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Economic analysis of the climate pledges of the Copenhagen Accord for the EU and other major countries

Bert Saveyn [a,*,1], Denise Van Regemorter [b], Juan Carlos Ciscar [a,1]

[a] European Commission, Institute of Prospective Technological Studies (IPTS), Joint Research Center (JRC), Ed. Expo, c/Inca Garcilaso 3, E-41092 Sevilla, Spain
[b] Katholieke Universiteit Leuven (KUL), Naamsestraat 69, B3000 Leuven, Belgium

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ABSTRACT

This article uses the world GEM-E3 computable general equilibrium model to assess the economic consequences of the climate 'Copenhagen Accord'. The model allows analyzing the macroeconomic costs in terms of GDP, the change in employment, as well as the impacts on production of specific energy-intensive sectors. Various 2020 climate scenarios are evaluated depending on the GHG mitigation pledges. We find that the cost for the developed countries is around 0.5% of GDP in 2020 for the more ambitious pledges, whereas the GDP effects are more heterogeneous across developing countries and Russia, reflecting the different pledges and the assumptions in the reference scenario across these countries. Further, the article explores whether there is a form of double dividend in the EU when the revenues from auctioning or taxation of GHG emissions are used to reduce the social security contributions of employees. We conclude that GDP and employment perform better compared to the free allocation of permits when more sectors are subject to auctioning or GHG taxes and the additional government revenues are used to reduce the cost of labour.

1. Introduction

Although short of a comprehensive legally binding agreement, the result of COP15[2] in Copenhagen was an extensive list of 'pledges' for GHG emission reductions in 2020 by all major economies and many other countries (UNFCCC, 2009). Under the Cancun agreements of COP16 the mitigation pledges of the 'Copenhagen Accord' have been anchored in the UN process. The United Nations (UN) also formally adopted that global temperature must be kept below 2 °C compared to the pre-industrial level.

The EU pledges state that the EU will unilaterally reduce its GHG emissions by 20% in 2020 compared to 1990. If there is an ambitious international agreement on GHG mitigation, the EU would reduce emissions by 30% in 2020. These pledges were already formally adopted by the European parliament and the European Council in June 2009 – in a legislation known as the 'Climate and Energy Package'[3] (European Commission, 2008).

After COP15 the European Commission analyzed the economic implications of going beyond the 20% reduction target in the context of the 'Copenhagen Accord' (European Commission, 2010a). The accompanying economic assessment relied on economic modelling[4] (European Commission, 2010b), including, among other models, the computable general equilibrium (CGE) GEM-E3 model.

This paper presents in detail the GEM-E3 results of this analysis. It builds further on the GEM-E3 modelling for the 2009 Communication "Towards a comprehensive climate change agreement in Copenhagen" (Russ et al., 2009), and the 2007 Communication "Limiting global climate change to 2 °C" (Russ et al., 2007).[5]

The EU 'Climate and Energy Package' foresees an enhanced use of auctioning in the EU Emission Trading System (EU ETS) from less than 4% in phase 2 (2008–2012) to more than 50% in phase 3 (2013–2020). This implies a substantial generation of public revenues. Auctioning (and taxation) complies better with the 'polluter pays principle' and avoids handing out 'windfall profits' to sectors that can easily pass on the opportunity cost of allowances to their customers. Indeed, full auctioning will be the rule in the power sector from 2013 onwards. Sectors exposed to a significant risk of 'carbon leakage' are exempted from auctioning and receive their share of allowances up to a benchmark level for free. In December 2009, the European Commission published

* Corresponding author. Tel.: +34 954488331; fax: +34 954488235.
E-mail address: Bert.Saveyn@ec.europa.eu (B. Saveyn).

[1] The opinions expressed in this paper belong to the authors only and should not be attributed to the institution they are affiliated to.

[2] 15th Conference of the Parties of the United Nations Climate Change Conference.

[3] Other pillars of the 'Climate and Energy Package' include a mandatory 20% share for renewable energy in the EU gross final energy consumption in 2020; and a 20% reduction in primary energy use to be achieved by improving energy efficiency. See Soria and Saveyn (2010) for an overview of European climate policies.

[4] See Delbeke et al. (2010) for an overview of the use of environmental economics and economic modeling in European climate policies.

[5] See European Commission (2007) and European Commission (2009a) for more detail.

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Table 1
GHG emissions and GDP evolution in 2020 compared to 2005[a].

	EU	US	Japan	Russia	China	Brazil	India
GHG emissions (vs. 2005)	−9.61%	1.93%	−4.65%	22.85%	80.61%	37.32%	98.25%
GDP (vs. 2005)	28%	46%	32%	102%	169%	61%	142%

[a] Excluding land-use (change) emissions.

the list of sectors and subsectors that are deemed to be exposed to a significant risk of carbon leakage (European Commission, 2009b).

