Journal of Environmental Economics and Management 61 (2011) 227–243

Contents lists available at ScienceDirect

Journal of Environmental Economics and Management

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

Household incidence of pollution control policies: A robust welfare analysis using general equilibrium effects

Abdelkrim Araar [a], Yazid Dissou [b,*], Jean-Yves Duclos [a]

[a] Département d'économique and CIRPÉE, Pavillon de Sève, Université Laval, Québec, Canada G1V 0A6
[b] Département de science économique, Université d'Ottawa, Ottawa, Canada

ARTICLE INFO

Article history:
Received 16 July 2010
Available online 1 January 2011

Keywords:
Pollution control policies
Household incidence
Stochastic dominance
General equilibrium effects

ABSTRACT

This study assesses the incidence of pollution control policies on households. In contrast to previous studies, we employ an integrated framework combining a multisector general equilibrium model with a stochastic dominance analysis using household-level data. We consider three policy instruments in a domestic emission trading system: (i) an output-based allocation (OBA) of permits; (ii) the use of the proceeds of permit sales to reduce payroll taxes (RPT); (iii) and the use of these proceeds to reduce consumption taxes instead (UCS). The general equilibrium results suggest that the return to capital is more negatively affected than the wage rate in all simulations, since polluting industries are capital intensive. Abstracting from pollution externalities, the dominance analysis suggests that all three policies have a normatively robust negative (positive) impact on welfare (poverty). Formal dominance tests indicate that RPT first-order welfare dominates OBA over all values of household incomes. UCS also first-order poverty dominates RPT for any choice of poverty line below $CAN 18,600, and poverty dominates for any poverty line (and thus welfare dominates) at the second order. Finally, while the three pollution control policies do not have a numerically large impact on inequality (in comparison to the base run), statistical tests indicate that inequality increases significantly more with OBA and RPT than with UCS.

1. Introduction

In recent years, much of the debate over the cost of pollution control policies has centered on their aggregate cost-effectiveness and not on their distributive welfare incidence. Yet, the distributive outcome of any policy that affects relative prices constitutes an important source of concern for policy makers. Concern for the incidence of the costs of green-house gas (GHG) abatement policies can be expressed from at least two perspectives: industries and households. With the first perspective, the concern is over the incidence of abatement costs across industries; with the second perspective, it is the policies' welfare incidence on households that is the main source of preoccupation. The interest over the joint incidence of pollution control policies has been growing among analysts and researchers. A recent body of literature has begun to examine the distributive impact across industries of the cost of pollution control policies. Dissou [11] and Goulder et al. [17] are just a few examples. The literature on the household incidence of environmental taxes is also increasingly abundant—see for instance Parry et al. [20] for an interesting and extensive review of the literature.

* Corresponding author. Fax: +1 613 562 5999.
E-mail addresses: aabd@ecn.ulaval.ca (A. Araar), ydissou@uottawa.ca (Y. Dissou), jyves@ecn.ulaval.ca (J.-Y. Duclos).

0095-0696/$ - see front matter © 2010 Elsevier Inc. All rights reserved.
doi:10.1016/j.jeem.2010.12.002

Most studies suggest that environmental taxes tend to be regressive. The main reason for this is that lower income households usually spend a larger share of their income on energy goods than more affluent households; increasing taxes on energy goods is thus proportionately more harmful to poorer households. Many such studies use a partial equilibrium analysis in which it is assumed not only that energy taxes are fully passed through to consumers, but also that these taxes have no effects on the prices of other goods. West and Williams [25] and Bento et al. [4] are a few examples of studies using such a partial equilibrium approach.

Considering the significant share of energy goods in the production cost of other consumption goods, the above conclusion on the regressive nature of environmental taxes could certainly be qualified in a more general equilibrium setting. For example, Solow [23] and Uri and Boyd [24] find that when the indirect effects, *i.e.*, the spillover and feedback effects from other industries, of energy taxes, such as a thermal tax, are taken into consideration, energy taxes tend to be proportional—as opposed to being regressive when these effects are ignored. Accounting for the indirect effects of energy taxes on other goods through input–output tables, Casler and Rafiqui [7] also find that these taxes are then only mildly regressive.

