takes

\textsuperscript{1} Greenhouse Gas.

\textsuperscript{2} Eminent climatologist, he is director of the NASA Goddard Institute of Space Studies. After the election of U.S. President Barak Obama in November 2008, J. Hansen sent him a letter to urge him to support a carbon tax.
place in Europe too, where France, following Sweden and other Scandinavian countries, considered to implement during 2010 a carbon tax at a rate equal to 17€/ton CO$_2$. Finally, in front of the opposition of the public opinion and the practical and legal difficulties, the government decided to postpone the project until a European policy would be put in place. The Swedish presidency of the European Union (second semester of 2009) encouraged the other member countries to implement carbon taxes bearing on all sectors of activity which are not regulated by the emission quotas system. The debate is still open, but takes place in the European area context.

As well as the cap and trade mechanism, the tax allows to achieve the environmental objectives while minimizing the global cost. One of the advantages of an environmental tax is that it provides public revenues which can be recycled. This is a reason why it can be preferred to subsidies or emission quotas. It has been argued that, as governments use these revenues to decrease other distortionary taxes, an environmental tax may simulataneously improve the environmental quality and achieve a less distortionary tax system, i.e. it may lead to a double dividend, according to Goulder [1995a]. This can be a strong argument in favour of an increasingly green tax system. But one of its disadvantages is that, like any consumption tax, it often appears to be regressive, i.e. more harmful for the welfare of the poorest households than for the richest ones. What would be the inequality consequences of a European Carbon Tax Project or of the Carbon Contribution planned by the French government as from 2010? Hence, as Hansen suggests it, an environmental tax can hardly be considered without adequate revenue recycling in order to enhance the acceptance of the environmental policy. But the aim of such a recycling can therefore be twofold to reduce, or even annihilate the gross cost of the policy, as measured by the global welfare loss, or to compensate the generated inequities.

This controversy about the environmental tax has apparently been closed after the French government forsaking to implement it and, under the pressure of the current economic crisis, the debate now steps aside for a wider debate about the tax system, the public debt and the financing of retirement pensions. But if we put together the long term costs involved by the ageing process of the population and the potential benefits caused by an environmental regulation, it seems particularly relevant to promote an ambitious tax reform involving an environmental tax as well as the income tax, the social contributions or the pensions financing.

The objectives of this paper are therefore to analyze the efficiency and distributional consequences of the implementation of an environmental tax and to enlighten the equity concerns arisen from the
recycling of its revenue. We wish to re-open and enlarge the French debate about the recycling of the Carbon Contribution revenues. In the Law project, the choice had been made of compensating the short-term equity detrimental consequences instead of seeking to enhance the global efficiency, by paying lump-sum compensations rather than by reducing the labor taxes. After the requirement by the Conseil Constitutionnel (December 29th, 2009) for some modifications of the governmental project as regards the perimeter of the taxed firms, the need to also tax the firms which are already participating in the EU makes now the compensation through labor tax cuts more appealing.

This article suggests some answers to these questions by giving insights of the results in the double dividend theory. We first present the main results of the literature, and we show that conditions to obtain successful environmental tax policy rely on the objectives and constraints of the policy: welfare equity, environmental quality, economic efficiency, and employment... Achieving all these goals simultaneously seems very hard and requires many structural conditions to be met. These conditions concern, as usual, specific characteristics of the production functions’ elasticities, agents’ preferences and initial level of the tax rates. Secondly, we analyze the distributional effects between different categories of households and put forward an appropriate policy mix to compensate them: we show that re-designing the progressivity characteristics of the tax system, instead of lump-sum transfers or any other way of homogeneous compensation, enables all categories to enjoy a benefit from the tax reform.

