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Regional burden sharing of GHG mitigation policies in a decentralized federation

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ABSTRACT

The distribution of the burden of cost of GHG mitigation policies is a contentious issue. This is particularly true among regional jurisdictions within a federal country with decentralized power. The regional allocation of emissions permits could hinder the political feasibility of national GHG mitigation policies. We build a multi-region computable general equilibrium (CGE) model to assess the implications of different burden sharing rules in a hypothetical national GHG abatement policy with a market-based instrument. In addition to assessing the impacts of regional permit allocation rules that entail inter-regional transfers of wealth, we consider a particular emissions allocation scheme, called 'no prior entitlement' (NPE), that avoids such transfers. The insights derived from the simulations suggest that the NPE policy avoids the politically contentious issues of inter-regional transfers of scarcity rents. Its welfare impact lies between those in the entitlement-based permit allocation schemes.

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1. Introduction

In this paper, we analyze the welfare and distributional implications of various regional emissions allocation rules in the context of a federation with decentralized power. The threat of global warming has induced the international community to launch negotiations to reduce greenhouse gases (GHG) within the framework of the United Nations. The ultimate objective of the discussions is to achieve an agreement on the reduction of GHG through voluntary international cooperation. Notwithstanding the environmental benefits of reduced GHG, achieving that objective will entail some economic costs. Given the public good nature of having a cleaner environment and the different economic structures of the countries involved in the negotiations, some countries are prone to the well-known free-rider problem. Several authors have analyzed the incentives that countries have to free-ride in such a context. The issue of free-riding has been a major factor justifying the withdrawal of the U.S. from the Kyoto protocol (Jacoby and Reiner, 2001; Sue Wing, 2007). If, at an international level, the issue of burden sharing relates to the distribution of the cost of supplying a public good among the participating countries, the same problem exists at a national level in countries with a highly decentralized political system.

Once a national abatement target is set through international discussions, its implementation could face the same free-rider problem in countries with a highly decentralized system of political power, like Canada and Belgium (Boucekkine and Germain, 2009; Boucekkine et al., 2010). In these countries, international treaties are signed by the federal government, but their implementation is carried out by regional

governments. The implementation of the GHG mitigation policy must be achieved with the cooperation of regional governments.

As the implementation of any plan to curb emissions at the national level would involve some costs, a consensus must be achieved on the burden sharing among the regional economies. In a decentralized system of governance, such negotiations are typically marked by each region willing to bear the minimum cost in anticipation that others shoulder the brunt of the national mitigation target.

Moreover, the costs arising from this equity-efficiency trade-off[1] also tend to differ not only over available carbon mitigation policy options, but also from one region to another. In other words, heterogeneity in the composition of regional economies plays a critical role in the debates over cost sharing. Thus, for the successful adoption of a binding accord and for its subsequent implementation, regional incidences of GHG burden costs must be carefully investigated. Such an investigation not only ought to identify the best policy from the set of feasible policy options, but also be grounded on equity principles with firm ethical standing.[2] This is the primary focus of this study.

In particular, based on the recent equity-efficiency debates in the literature concerning GHG mitigation efforts and its impacts on different

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[1] In recent literature, the equity-efficiency trade-off has received considerable attention. See Fischer and Fox (2004) for further discussions on this. Essentially, the tension arises from the fact that while efficiency criteria emphasize the importance of achieving environmental goals in the most cost-effective manner, equity criteria stress the importance of reducing the uneven burden costs experienced by various competing sectors of the economy due to the implementation of the stated environmental objectives. Hence, upholding equity considerations often comes at the cost of efficiency losses.

[2] For an excellent discussion on equity principles considered in international negotiations, see Rose (1992) and Rose et al. (1998). Barrett (1992) also provides some interesting discussions on the moral and ethical aspects of some widely recognized equity principles.

industrial sectors, we present an assessment of four policy scenarios, where we explicitly consider the heterogeneity in the regional economic structures and the associated burden sharing consequences. We use Canada as an illustration for our purpose, even though no national GHG mitigation policy is currently under consideration in that country.

In the context of international climate policy negotiations, existing literature offers a wide range of criteria for evaluation of the burden-sharing rules involving efficiency and equity considerations (Torvanger and Ringius, 2002). Generally, these rules may also be applicable in the regional context. Within the cap-and-trade (CAT) framework, equity in these negotiations typically implies assigning implicit (and often a priori) emissions entitlements (i.e. assigning emissions rights). All these entitlement schemes entail the contentious issue of inter-regional transfer of wealth stemming from the scarcity rents granted to the regions. The possibility of a wealth transfer from one region to another, induced by the emissions entitlement scheme, is a serious hurdle that makes negotiations contentious and largely diminishes the political palatability of available allocation policy options.

The reason for this is that given the national emissions targets, when regions are initially assigned emissions entitlements, they are implicitly assigned a given share of the emissions rents associated with the national unabated emissions. Since regional unabated emissions are not necessarily identical to the regional emissions entitlements, wealth transfers could occur among regions. Such transfers would affect the regional distribution of welfare costs of the GHG mitigation policy.