In a recent paper, Fullerton and Heutel [16] discuss another channel through which environmental taxes can have a redistributive impact across households. As polluting industries tend to be relatively capital intensive, the use of market-based instruments to control emissions, under certain conditions on substitution elasticities, tends to reduce the relative return of capital to labor. Such a backward shift of a pollution tax on primary factors will then affect the distributive incidence of the tax since richer households generally derive a higher share of their income from capital.

The analysis of the incidence of environmental taxes can therefore be improved by considering the indirect effects of the taxes on the prices of other products and on factor returns. Existing general equilibrium analyses of the household incidence of environmental policy, such as Rose and Oladosu [21] and Wiese and Schluter [26], are nevertheless limited in their ability to show the distributive impacts of policies affecting relative prices. In contrast to partial equilibrium studies, which usually rely on detailed household-level survey data, existing general equilibrium studies indeed only include a rather limited number of representative households. Because of their aggregative nature, they are unable to take fully into account the considerable heterogeneity that can exist across households. The distributive changes suggested by these models only capture redistribution *between* groups, ignoring *intra-group* changes. The latter can only be accounted for fully using microeconomic household-level survey data.

This paper draws upon the strengths of both of the approaches described above by accounting for both general equilibrium effects and household-level heterogeneity in incomes and consumption. To do this, we use a two-step approach in which we first compute the general equilibrium effects on commodity prices and on primary factor returns, and then perform stochastic dominance analysis using household-level data.

A recurring insight derived of most studies on the economic cost of environmental policies is that the final outcome depends on the policy instrument used and on the method for recycling the revenue raised by these instruments. We thus consider three domestic emissions trading (DET) experiments: (i) a DET with an output-based allocation of permits (OBA); (ii) a DET with a recycling of permit proceeds to reduce payroll taxes (RPT); and (iii) a DET with a recycling of permit proceeds to reduce consumption taxes (UCS). While the last two types of DET are well known in the literature, the first is relatively new and is gaining popularity among policy makers in Europe and North America. An interesting characteristic of the OBA-DET is that it helps to even the distributive impact of pollution control policies across industries—see Dissou [11], Bernard et al. [5], Goulder et al. [17] for an analysis of the cost-effectiveness of an OBA-DET scheme. We are not aware of any study that compares the household incidence of these types of emission trading.

We consider the Canadian economy, for which we elect to analyze the impact of a 15% reduction of GHG emissions from their business-as-usual (BAU) level using a cap-and-trade DET with different revenue-recycling methods. Note that this analysis does not have any link with official government policies to reduce GHG emissions in Canada. It is only done illustratively in order to derive some insights on the distributional impacts of alternative GHG mitigation policies using our suggested methodology.

For that purpose, the paper develops a multi-sector static general equilibrium model of the Canadian economy. This serves to provide the commodity and primary input price impacts of the three policy experiments described above. The commodity and primary input price changes obtained from the general equilibrium model are subsequently used in a stochastic dominance analysis using household-level data.

The dominance approach to assess the distributive and welfare implication of taxes is relatively well established in the public finance literature—see for instance Yitzhaki and Slemrod [28], Mayshar and Yitzhaki [18], and Duclos et al. [13]. Using stochastic dominance for analyzing the social welfare impact of policy has several advantages. The most important of these is to free the analysis from the need to make restrictive and arbitrary assumptions on the way in which social welfare is assessed. As we will see in greater details below, stochastic dominance can indeed be used to conclude that an environmental policy is good for society *regardless* of whether the normative focus is on poverty reduction or on social welfare improvement, of whether a particular social welfare function is used as opposed to another, and of whether one or another poverty line is chosen. In short, using the dominance approach helps free the analysis from difficult measurement and normative choices, and thus helps make a policy conclusion more robust and less ambiguous. We are not aware of other studies analyzing the household incidence of environmental policies using a stochastic dominance approach, especially in a general equilibrium framework.