2- The conventional double dividend approach: efficiency at the expense of equity

The optimistic first intuition of the double dividend

The double dividend debate arose from the warm controversy about the size of the additional greenhouse effect, the analysis of its causes and the evaluation of its effects. Indeed, there is no consensus yet about the size and monetary value of the potential damages of climate change. Such an uncertainty calls the efficiency of climate policies to fully internalize this externality into question. It appeared thus useful to estimate the gross economic costs of climate policies, especially of environmental taxes, defined by excluding the economic benefits, potential but controversial, due to the avoided environmental damages. In a cost-benefit analysis, the level of these costs can be viewed as a lower bound for the environmental benefits to justify, from an economic efficiency point of view, the implementation of climate policies.
Compared with other internalization instruments (subsidies, standards or tradable emission permits), one of the advantages of the environmental tax is that it provides revenues to the government and that this revenue can be recycled. Terkla [1984] was the first one to argue that the revenue recycling should be able to reduce, or even to annihilate the gross cost of the implementation of an environmental tax (this argument has been taken up by Lee and Misiolek [1986], Parry [1995] or Poterba [1993]). Indeed, the first estimations of the costs of the environmental policies (in terms of GDP loss and unemployment rise) were very high because the potential recycling of the tax revenues had been neglected. In a second time, the gross costs of environmental taxes were estimated under the implicit assumption of a lump-sum recycling, in order not to induce supplementary distortions. They revealed to be lower than without any revenue-recycling. After that, Baumol and Oates [1988], Pearce [1991], Oates [1991] or Poterba [1993] suggested that it should be more efficient to substitute environmental taxes to socially costlier taxes. Pearce [1991] argued that using the revenues from environmental taxation to reduce preexisting distortionary taxes may overcompensate for negative costs of the environmental policy and thus yield a double dividend by (1) discouraging polluting activities and (2) reducing the deadweight loss of the tax system.

According to Goulder [1995a], one can notice that the debate about the existence of a double dividend reflects mainly the uncertainties about the environmental dividend because, if it were possible to show that a revenue-neutral environmental tax is costless, its implementation could be justified on benefit-cost grounds by even slightly positive environmental benefits.

The first empirical studies using neo-keynesian macroeconometric models exhibited the possibility of negative gross costs of the ecotax, by using the revenues from environmental taxation to reduce wage taxes, and the term of double dividend began to be used to designate any economic benefit, except the environmental one, obtained through an improvement in growth or employment (EC[1992] and [1994], Beaumais and Godard [1994], Lemiale and Zagamé [1998]). The elaboration of no regret strategies has been based on this possibility of obtaining a double dividend, corresponding to measures which, even if the global risk reveals groundless, have a proper interest and can be implemented at a null or even negative cost (Beaumais, Schubert and Zagamé [1998]).

After several years of confusion about the double dividend concept, Ekins [1997] distinguished different kinds of second dividend: an employment dividend when recycling the tax revenues allows a decrease in unemployment (the macroeconometric models generally base their evaluations on this concept), an efficiency dividend when the tax reform reduces the existing tax
distortions (concept used by most theoretical studies in a general equilibrium framework), an *equity dividend* or *distributional dividend* when the chosen way of recycling enhances the equity between agents.

Goulder [1995a] already had defended the efficiency dividend (abandoning the equity dimension) as the only relevant definition of a second dividend because the monetary evaluation of the welfare gains or losses constitutes the only rigorous global measure of the impact on the economic situation. He denies thus the use, in numerous empirical works, of GDP variations or of employment variations as a measure of the second dividend (Carraro et al. [1996], Majocchi [1994], etc), and argues that the empirical results obtained with such a definition of the second dividend often contradict the theoretical results because “*the economic cost can differ in sign and magnitude from changes in important macroeconomic variables such as GNP or the growth of GNP. The question whether a given revenue-neutral tax swap entails positive costs is different from the question whether the swap entails a reduction in GNP or its growth rate*” (Goulder [1995a]). All the previously debated dividends, except the distributional one, are part of the one and only convenient criterion that refers to economic efficiency. Nevertheless, an employment dividend can also be defined, which plays in favour of the efficiency dividend without coinciding with it.

Furthermore, Goulder [1995a] distinguished mainly a weak and a strong forms of the double dividend hypothesis: a weak form if, “by using revenues from the environmental tax to finance reductions in marginal rates of an existing distortionary tax, one achieves cost savings relative to the case where the tax revenues are returned to taxpayers in lump-sum fashion” and a strong form when “*the revenue-neutral substitution of the environmental tax for typical or representative distortionary taxes involves a zero or negative gross cost*”\(^3\) The debate focused rapidly only on the strong form of the double dividend, mostly because it was widely thought that the weak form of the hypothesis is in any case obviously met (but Babiker *et al.* [2003] show that it is not the case in a general equilibrium framework with multiple distortions).

