Energy Policy 39 (2011) 4253–4263

Contents lists available at ScienceDirect

Energy Policy

journal homepage: www.elsevier.com/locate/enpol

Optimal green tax reforms yielding double dividend

Esther Fernández [a,b], Rafaela Pérez [a,b], Jesús Ruiz [a,b,*]

[a] Universidad Complutense de Madrid, Spain
[b] ICAE, Spain

ARTICLE INFO

Article history:
Received 4 August 2010
Accepted 17 April 2011
Available online 12 May 2011

Keywords:
Double dividend
Emissions tax
Dynamic Laffer effects

ABSTRACT

In an stylized endogenous growth economy with a negative externality created by CO2 emissions and in which abatement activities are made by private firms, we find a wide range of dynamically feasible green tax reforms yielding the double dividend without any need to assume a complex production structure or tax system, or a variety of externalities in production. As a remarkable finding, we obtain certain scenarios in which increasing the emissions tax up to the Pigouvian level and removing completely the income tax is dynamically feasible and, also, it is the second-best reform. Hence, as a difference to previous literature, in these scenarios the first-best tax mix is implementable, allowing for the elimination of both environmental and non-environmental inefficiencies. Our result arises because of the consideration of public debt issuing and the management of the government budget balance with an intertemporal perspective. The result is obtained for an intermediate range of environmental bearing in preferences, the valid range being contingent on the pre-existing income tax rate. The type of tax reform that we propose could also be implemented for different energy taxes.

1. Introduction

In the 16th session of the Conference of the Parties (COP 16) to the United Nations Framework Convention on climate change (UNFCCC) celebrated in Cancún in 2010, the participant governments "recognize that warming of the climate system is unequivocal and that most of the observed increase in global average temperatures since the mid-twentieth century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations." Also, the shared vision for long-term cooperative action "realizes that addressing climate change requires a paradigm shift towards building a low-carbon society that offers substantial opportunities and ensures continued high growth and sustainable development, based on innovative technologies and more sustainable production and consumption and lifestyles."[1]

Carbon dioxide (CO_2) is regarded as the main source of greenhouse effect. Herzog (2009) estimated that about 67 percent of global CO_2 emissions come from burning fossil fuels, such as coal, oil and gas. Thus, it seems crucial to design energy policies that encourage firms in energy-intensive industries (such as iron and steel, petroleum refining, pulp and paper) to reduce CO_2 emissions through both energy consumption and fuel choice.

The key point is to identify the policy most appropriate for achieving two government goals: (1) lower CO_2 emissions and (2) high economic growth and sustainable development, leading to higher welfare. With this purpose in mind, we analyze tax reforms yielding these two goals. In what follows we refer to lower CO_2 emission as *green dividend*, while we denote as *blue dividend* the achievement of higher welfare coming from private consumption. An excise tax based on the carbon emissions of energy sources creates numerous incentives to reduce the use of carbon-intensive energy. However, the overall impact of a carbon tax or an emissions tax[2] will depend on how revenues are recycled. Some papers on the double dividend (Bovenberg and Goulder, 1996, Bovenberg and de Mooij, 1994, Bovenberg and de Mooij, 1997, Goulder, 1995, among others) have already shown that the implementation of a revenue-neutral green tax reform, consisting of increasing the CO_2 emissions tax and using the proceeds to exactly offset a reduction in revenues coming from distortionary taxes, may lead to lower emissions but possibly also to higher non-environmental welfare as a result of a less distortionary system. Unfortunately, these papers incorporate a relatively complex

* Corresponding author. Departamento de Economía Cuantitativa, Facultad de CC. Económicas y Empresariales, Universidad Complutense de Madrid, Campus de Somosaguas, 28223 Madrid, Spain.
E-mail address: jruizand@ccee.ucm.es (J. Ruiz).

[1] See http://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf#page=2.

[2] A tax on CO_2 emissions requires individual emitters to pay a tax for every tonne of CO_2 released into the atmosphere, while a carbon tax is levied on the carbon content of fuels. In terms of mitigating climate change, a carbon tax is not a perfect substitute for a tax on CO_2 emissions. For example, a carbon tax encourages reduced use of fossil fuels, but it does not provide an incentive to improve mitigation technologies such as carbon capture and storage (see Fisher et al., 1995). Most research has focused on the carbon content of primarily fossil fuels consumed as the most practicable base for a tax on CO_2 emissions.

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doi:10.1016/j.enpol.2011.04.041

combination of tax structure and economic externalities, which could give the impression that the possibility to achieve a double dividend may be relatively unlikely to arise.

With the aim of designing green tax reforms yielding a double dividend, we use as theoretical framework a stylized dynamic general equilibrium model with endogenous growth. In our model economy only a negative environmental externality is included in households preferences, in the form of CO_2 global emissions generated by firms as a by-product of their production process using polluting inputs. The government establishes an emissions tax in order to incentivate abatement activities by the firms.[3] As a novelty with respect to more standard revenue-neutral reforms in most of previous literature, we introduce debt issuing as an available public financing device, thereby shifting the tax burden from the present to the future. Since fossil fuels are exhaustible resources, both its shortage and the decrease in environmental quality could lead to a consequent reduction in the well-being of future generations. So, future generations will benefit from the implementation of governmental policies leading to achieve energy efficiency improvement and switching between energy sources, without reducing economic performance. Consequently, it seems fair that the current and future generations share the cost of green reforms, possibly through public debt issuing.

