Energy Policy 47 (2012) 172–179

Contents lists available at SciVerse ScienceDirect

Energy Policy

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

Does climate policy make the EU economy more resilient to oil price rises? A CGE analysis

Hélène Maisonnave [a,b], Jonathan Pycroft [b,*], Bert Saveyn [b], Juan-Carlos Ciscar [b]

[a] Laval University, Quebec, Canada
[b] IPTS, European Commission, Sevilla, Spain

ARTICLE INFO

Article history:
Received 24 December 2011
Accepted 24 April 2012
Available online 18 May 2012

Keywords:
Climate policy
Oil prices
Computable general equilibrium (CGE)

ABSTRACT

The European Union has committed itself to reduce greenhouse gas (GHG) emissions by 20% in 2020 compared with 1990 levels. This paper investigates whether this policy has an additional benefit in terms of economic resilience by protecting the EU from the macroeconomic consequences due to an oil price rise.

We use the GEM-E3 computable general equilibrium model to analyse the results of three scenarios. The first one refers to the impact of an increase in the oil price. The second scenario analyses the European climate policy and the third scenario analyses the oil price rise when the European climate policy is implemented.

Unilateral EU climate policy implies a cost on the EU of around 1.0% of GDP. An oil price rise in the presence of EU climate policy does imply an additional cost on the EU of 1.5% of GDP (making a total loss of 2.5% of GDP), but this is less than the 2.2% of GDP that the EU would lose from the oil price rise in the absence of climate policy. This is evidence that even unilateral climate policy does offer some economic protection for the EU.

© 2012 Elsevier Ltd. All rights reserved.

1. Introduction

The European Union addresses the inter-related issues of climate change and energy security through its Climate and Energy Package, which commits the Union to reducing greenhouse gas (GHG) emissions by 20% in 2020 compared with 1990 levels (European Commission, 2008b). Significant reductions in GHG emissions can reduce the risks of large damages from climate change (e.g. Mastrandrea and Schneider, 2004; Stern, 2007). By meeting these goals, the EU would directly reduce world GHG emissions, to which the EU is a large contributor, and, it is hoped, would encourage other regions to do likewise.

A second justification of the ambitious EU climate policy is energy security. The potential benefits for Europe in terms of energy security have been recently assessed in the Commission roadmap to a low-carbon economy (European Commission, 2011a, 2011b). Oil and gas imports could be halved compared to today thanks to the decarbonisation of the energy system, with a reduction of average annual fuel costs estimated to be between 175 and 320 billion Euro. Without the proposed transformation of the energy system, the EU energy import bill could double by 2050, with additional expenditure of around 400 billion Euros, around 3% of the current EU GDP.

Historically, oil price rises have been a contributory cause to a number of economic recessions, perhaps including the current economic slowdown, which occurred following the 2007–2008 oil price shock (Hamilton, 2009). Intuitively, one might expect that adopting climate policies would make a region less susceptible to oil price changes. Climate policies, in general, reduce a region's reliance on fossil fuels, reducing its macroeconomic vulnerability to fossil fuel price shocks. Furthermore, if the sources of energy are more diversified, there would be more alternatives should there be a rise in the price of oil, or any particular energy commodity (see Toman, 2002). On the other hand, if the economy has already reduced the use of fossil fuels (e.g. to meet climate policy objectives) in those areas where it can be done most easily, then the remaining demand may be fairly difficult to replace,[1] suggesting that relatively high economic impacts could result from rising fossil fuel prices. Therefore numerical simulation is required to examine both the sign and the magnitude of the net effect.

The main purpose of this article is to analyse whether a unilateral EU climate policy makes the EU more resilient to the

* Corresponding author. Tel.: +34 954488333; fax: +34 954488235.
E-mail address: Jonathan.Pycroft@ec.europa.eu (J. Pycroft).

[1] If this were the case, though the country would be less dependent on oil, the marginal cost of reducing the degree of dependence on oil would be increasing.

0301-4215/$ - see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.enpol.2012.04.053

macroeconomic consequences of an oil price rise. We will use the dynamic computable general equilibrium (CGE) GEM-E3 (General Equilibrium Model for Economy-Energy-Environment interactions) model, specifically designed to analyse climate and energy policies (E3M Lab, 2010a).

The remainder of the paper is structured as follows. The second section describes the theoretical framework, outlining the relevant literature. The third section shows the modelling framework, giving a description of the model, the model calibration and the scenarios implemented. The fourth section explains the results, and the final section concludes.

2. Theoretical framework

There are a fair number of studies that investigate the two issues of oil prices and climate policy separately. To take two examples that are especially pertinent to this research using earlier versions of the GEM-E3 model, Ciscar et al., 2004 simulate the impact of high oil prices on the EU economy. Inter alia, they find that a rise in the price of oil of $30 per barrel would lead to a 2.56% decrease in EU GDP.[2] With respect to climate policy, Saveyn et al. (2011) assess the economic consequences of the climate 'Copenhagen Accord', explicitly distinguishing between Emissions Trading Scheme (ETS) sectors and non-ETS sectors. Inter alia, this distinction allows an investigation of the GDP and employment effects of different methods of emission permit allocation.