The existence of the economic dividend depends on the relative size of the *revenue-recycling* effect, which allows to decrease the deadweight loss of pre-existing distortionary taxes and the *tax-interaction* effect, which may increase the welfare gross costs of the environmental tax (Parry [1995]).

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\(^3\) In fact, he also considered an *intermediate form* corresponding to the assumption that “it is possible to find a distortionary tax such that the revenue-neutral substitution of the environmental tax for this tax involves a zero or negative gross cost”.

5
Early literature denying the double dividend

The first theoretical studies denied the strong version of the double dividend, like Bovenberg and de Mooij [1994a], [1994b] and [1997b], Bovenberg and van der Ploeg [1994a], [1994b] et [1996], Parry [1995], Goulder [1995b] or Bovenberg and Goulder [1996]. According to these works, the economic dividend may be negative because the environmental taxes are themselves distortionary and because they exacerbate the pre-existing distortions rather than alleviate them. The argument is that the capability of such taxes (especially the carbon taxes) to generate revenues is rather limited, because of the high elasticities of polluting activities to the tax which erode in the long term the tax base. The probability of obtaining a second dividend is weaker when the first dividend is likelier. These various contributions seemingly showed that the pre-existing tax distortions do not represent a good reason to implement an environmental tax. On the contrary, the higher the efficiency costs are, due to existing distortions, the higher should be the potential environmental benefits to justify the extra costs implied by the environmental tax.

These uncertainties, mainly bearing on the elasticities values, explain that there is no consensus yet about the double dividend and that this issue gave birth to a huge literature (reviewed by Chiroleu-Assouline [2001]). The claim of its existence seems to become an even more political message, delivered only by the advocates of environmental taxes. Thus, on the one hand, the European Commission reports (EC [1993a], [1993b]) were among the first to promote an environmental tax reform that would use the carbon tax revenues to reduce the social security contributions without any change in public expenditures, and then fight the high levels of unemployment of the European countries. In the recent French debate, a large place was given to the demonstration of the possibility of a double dividend (Combet et al. [2009]). On the other hand, the FMI's annual report for 1996 (FMI [1996]) was more cautious about the potential benefits of such a tax reform, doubting that the fiscal base of environmental taxes would be sufficiently broad to replace social contributions and estimating the existing energy taxes already high enough in several developed countries. These two positions summarize the debate about the existence conditions of a double dividend or, more generally, about the conditions for the environmental taxes to induce both environmental and economic benefits. This property cannot be considered as a general one since it strongly depends on specific conditions regarding the initial tax system and the distribution of the tax burden between the production factors or among different classes of households.
The conditions for a double dividend

In his central paper, Goulder [1995a] proposes several conditions that enhance the probability of obtaining the strong form of a double dividend: firstly, the initial tax system has to be greatly suboptimal, which coincides with great differences in the marginal excess burdens of the different taxes; secondly, the environmental tax burden should bear ex post on a commodity or a production factor initially relatively exempted from distortion, such that the supplementary distortion induced by the environmental tax would be the lightest possible. As Bosello et al. [2001] summarize this point, when the economy is made of one productive sector, using only one productive factor (labor), and one representative consumer, the strong version of the double dividend is rejected. It means that the obtaining conditions for a strong form of the double dividend depend on the existence either of a production factor or of economic agents to whom the tax burden can be transferred.

Ligthart [1998] distinguishes three kinds of final recipients of the fiscal burden: (i) the fixed production factors, (ii) the households who receive incomes from other sources than wages, like unemployed or retired people and (iii) foreign countries who cannot influence the terms of trade.