Since auctioning raises government revenues, other taxes such as labour or capital taxes could be reduced, potentially improving the overall efficiency of the economy. This links the analysis of this article with the 'double dividend' literature.[6]

This literature argues that substituting environmental taxes for pre-existing distorting taxes (i.e. an environmental tax reform) may yield not only a cleaner environment but a second non-environmental dividend. The 'double dividend' literature implicitly assumes that the initial state of the economy may be suboptimal from a non-environmental point of view. This state can be observed in the real world, which can be explained, alternatively, by interest groups, distributional concerns, or the export of the tax-burden to non-residents. A number of different definitions for the non-environmental dividend have been analysed. In this study we look at three of the main forms[7]:

Weak double dividend: The recycling of the additional environmental tax revenues through lower pre-existing distorting taxes (e.g. capital or labour) reduces the costs of the environmental policy, compared to the case where the environmental tax revenues are recycled in a lump-sum way. The weak double dividend is relatively uncontroversial (Goulder, 1995).

Strong double dividend: The environmental tax reform not only reduces the costs of the environmental policy, but even generates a non-environmental benefit ('dividend') in the form of a more efficient tax system, raising the non-environmental welfare. Recent studies qualify in detail under which conditions a (strong) double dividend may appear,[8] whereas others have studied the double dividend hypothesis in the context of climate change policies.[9]

Employment double dividend: The environmental tax reform increases the environmental quality and boosts employment as well.

This study tries to answer three policy questions with respect to the EU climate policy in an international context. Firstly, it studies the macroeconomic implications of the Copenhagen Accord for the major world economies in 2020. Secondly, the research also pays particular attention to the economic implications on the EU in terms of GDP and employment, taking into account various possible auctioning and tax schemes. Thirdly, we explore the politically sensitive issue of the competitiveness effects in the energy intensive sectors in the EU.

This paper has the following structure: Section 2 describes the main features of the GEM-E3 model. Section 3 presents the reference, with which the Copenhagen Accord scenario will be compared. The reference scenario considers the 'Climate and Energy Package' and the effects of the on-going economic crisis. Section 4 presents the policy scenarios assessed. Section 5 analyses the results for the major world economies and the EU. Section 6 concludes.

2. Model

The computable general equilibrium GEM-E3 model covers the interactions between the economy, the energy system and the environment (Capros et al., 2010; Van Regemorter, 2005). The world version[10] of GEM-E3 is based on the GTAP 7 database (base year 2004) and has 21 geographical regions (including the major world economies individually represented), linked through endogenous bilateral trade.

The GEM-E3 model computes the simultaneous equilibrium in the goods and services markets, as well as in production factors (labour and capital). The competitive market equilibrium under Walras' law also includes more detailed equilibria in energy demand/supply and emission/abatement. The structural features of the energy/environment system and the policy-oriented instruments (e.g. taxation) have considerable sectoral detail.

GEM-E3 can evaluate consistently the distributional effects of policies for the various economic sectors and agents across the countries. The economic consequences of environmental or economic policies can be analyzed on a national level, while ensuring that the world economy remains in equilibrium. The model is recursive-dynamic,[11] driven by the accumulation of capital and equipment. Technological progress is explicitly represented in the production functions.

The economic agents optimize their objective functions (welfare for households and cost for firms) and determine separately the supply or demand of capital, energy, environment, labour and other goods. Market prices guarantee a global equilibrium endogenously.

The production of the firms is modelled with a nested CES neo-classical production function, using capital, labour, energy and intermediate goods. The model allows for different market clearing mechanisms and alternative market structures, in addition to perfect competition. The amount of capital is fixed within each period. The investment decisions of the firms in the current period affect the stock of capital in the next period. Labour is immobile across national borders.

The consumers decide endogenously on their demand of goods and services using a nested extended Stone Geary utility function. In a first stage, a representative consumer for each region allocates their total expected income between total consumption of goods and services (both durables and non-durables), leisure and savings. If the economic conditions are favourable, households can decide to work more and have less leisure time. In a second stage, the utility function distinguishes between durable (equipment) and consumable goods and services. Households obtain utility from consuming a non-durable good or service and from using a durable good above a subsistence level. The consumption of a durable good is directly linked to the consumption of non-durable good, e.g. fuel for the use of transport equipment.

The demand of goods by the consumers, firms (for intermediate consumption and investment) and the public sector constitutes the total domestic demand. This total demand is allocated between domestic goods and imported goods, using the Armington specification.

[6] For an overview see e.g. Goulder (1995), and Bovenberg (1999).
[7] The 'weak double dividend' and 'strong double dividend' are due to Goulder (1995), while Carraro et al. (1996) uses the 'employment double dividend'.
[8] See e.g. De Mooij and Bovenberg (1998); Metcalf and NBER (2003); Chiroleu-Assouline and Fodha (2005); Saveyn and Proost (2008).
[9] See e.g. Babiker et al. (2003); and Parry (2003).

[10] There are two versions of GEM-E3: GEM-E3 Europe and GEM-E3 World. They differ in their geographical and sectoral coverage, but the model specification is the same. The European version covers 24 EU countries (all EU countries, except for Luxemburg, Malta and Cyprus) and the rest of the world (in a reduced form). It is based on EUROSTAT data.
[11] Babiker et al. (2009) find that for a climate policy analysis recursive-dynamic (RD) and forward-looking models (FL) produce similar behaviour in the energy sector. However, - due to computing limitations – a recursive-dynamic model is able to give a more detailed representation of the real world. Although a FL model may be better suited to deal with inter-temporal questions such as the depletion of resources or banking and borrowing of allowances, the results of Gurgel et al. (2007) suggest that the differences between FL and RD may be rather limited for a climate policy with tax revenue recycling.