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Increasing carbon and material productivity through environmental tax reform

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ABSTRACT

Environmental tax reform (ETR), a shift in taxation towards environmental taxes, has been implemented on a small scale in a number of European countries. This paper first gives a short review of the literature about ETR. An Appendix briefly describes the model used for a modelling exercise to explore, through scenarios with low and high international energy prices, the implications of a large-scale ETR in the European Union, sufficient to reach the EU's emission reduction targets for 2020. The paper then reports the results of the exercise. The ETR results in increased carbon and materials, but reduced labour, productivity, with the emission reductions distributed across all sectors as a reduction in the demand for all fossil fuels. There are also small GDP increases for most, but not all, EU countries for all the scenarios, and for the EU as a whole. Both the environmental and macroeconomic outcomes are better with low than with high energy prices, because the former both increases the scale of the ETR required to reach the targets, and reduces the outflow of foreign exchange to pay for energy imports. ETR emerges from the exercise as an attractive and cost-effective policy for environmental improvement.

1. Introduction

This paper explores the economic and environmental implications of a large-scale environmental tax reform (ETR) for the European Union (EU), where ETR has been defined by the European Environment Agency as "a reform of the national tax system where there is a shift of the burden of taxes from conventional taxes such as labour to environmentally damaging activities, such as resource use or pollution". (EEA, 2005, pp. 84). ETR is therefore a tax *shift*, rather than a tax increase, whereby taxation is shifted from 'goods' such as labour (e.g. income taxes, social security contributions) or capital (e.g. corporation taxes) to 'bads' (pollution, resource depletion). ETR was implemented in a number of North European countries in the 1990s and early 2000s (see NERI et al., 2007), with broadly positive results (as the brief literature review in Section 2 shows). However, although interest in market-based instruments has since grown, no coordinated action has yet been taken in Europe. The ETRs carried out to date in Europe have also been relatively small in scale, in terms of the proportional tax shift towards environmental taxes that they brought about. This paper reports the results of modelling a much more substantial tax shift up to 2020 at the European level, of a scale that could achieve the EU's greenhouse gas (GHG) reduction targets by 2020. A well-developed macro-econometric model of the EU, E3ME is used to explore the economic implications for Europe of such a large-scale ETR, and is briefly described in Appendix A.

ETR has attracted interest because of the possibility of a 'double dividend', whereby switching from conventional to environmental taxation not only corrects an environmental externality, but also reduces distorting taxation effects in other markets, and consequently improves welfare.

Section 2 contains a brief literature review of the effects of ETR, concentrating on its macroeconomic and environmental impacts. Much of the empirical literature takes the double dividend to be improvements in macroeconomic outcomes such as GDP or employment, although theoretically this need not be the case. The following sections describe the scenarios that were examined (Section 3). Results, at aggregate and more detailed levels, are presented in Section 4, with concluding comments presented in Section 5.

2. Summary literature review on ETR

Six EU15 countries have introduced ETRs of varying scopes (Sweden 1990, Denmark 1993, Netherlands 1996, Finland 1997, Germany 1999 and the UK 1996, 2001) Tax increases on energy consumption or CO_2 emissions are the most common instruments of ETR, although the UK has also introduced landfill and aggregate

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taxation, while Denmark and the Netherlands have increased existing taxes on waste disposal. Often, ETR design is modified by concerns over the effect of unilateral environmental taxation on international competitiveness. This has led to a variety of exemptions for certain industries, often in contradiction of the Polluter Pays Principle, namely the judgement that the burden of taxation should fall on those who have a negative impact on society through producing harmful environmental effects.

2.1. Methods used to assess the impacts of ETR

2.1.1. Computable general equilibrium (CGE) modelling

Analysis of the impact of ETR has often employed a CGE modelling framework of the economy and energy systems. CGE modelling is most naturally suited to long-run analysis; that is, a static comparison between an economy's initial equilibrium and its new equilibrium under each test scenario.