The ability of the fixed production factors to generate a second dividend has been showed for the first time by Bovenberg and van der Ploeg [1996] or by Ligthart and van der Ploeg [1996]. The last paper relies on a model allowing substitution between labor, a polluting factor (energy) and a fixed factor (capital). Wage rigidity causes involuntary unemployment. If the environmental quality is socially valued, a double dividend can be obtained through a revenue neutral environmental tax reform if the share of the fixed factor is high and if labor is more substitutable to the polluting factor than is the fixed factor. The quality improvement of the environment is obtained by producing with more labor rather than by decreasing the level of production. At the contrary, if capital is perfectly mobile, or if the long term interest rate is endogenous, the existence of a double dividend is greatly compromised (Bovenber and van der Ploeg [1994c]).

Bovenberg and van der Ploeg [1996] are the first ones to emphasize the role of unemployment in the occurrence of a double dividend. They study a small open economy, with perfect mobility of capital and unemployment due to adjustment costs (job search theory). A strong double dividend may only appear if the environmental tax burden is shifted to the unemployed who consume their whole
income, formed out of budget transfers. A budget-neutral increase in the environmental tax rate allows a cut in the labor tax rate that compensates the welfare loss of employed workers but does not compensate the unemployed losses.

It is then absolutely clear that a double dividend can only occur if the initial state of the economy is sub-optimal, i.e. if there are some great tax distortions. The developed economies are in this case. Different evaluations of the marginal excess burden of the US tax system suggested that it is very high (in the order of 40 to 50 cents for one dollar of fiscal revenues, according to Ballard et al. [1985] or Nordhaus [1991]). Labor taxes are highly distortionary in European countries (EC [1998] or Fiorito and Padrini [2001]), at the opposite of United States where the tax bearing on capital exerts the highest distortion and was targeted by the first studies addressing the double dividend issue (Goulder [1995b] and Bovenberg [1999]). For example, Scott [2007] finds that the excess burden of labor taxes in European countries (France, Germany, Italy) is about twice than in USA, Canada or Japan. This leads to promote different environmental tax reforms for different countries: substituting the environmental tax to capital taxes promises more efficiency in the United States while in the European continental countries the second dividend would more likely come from a decrease in labor taxes. We have enlightened in a recent paper the existing rooms of manoeuvre for greening the European tax structure (Chiroleu-Assouline and Fodha [2010]), that appear in Figure 1.
The crucial role of the labor-market characteristics

Moreover, the essential role played by the uncompensated labor supply elasticity to the real wage in the results of Bovenberg and de Moij emphasizes the crucial importance of the assumptions of perfect competition and of labor-market clearing in their analysis in a theoretical general equilibrium framework. In their model, welfare grows with labor supply. But environmental taxation raises the consumption price and reduces labor supply. The double dividend could be reached if and only if labor supply elasticity were negative. This consideration, along with the observed differences between empirical studies and theoretical works, led some authors to deal with involuntary unemployment in the double dividend debate.

Bovenberg and van der Ploeg [1994a, b] and [1996] and Bovenberg [1997] conduct an analysis in a framework in which unemployment is due to matching frictions. For example, Bovenberg [1997] assumes that the agents are heterogenous: some are wage-earners but the others only receive budget transfers (unemployed or retirees). When a tax is implemented or its rate increased on polluting commodities, the tax burden initially bears on all consumers. Its primary effect

Figure 1
is to deteriorate the purchasing power of every consumers and it yields a decrease in employment because employed people substitute leisure to polluting consumption. But a budget-neutral reform through a cut of the labor taxes reduces the labor-market distortions and enhances employment, without benefitting the unemployed households whose real income decreases. The tax burden is shifted from the employed to the unemployed because the environmental tax base is broader than the labor tax base. If this burden shifting effect is greater than the primary effect, a second dividend may appear. It is worth noticing here that this second dividend is both an employment and welfare dividend but that it collides with any equity concern.

Schneider [1997] uses an efficiency model, where wages are endogenous, to link the presence of involuntary unemployment and the existence of a double dividend. Labor productivity depends on the workers effort that in turn increases with the wage level. In this case, unemployment may appear when firms set incentive wages higher than the level able to clear the labor market. In such a model, employment go hand in hand with wages because any decrease in unemployment would lead to a decrease of the workers effort, and that is what firms want to avoid by increasing the wage. The production process is assumed to use a polluting input (energy). The implementation of an energy tax reduces the use of all production factors but the cut in the labor tax rate may offset this effect on employment. Indeed, a lower tax burden on labor allows the firms to offer a lower wage to the workers without modifying their effort and thus their productivity: the unemployment rate decreases if the effort, and then the wage, are weakly sensitive to the unemployment rate. Moreover, the greater the initial labor-market distortions are and the higher the welfare benefits of the tax reform.