In that framework, we study the consequences for the level of CO_2 emissions, the economic growth rate and the path of private consumption of implementing a green tax reform that consists of increasing the emissions tax and reducing the income tax, adjusting the budget with government debt issuing as necessary. The green tax reform is said to be dynamically feasible if the growth stimulus is sufficient to allow the government to eventually retire the debt that was initially issued. Dynamic feasibility holds whenever the present value of current and future revenues under the new tax structure is, at the time of the reform, at least as large as the present value of current and future expenditures.

Our results suggest that this type of reforms are more likely to reach the double dividend than revenue-neutral reforms, because they allow for a reduction not only in the standard cross-sectional tax inefficiencies present in the revenue-neutral experiments, but also in the intertemporal inefficiency of the income tax. A pre-existing intertemporal inefficiency is present when it is possible to obtain a non-environmental welfare gain simply by changing the time-profile of tax revenues by means of debt issuing.[4]

Higher emissions taxes create a disincentive for capital accumulation which negatively affects long-run growth, while the income tax cut yields the opposite effect. Since our proposed reform allows for a larger income tax cut than standard revenue-neutral green reforms, it leads to larger economic growth than revenue-neutral experiments. As a consequence, we prove that it is relatively easy to find the green tax reforms yielding double dividend for empirically plausible parameterizations, without any need to assume a complex production structure or tax system nor a variety of externalities in production. Therefore, such reforms satisfy the two requirements that an appropriate green reform must fulfill according to the Cancún Conference.

Furthermore, under empirically plausible parameter values, we show that the implementation of a tax reform capable of removing the environmental externality as well as all the pre-existing inefficiencies of the tax system is budgetary feasible, while guaranteing that the government still satisfies the pre-committed expenditures path. More precisely, implementing a green tax reform that consists of increasing the emissions tax up to the Pigouvian level and completely removing the income tax is dynamically feasible. This result, which is a remarkable difference with respect to previous literature,[5] implies that the governments can simultaneously achieve the optimal reduction in global emissions as well as the best economic growth rate.

The key is that implementing the green tax reforms, and in particular, the first-best reform, allows for a remarkable environmental gain in spite of the increase in growth. The key channel for this result are the abatement activities, which are enhanced as a consequence of the emissions tax rise, offsetting the polluting effect of increased production. In this sense, there is plenty of empirical evidence about the potential gains in terms of emissions reduction that could be obtained by means of abatement activities, also known as mitigation options (see IPCC, 2007).[6]

A high stock of debt outstanding, in terms of output, is not necessarily a problem but, for the sake of realism, we will limit our attention to tax reforms leading to a maximum stock of debt below 60% of output (the limit imposed in the Stability and Growth Pact of the European Union). The qualitative results of the model suggest that the implementation of our policy reform could seem very attractive in actual economies. First, because substituting debt for distortionary taxation should get a strong social support for the green reform. And second, because the highest stock of debt reached as a consequence of the proposed tax reform will be quite reasonable, as a proportion of output.

We describe the model economy in Section 2. In Section 3, we define the proposed green tax reforms. In Section 4, we simulate the model and explore the results regarding the possibility of achieving a double dividend and the relative position of the first-best tax mix with respect to the second-best. The paper ends with some conclusions.

2. The model

The structure of the model is based on Fernández et al. (2010) regarding to the agent's preferences, technology of production and the inclusion of debt issuing as a device for the green tax reform. But the remaining aspects depart remarkably between both papers, leading to qualitatively and quantitatively very different results. The following differences have been included in order to gain realism in the assumptions of the model, so in the present paper we use: (i) emissions tax, instead of a tax on the use of capital input; (ii) private abatement, instead of public abatement; (iii) cost of adjusting investment; (iv) pre-committed transfers to households can be jointly financed with the income and emissions tax revenues, instead of using the income tax as the only financing source.

[3] Abatement is the use of available CO_2 mitigation options, mainly consisting of the implementation of new technologies to improve energy efficiency, or the use of renewable energy (solar and wind generated electricity, biomass fuels, among others) and fuel switching.

[4] Fernández et al. (2010) has also studied, in a substantially different theoretical framework, the effects of reducing the intertemporal inefficiency of an income tax in an economy with environmental externalities.

[5] In second-best frameworks the welfare-maximizing environmental tax rate typically departs from the Pigouvian rate, and a zero tax rate on income is not feasible due to the standard constraint of balancing the government budget every period (see Bovenberg and de Mooij, 1997 and Bovenberg and de Mooij, 1994). Our result differs from these because of the inclusion of public debt issuing and the management of government budget balance with an intertemporal perspective. In Fernández et al. (2010), debt issuing is also allowed, but the reform leading to the first-best tax mix was not achievable due to the impossible cross-substitution between environmental and income taxes.

[6] IEA (2006) reports "The energy intensity of most industrial processes is at least 50% higher than the theoretical minimum determined by the laws of thermodynamics. Many processes have very low energy efficiency and average energy use is much higher than the best available technology would permit". This provides a significant opportunity for reducing energy use and its associated CO_2 emissions. See, IPCC (2007) for a deeper quantitative analysis of the potential effects of mitigation in actual economies.