The challenge, thus, is to devise a mechanism that can avoid this contentious issue of inter-regional transfer of emissions rents. In this paper, we ask whether there exists a regional emissions entitlement scheme that avoids such transfers, and that is capable of achieving the national objective with an "equitable" distribution of the burden costs across regional jurisdictions.

We propose a simple emissions entitlement scheme, called the no prior entitlement (NPE) scheme that will not lead to an ex-post transfer of wealth from one region to another. In that scheme, regions are not assigned any ex-ante emissions entitlements. We consider a cap-and-trade system in which all emitters are required to purchase emissions permits that are auctioned in a single national market. The scarcity rents related to these permits are then distributed to the regions according to their share in the national unabated emissions. The difference of this scheme in comparison with the existing ones in the literature is that regions no longer receive a portion of the national emissions rents based on an ex-ante distribution of emissions entitlements. They rather receive the rents associated with the unabated emissions in their regions. As such, there are no ex-post wealth transfers among regions.

In this study, we also analyze the regional welfare and distributional implications of three commonly suggested emissions allocation rules and compare them with our proposed allocation rule. Namely, we consider i) the emissions based allocation (EBA) or the proportional allocation of rights based on the past levels of emissions; ii) the allocation based on efficiency index (EI); and iii) the allocation based on multi-criteria index (MI).[3] A detailed discussion on each of these allocation schemes and the underlying equity rationale is provided in Section 3. In all allocations schemes, a regional government distributes its emissions rents to the representative household.

An assessment of the regional and welfare implications of various emissions entitlement schemes requires a detailed regional framework that could capture interactions across agents, sectors and regions. Computable general equilibrium (CGE) models have proven to offer interesting insights in the analysis of the potential national and regional implications of climate change policies with market based-instruments. As such, in this paper we develop a multi-sector multi-regional CGE model of the Canadian economy to assess the distributional implications of

various emissions entitlement schemes using a CAT emissions policy. For this purpose, we divide Canada into six regions (Region 1 to Region 6) that do not coincide with the political jurisdictions of Canada.[4]

We are not aware of any regional CGE model that assesses the whole set of emissions entitlement schemes considered in this study. Existing regional CGE studies on climate change include Snoddon and Wigle (2007, 2008), and MKJA Associates (2009) for the Canadian economy and Sue Wing (2007) and Sue Wing and Kolodziej (2008) for the U.S. economy. None of these studies have considered the NPE allocation scheme. It is important to note that the analysis conducted in this study is not related to any actual GHG mitigation policy in Canada. Some provinces, like Quebec and British Columbia have designed and started implementing their own GHG mitigation policies without any coordination with the other provinces. The present analysis is only meant to provide insights on the potential distributional implications of various regional allocations of permits in a federal jurisdiction with decentralized power.

The remainder of the paper is organized as follows. In the next section, we provide a short description of the model, where we discuss the behavior of all economic agents, as well as the equilibrium conditions and the closure rules of the model. In the third section, we present the simulations and review the equity implications of the allocation schemes discussed in the paper. Section 4 provides an overview of data from the reference year and the calibration method used in the paper. We discuss the simulation results in Section 5 and conclude in the last section.

2. The model

In this section effort is made to evade the black-box syndrome of most general equilibrium results by providing an intuitive description of the model, aimed at helping the readers put the simulation results in proper perspective. The current model belongs to the family of multi-sector, multi-region, static general equilibrium models, like the one in Decaluwé et al. (2004) that can be found in the literature. Canada is considered a small-open economy divided into six regions that trade with each other and with the rest of the world.

In each of the six regions, we consider 19 industries that produce 26 commodities, which can be sold in the domestic, regional and world markets.[5] In contrast to the existing Canadian regional CGE models, the present model features a rich disaggregation of production activities in the manufacturing sector (11 manufacturing industries). Moreover, in each region, the model captures not only the international trade flows with the rest of the world, but also the bilateral regional trade flows.

We assume that all economic agents consider prices as given and we restrict our attention to combustion carbon dioxide emissions. We consider a cap-and-trade (CAT) system in which all economic agents need to purchase emissions permits in proportion to the carbon content of the goods used. The permits are sold in a national permit market, and the proceeds from the permits are allocated among the regional representative households according to a burden sharing rule.

2.1. Households

In each region, we assume a single representative household that makes decisions over the consumption of goods based on its utility function subject to a budget constraint. The utility function is a two-level CES (constant elasticity of substitution) aggregator of the consumption commodities. At the first level, we aggregate the index of energy goods and the index of non-energy goods using a CES function. At the second level, two other CES functions combine separately energy

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[3] Note that each of these schemes renders a specific value judgment on equity and caters to a specific set of considerations.

[4] The choice of regional disaggregation has been guided by the available set of data. See Table 1 for the characteristics of each region.

[5] See Table 5.1 for the list of industries.