Most of the remaining studies use a wage bargaining model (Brunello [1996], Koskela and Schöb [1999], Bayindir-Upmann and Raith [1997], Marsili and Renström [1997], Pfüger [1997], Holmlund and Kolm [1997], De Mooij [1999]). Despite the differences in the modelling approaches, a general result gets confirmation: when labor market does not clear, the double dividend is more likely to occur. They all confirm that employment can rise if the tax burden is shifted from workers to unemployed. For example, Bovenberg and van der Ploeg [1994a] assume that the wage is set by adding a mark-up to the labor productivity in a matching model (in Brunello [1996], wages result from bargaining between firms and labor-unions). The unemployment benefits are, by assumption, indexed on the wage rate. The increase in the environmental tax rate deteriorates the purchasing power of the wage-earners as well as of the unemployed but the last ones do not benefit from the
decrease in the labor tax rate and they end by bearing the whole tax burden. The double dividend occurrence results once again from an equity degradation.

Hence, all these results depend crucially on the characteristics of the labor market and of the unemployment benefits, as it has been shown by Chiroleu-Assouline and Lemiale [2001]. They investigate the double dividend issue in a broader encompassing framework where both households and firms are polluters and firms are monopolistic competitors on the non-polluting good markets. Three kinds of the unemployment benefits are considered: fixed in real terms, indexed on the production price and fixed replacement ratio. It is shown that if environmental taxes pre-exist, an increase in their rates can boost employment if and only if at least households energy consumption is taxed, regardless the unemployment scenario. Moreover the reform yields more easily a second dividend in the wage bargaining model than in the efficiency wage model. Finally, the maximum level of initial environmental tax rate compatible with the occurrence of a second dividend depends on the characteristics of the unemployment benefits.

3- Equity, environmental justice and distributional effects

While positive net benefits from environmental policy imply that the gains have exceeded the losses for society as a whole, this may not be true for all members of society. Some segments of society may bear a disproportionate share of costs. Paying attention to environmental justice makes sense for two reasons, one ethical and the other pragmatic. The ethical dimension concerns whether the distribution of benefits and costs is in accordance with the norms of social justice. Desirable policies are both efficient and fair. The pragmatic dimension emphasizes the relationship between the distributional burden and both the likelihood that environmental legislation will pass and its ultimate form. Policies and programs that are perceived as unfair will stand little prospect of passage even if they enhance the prospects for efficiency and sustainability. Identifying the sources of unfairness and restructuring programs to eliminate them increases the likelihood that otherwise desirable programs can proceed.

Basically, costs and benefits of the environmental policies are unequally distributed among agents. First, the poor and the rich seem to assign different degrees of priority to environmental protection (Baumol and Oates [1988]). This is quite intuitive since assuming environmental quality as a normal good, one would expect that wealthier individuals would have a greater willingness to pay for any improvement of it. Second, distributive elements also matter when we consider how the costs
of a policy of environmental protection are likely to be distributed among individuals with differing incomes. Since indirect taxes have been proved to be regressive, any environmental tax policy is likely also to be regressive. Pearson and Smith [1991], Smith [1992] or Barker and Johnstone [1993] already showed that carbon taxes bear relatively more on the lowest income households and that, without proper transfers, they should induce extra equity costs. In particular, in the French case, a tax on energy or transport consumption harms the lowest wage households three times more than the highest wage households (Ruiz and Trannoy [2008]). In the case of Denmark where a high carbon tax has been implemented (which yields 10% of the total tax revenues), Wier et al. [2005] exhibits the regressive properties of this tax, getting worse due to the transfer through prices of the firms tax burden on the households.

Moreover, the usual recycling of the environmental tax revenues through a decrease in the labor tax rate could also be regressive (Metcalf [1999]). This second point is of interest in a world in which inequality and poverty have assumed high priority among social issues. In addition, without adequate consideration of this aspect of the matter, it would be hardly possible to design policies that can obtain the support they require for adoption. Thus, by ignoring their distributive effects, environmental policies may unintentionally harm certain groups in society.