Recent investigations into the effects of ETR using CGE modelling tend to alter one or two variables or assumptions of interest in order the isolate their effects. For example, Bovenberg and van der Ploeg (1998) consider how the existence of structural unemployment affects the operation of the double dividend. To do this, they relax the assumption of market clearing in their model. Jaeger (2002) makes the assumption that pollution damage reduces welfare by lowering factor productivity. In contrast, previous CGE model-based research has assumed that environmental damage enters consumer utility directly. The results of these studies are briefly discussed below.

2.1.2. Econometric estimation modelling

The main alternatives to CGE modelling are time-series based econometric models, including Cambridge Econometrics' E3ME model used in this research. The key difference from CGE modelling is that parameters are not set by the modellers on a priori theoretical grounds but are fitted to the data using statistical techniques. These models are quite well suited to analysing short-run dynamics and out-of-equilibrium behaviour. The downside to this approach is the extensive data requirements for estimating model parameters.

2.1.3. Comparison of modelling methods

Pissarides (2008) compares the merits of a number of examples of these types of models for the analysis of carbon-reduction policies. He argues that econometric modelling is better suited to the analysis of short-run dynamics, but that in the long run the lack of equilibrium discipline could allow errors to cumulate. He also points out that econometric modelling is subject to the 'Lucas Critique'. That is, as the parameters in econometric models are estimated from the past, they may not be applicable in the future, and that the very policy changes being modelled may change the parameter values (i.e. cause a change in behaviour). Pissarides suggests that CGE modelling is generally superior in the long run and is also better at handling disaggregation into sectors; econometric models may be more subject to statistical errors when dealing with smaller data sets. However, he also concludes that CGE modelling is not well suited to short-run or dynamic analysis. Overall, he concludes that the differing modelling techniques should be viewed as complements, rather than alternatives in policy analysis.

2.2. Theoretical considerations

There is a clear theoretical case for environmental taxation going back to Pigou (1920), whereby the tax places a price on a negative environmental externality and allows it to be rationed efficiently using the price mechanism. However, the strong double-dividend hypothesis – that ETR can produce net economic benefits in addition to the environmental benefits – is somewhat more controversial, and is not usually supported by traditional economic theory or by standard CGE modelling. Oates (1995) notes that such models have often found a 'tax interaction' effect, whereby the environmental tax has a knock-on effect that increases the distortions arising from taxes that already exist, that offsets the double dividend and may even lead to a net reduction in welfare.

Numerical results from CGE models have often found the optimal environmental tax to be below the marginal social cost of pollution. However, Jaeger (2002) derives a very different result by assuming that pollution damage enters the model by reducing labour productivity rather than consumer utility (the conventional neoclassical assumption), and finds that the optimal carbon tax rate is 53% higher than the marginal social cost. Jaeger therefore provides some CGE-based justification for a substantial double dividend.

Bovenberg and van der Ploeg (1998) derive conditions under which revenue recycling can boost employment by dropping the assumption of market clearing in the labour market from their model and introducing informal (ie illegal and untaxed) labour. They conclude that an ETR, under certain circumstances, can boost employment if it shifts the tax burden away from workers in the formal sector towards those in the informal sector. This comes at the cost to workers of reduced wages in both the formal and informal sectors, and it is unclear whether this represents a true double dividend.

Schöb (1996) derives welfare measures to estimate the two hypothesised benefits of revenue-neutral green tax reforms—an environmental improvement and a reduction in distortionary taxes. In this case, even whether or not there is a net environmental benefit depends critically on the nature of the existing tax system.

Heady et al. (2000) survey the literature on the subject and, in addition to the two main points above, list the following key factors that will make ETR more likely to raise employment:

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

Prasad (2008) considers some further factors that are outside the bounds of conventional economic theory but may be important in determining the success of ETR, namely: whether firms respond to the tax; whether government is committed to using the tax to improve environmental conditions; and whether the tax 'crowds out' an intrinsic motivation to improve the