A few studies address the synergies between climate policy and oil prices in the context of energy security. Turton and Barreto (2006) investigate such synergies using a "bottom-up" multi-regional energy-systems optimisation model, ERIS (Energy Research and Investment Strategies; Turton and Barreto, 2004). They find that achieving emissions cuts does improve the security of oil supply; however the reverse is not true, which suggests that the synergies are weak. In terms of technologies, both energy security and GHG emission reduction encourage movements towards hydrogen fuel cells and nuclear energy. They emphasise keeping a flexible energy system in the face of "scientific, geopolitical and policy uncertainty" (p.2247).

Vielle and Viguier (2007) study the extent to which high oil prices have the positive side effect of reducing GHG emissions. Using a global CGE model, GEMINI-E3 (General Equilibrium Model of International Interactions between Economy, Energy and the Environment; Bernard and Vielle, 2008), they find some impact of higher oil prices in terms of reducing GHG emissions, however the benefits are much smaller than one might expect. This is due to the substitution process, especially towards coal, an even more intensive source of GHG emissions. They also note that high oil prices are a less equitable and less efficient manner of reducing GHG emissions than a well-designed climate policy.

Protection against high fossil fuel prices is explicitly stated as a justification for the EU policies mentioned above in the European Commission Impact Assessment documents (European Commission, 2008a, 2008c). This Assessment cites results from the partial equilibrium PRIMES model (Partial Equilibrium Model for the European Energy System; E3Mlab, 2010b) that investigated the cost of meeting the 2020 GHG targets under different fossil fuel prices. The additional cost required to meet the GHG targets would fall if a higher fossil fuel price was assumed (though naturally, the total energy cost rose) pointing to a protection effect from climate policy.

Perhaps the most similar analysis to ours comes from Rozenberg et al. (2010). Using a hybrid simulation model of the world economy, IMACLIM-R, the study compares the cost of implementing climate policy in a reference case, with that under the scenario when oil and gas production is very constrained. In the reference case, oil and gas are presumed to be "abundant and easily extracted", with oil production reaching 115 Mb per day, while in the 'very constrained' scenario oil production peaks at below 95 Mb per day. They estimate that climate policy implemented by all world regions costs 1.7% of gross world product (GWP) on average, whereas 'very constrained' fossil fuel availability alone costs 2.6% of GWP. Implementing climate policy, when fossil fuels are very constrained, costs a total of 3.3% of GWP, i.e. the *additional* cost of climate policy falls to 0.7% of GWP. Alternatively, one could consider the *additional* cost of a high oil and gas price scenario, which is 1.6% of GWP (3.3 less 1.7). The authors conclude that "Climate policies … can be considered as a hedge against the potential negative impact of oil scarcity on the world economy" (p.5).

3. The modelling framework

In this section we present the main features of the modelling framework, outlining (i) the model structure, (ii) the calibration of the base year and model baseline and (iii) the scenarios implemented.

3.1. Model structure

This sub-section introduces the structure of the GEM-E3 model (E3M Lab, 2010a), in particular the behaviour with respect to production, domestic consumption and trade, and also the model closure choices. The GEM-E3 model is a world recursive dynamic computable general equilibrium (CGE) model, especially designed to evaluate GHG emissions policies.

Producers are assumed to maximise profits subject to their technology, which is represented in a four-level nested production structure. Producers are able to partially substitute between inputs at each level, subject to constant elasticity of substitution (CES) functions. At the top level, capital can be substituted with an aggregate (or composite factor) of labour, energy and materials. At the second level, this aggregate is split between electricity and an aggregate of labour, materials and fuels, which can again be substituted subject to a CES function. At the third level, this aggregate is split into its components: labour, materials and fuels, which are partially substitutable (CES). Finally, at the lowest level, the substitution between types of materials is defined by a CES function, as is (separately) the substitution between types of fuels (coal, oil and gas). We assume full labour mobility between sectors but no international mobility. Capital is region-specific and fully mobile for all sectors with the exception of the oil sector.

Total domestic demand is constituted by the demand of products by government, producers and consumers. Households maximise their utility according to a Stone–Geary function (Stone, 1954), whose arguments are leisure and consumption. In other words, the household determines the amount of leisure it is willing to give away to get the desired amount of income. In a second stage, total consumption is decomposed into demand for specific consumption goods. The split refers to demand for durable and non-durable goods, following Conrad and Schröder (1991).

Total demand is allocated between domestic and imported products, following the Armington (1969) specification. According to this specification, products are imperfect substitutes given their origin. Each region buys and imports at the prices set by the supplying regions following their export supply behaviour.

As explained in detail in the GEM-E3 manual (E3M Lab, 2010a), the environment module contains two parts: the "behavioural"

[2] Among the differences between this analysis and the OP scenario below is that this uses a static version calibrated to 1995 data.

Download English Version:

https://daneshyari.com/en/article/7406018

Download Persian Version:

https://daneshyari.com/article/7406018

Daneshyari.com