At the same time, several empirical studies of different fields (natural sciences, medical science) enlighten the close links between the rise of polluting emissions and human health deterioration. Among the benefits of environmental policies, it is worth taking into account the links between pollution and workers productivity, and more precisely to study the social inequalities due to the environmental quality decline and to analyze their macroeconomic consequences. Even if most of the empirical studies about the distribution of environmental policies benefits are old and insufficiently detailed (Christiansen et Titienberg [1985], Harrison [1994], Peskins [1978]), this issue became recently a public policy concern. Thereby, the main objective of the French Health-Environment National Program (2009-2013) is to reduce the environmental inequalities. This program has been designed in line with the National Strategy of Sustainable Development adopted in 2003, and it integrates commitments of the Grenelle de l’environnement. But, even if some works have been undertaken in this direction, the effect of environmental exposure on social health inequalities remain a nearly unexplored field. If it happened to be proved that the poors are more harmed by a degradation of their environment, they should benefit more from an environmental policy and that should offset, at least partially, the regressive effects of an environmental tax.
This equity issue needs to be closely studied in order to assess the size of the distributional consequences of the implementation of a carbon tax and to propose some adequate means to compensate its negative effects. This is the way to design a climate change mitigation policy without increasing social inequalities. Indeed, as it was shown by Goulder [1995a] and Ligthart [1998], because the existence of the double dividend essentially depends on the possibility for transferring the global tax burden from the wage-earners to other fixed production factors or classes of households, it relies on the heterogeneity of agents and it generally implies inequity.

Nevertheless, the large literature related to the double dividend issue has surprisingly neglected the distribution issue of the welfare gain, although it is usually obtained at the expense of some groups of agents. The potential contradiction between efficiency and distributional concern has yet already been emphasized by some works in other frameworks like Bovenberg and van der Ploeg [1995] already quoted, or Proost and van Regemorter [1995] who use a a dynamic (two-period) applied general-equilibrium (AGE) model with different classes of households to show that the weak assumption of the double dividend may fail if equity concerns are considered.

Can an environmental tax reform be designed without negatively affecting the welfare of any class of households? The answer to this question is the *sine qua non* condition to make it acceptable by the public opinion. Our recent works contribute to this debate.

**Distributional intergenerational effects in case of unemployment**

Moreover, as explained before, beside potential efficiency properties, environmental decisions have an impact on the welfare of both current and future generations. These intergenerational issues on environmental externalities or on taxation have been quite widely studied in the economic literature. In an overlapping generations framework, John *et al.* [1995] examine the effect of an environmental tax whose revenue is financing a public pollution abatement activity. Fisher and van Marrewijk [1998], using an endogenous growth model with pollution, derive the conditions for a pollution tax not to slow economic growth. In line with the previously quoted literature about the obtaining of a double dividend at the expense of equity (Bovenberg and van der Ploeg [1995], Proost and van Regemorter [1995]), Bovenberg and Heijdra [1998] examine the effects of a green tax on polluting capital when the tax revenue is redistributed by lump-sum intergenerational transfers and find that this tax benefits the younger generation but harms the older ones. This property might
question the relevance of the fiscal reform if it harms some generations. Nevertheless, any environmental tax is based on the equity and intergenerational solidarity principle: it aims to give to the future generations the same environmental amenities as to the present generations. But such a fiscal reform will only be acceptable if it improves the global welfare of all generations, the present like the future ones.

All these papers conclude that environmental taxation implies such a welfare loss in the short run that its implementation cannot be wished: the generations which would decide it would also bear the heaviest burden.

We study the existence conditions of a double dividend (according to Goulder’s definition), but also the role of the employment dividend and the distributional equity issue in Chiroleu-Assouline and Fodha [2005]. The distributional concern can be viewed between different classes of households (employed and unemployed) or between different generations.

We take into account both efficiency and intergenerational distributional aspects of environmental taxes. Under the assumption of involuntary unemployment, we examine whether a revenue-neutral increase in the pollution tax compensated by a change of the labor tax can yield a double dividend. This general framework can be related to those of Bovenberg and Heijdra [1998] and Bovenberg and van der Ploeg [1996] but differs from them in several ways. Bovenberg and Heijdra [1998] do not explicitly address the double dividend issue but investigate whether a higher pollution tax can be Pareto welfare improving by benefiting all generations. In their paper, pollution is due to capital utilization while we assume that the fiscal base of the environmental tax is consumption (which causes pollution) rather than capital; their paper focus mainly on optimal capital taxation which allows them to pay little attention to the employment issue. But we show that the existence of unemployment adds another way for obtaining a double dividend. Lastly, we assume that involuntary unemployment is caused by an exogenous minimum wage rate, like Bovenberg and van der Ploeg [1996] (who do not consider more than one generation).

Hence, in Chiroleu-Assouline and Fodha [2005], the economy consists of two periods lived individuals working and consuming when young and consuming and being affected by the quality of the environment only when being old. The government is financing its spending (public investment and unemployment benefits) with a labor tax and a pollution tax. We characterize the specification of
the fiscal reform when the revenue of the pollution tax is recycled by a variation of the rate of social contributions.

We show that the fiscal change does not always harm the welfare of the present generation and that, under certain assumptions about agents’ preferences, it is possible to obtain both a double dividend and the respect of intergenerational equity. We show finally that, under some conditions on the variations of the unemployment rate and of the interest rate, an inter-generations distributional dividend can also be obtained. We focus on the new mechanisms that arise from the life cycle assumption. In this case, the interest rate plays an important role in the agents ‘arbitrage between present and future consumptions, restoring thus the role of savings and of capital accumulation. The consequences of the variation of the wage rate are counteracted by the opposite variation of the interest rate. More precisely, we show that the employment dividend is always warranted and that, under some conditions, a double dividend can be obtained. It depends on the relative magnitude of the effects on the income, on the interest rate and on the fiscal base of the pollution tax. Indeed, if the environmental enforcement of the tax system yields a decrease of the labor tax rate (i.e. assuming hence tax efficiency), the environmental dividend is more likely to occur but the second dividend and the respect of intergenerational equity are less likely to occur that the fall in unemployment and the rise in interest rate are lower.

Acceptability of environmental taxes by heterogeneous households

One of the reasons for the failure of the French carbon tax (so-called Carbon Contribution) in 2010 was that the intended revenue-recycling process was hardly understood by the tax-payers and that it did not manage to make the reform acceptable. But in fact, a careful design of a broader tax reform should have reached this goal by alleviating the effect of the carbon tax on the poorest agents and increasing the fairness of such a policy.

In our most recent paper (Chiroleu-Assouline and Fodha [2009]), we analyze whether an environmental tax policy can respect the two equity principles simultaneously, the vertical as well as the horizontal one and we propose a simple policy-mix in order to smooth or even eliminate the detrimental consequences of an environmental tax. We consider the possibility of designing an environmental policy in order to ensure a non-decreasing welfare for each class of workers. Compared to the standard double dividend literature which pursues two objectives - improve the environment by
increasing an environmental tax (first dividend) and the economic welfare by decreasing another distortionary tax (second dividend) - we add the third objective of Pareto improvement. It corresponds to an acceptability/unanimity criterion for the policy when agents are heterogeneous. The aim of this paper is therefore to design a balanced environmental tax reform able to correct these regressive properties of taxes and to leave all classes of worker better off.

This paper relies on an overlapping generations model, with polluting capital, but sharing the mean features of Chiroleu-Assouline and Fodha [2005] and [2006].

As in Chao and Peck [2000] or Williams [2002] or [2003], we assume that the degradation of environmental quality has a negative impact on the total productivity of factors. This assumption is justified by the results of an increasing number of empirical studies measuring the health effects of pollution (OECD [2008]) and the impact of the health of workers on labor productivity (Bloom et al. [2004], in a sample consisting of both developing and industrial countries, found that good health, proxied by life expectancy, has a sizable, positive effect on economic growth). Since Ostro [1983], many papers have emphasized the loss of productivity caused by the health effects of pollution, e.g. Samakovlis et al. [2005], or Pervin et al. [2008] for air-pollution, and also Bosello et al. [2006] or Hübler et al. [2008] for the health effects of climate change. Following Bovenberg et de Mooij [1997], this effect increases the probability to obtain a double dividend.

We assume that the production technology is a function of capital and heterogeneous labor. Heterogeneous workers live two periods (young and old) and earn wages corresponding to their skill and consequently to their productivity. The income tax is a very general one that could be either a progressive or proportional tax. Our demographic assumptions allow us to take into account several income classes; indeed, we consider (i) the heterogeneity characteristics of the labor market (high wages - skilled workers, middle wages, low wages - non skilled workers...), (ii) the heterogeneity of the individual income sources (wages for workers, savings for retirees). The environmental policy consists of increasing the environmental tax on savings, in a second-rank framework. We then characterize the necessary conditions for the obtaining of a double dividend, i.e. an improvement of the environmental quality and an improvement of the welfare when the revenue of the pollution tax is recycled by a change in the income tax rates. Previous studies show that the existence of a double dividend requires economic conditions such that the double dividend hypothesis seems unrealistic. Conversely, we show that the conditions for the double dividend existence lie in the distributive
properties of the income taxes. We first compare the welfare consequences of the two tax policy options, i.e. when the increase of the environmental tax is compensated by:

1. a uniform decrease of all income tax rates (with invariant progressivity) corresponding to a decrease in the rate of the first bracket of income tax;

2. a variation of the progressivity characteristics of the income tax, with invariant tax rate for the poorest, corresponding to a lower tax burden for the upper brackets.

We then show that (i) an increase of the environmental tax deteriorates the welfare of all and is regressive, (ii) the low paid workers prefer an environmental tax reform balanced by a decrease in the flat rate component of the income tax, while the high paid workers prefer a decrease of the progressivity properties of the income tax. We conclude that the distributive properties of the tax policy could be one of the instruments of internalization of the intergenerational externalities. It seems hence possible to design a tax reform which could be accepted by all by increasing the progressivity index along with the environmental tax and decreasing more the flat component of the income tax.

In order to illustrate the economic and welfare consequences of this so-called environmental policy-mix, we have numerically computed some realistic values for the parameters of our theoretical model. In this example, we assume ten classes of workers \((i = 1...10)\) ranked by growing revenues. The tax policies are evaluated using the indirect utility approach for each class of worker. This criterion is measured by the individual compensatory income variation \((dR_i)\) which, after the tax reform, would leave the level of life-cycle utility of the agent unchanged. Any positive variation of this income means a life-cycle welfare loss. The consequences on welfare of the alternative policies, measured separately, show that these policies are never Pareto improving (see Fig. 2 and 3). Figures 2 and 3 present the individual compensatory income variations of the ten classes of workers after the alternative policies (decrease of the first rate bracket of income tax or lower tax burden for the upper brackets), in a low progressivity initial tax structure case (fig. 2) and in an intermediate progressivity initial tax structure case close to the French case (fig. 3).
But, the government can combine variations of the two parts of the income tax rate and design a policy-mix system by increasing the tax burden for the upper brackets, it is possible to earn greatest tax revenues than through the environmental tax alone, and then to decrease more the income tax of the first rate bracket. Therefore, all classes are less taxed but even the poorest class would benefit from the environmental tax reform (see Fig. 4). The increase in the welfare of the upper classes will be reduced, but is still high, comparatively to the lower classes.

We show that, for the French case for instance, if the balanced environmental tax reform needs to decrease the flat component of the income tax by 10%, the government needs to increase the design of the progressivity of the income tax by 2.5% in average. In that very precise case, the environmental policy would benefit all the agents. The environmental tax policy is then Pareto-improving and acceptable.
To a certain extent, our paper highlights the gap between economic efficiency and vertical equity and illustrates the problem of the aggregation of positive and negative compensatory variations: the usual method of aggregation gives a higher weight to the wealthiest classes and introduces a bias when assessing the desirability or the acceptability of any environmental tax reform.

4 – References


European Commission, 1993b, Potential Benefits of Integration of Environmental and Economic Policy..


