

Carbon Pricing after Paris: Overview of Results from EMF 36

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Abstract

Anthropogenic climate change is one of the most important global challenges. The Paris agreement of 2015 is the central international agreement to deal with this challenge. Against this background, a multi-model study in the context of the Energy Modeling Forum (EMF) is conducted with the objective of providing a thorough economic impacts assessment for the implementation of national greenhouse gas emission reduction targets that countries submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in the context of the Paris agreement as their Nationally Determined Contributions (NDCs). The analysis is based on a systematic cross-comparison of around 15 internationally established energy-economy models. Carbon pricing is commonly regarded as a central policy instrument to meet the Paris targets at relatively low costs and is at the core of the analyzed scenarios.

The analysis focuses on two key aspects of future climate policies: First, the global and regional economic cost of implementing NDCs, as well as implications of different degrees of international cooperation and coalition building; Second, the incidence of carbon pricing on the household level for different carbon prices and different policy designs.

Introduction

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Study framework

In order to allow for a meaningful cross-comparison between the participating model results, some key assumptions have been streamlined across modeling teams. This regards (i) minimum requirements for the regional and sectoral resolution; (ii) baselines, that is, projections of GDP and CO₂ emissions up to 2030 for the modeling regions, as well as (iii) specifications of 30 core scenarios. The streamlining of assumptions allows to explain variations in results across models due to policy-relevant parametric and structural choices by modelers concerning data and models.

As to (i), we explicitly represent nine individual countries including the USA, China, and India, as well as important aggregate regions including the European Union and the Middle East. On the sectoral level, we represent five energy sectors, including the fossil fuels coal, oil, and gas, which are associated with CO₂ emissions. The remaining economy is represented in five aggregate sectors.

As to (ii), we define two alternative business-as-usual scenarios, one based on GDP and CO₂ projections from the International Energy Outlook 2017 (IEA, 2017), and one based on GDP and CO₂ projections from the World Energy Outlook 2018 IEA (2018).

As to (iii), we devise core scenarios along three dimensions, totalling to 30 scenarios:

(1) Baseline

Two different baselines (BaUs) for 2030 (see (ii)):

- IEO 2030 GDP and CO₂ based on the International Energy Outlook (IEA)
- WEO 2030 GDP and CO₂ based on the World Energy Outlook (IEA)

(2) Reduction ambition

We translate the NDCs into three different regional ambition levels expressed as BaU-specific percentage CO₂ emission reduction requirements.

- NDC Unconditional NDCs, lower bounds
- NDC+ Conditional NDCs, upper bounds
- NDC-2C Scaling of NDC+ to reach 2°C path

(3) Degree of international cooperation

We devise one reference scenario (REF), where regions implement their respective reduction targets through uniform carbon pricing. From there, we investigate differing degrees of where-flexibility through international cooperation, that is, emissions trading across regions and/or sectors.

- REF Imposition of NDCs
- GLOBAL Global trading across all sectors
- PARTIAL Global trading only in energy-intensive and trade-exposed sectors
- EUR_CHN Club-trading: EU and China link emissions-trading systems for energy-intensive and trade-exposed sectors
- ASIA Club-trading: China, Japan, and Korea link emissions-trading systems for energy-intensive and trade-exposed sectors

Results

At this stage, we conducted and analyzed the first round of simulations. Until the conference is due, we will have a new and improved set of results that will also incorporate a cross-comparison on the household incidence of carbon pricing on the decile level.

The first round of results indicates substantial variation in results across models, hinting at the great significance of differing calibration procedures to hit the streamlined baselines, in particular w.r.t. explicit and implicit CO₂ prices, energy prices, and key elasticity parameters.

Regarding increasing where-flexibility, we find in our first-round results that only a comprehensive global trading scheme (GLOBAL) substantially reduces global cost. The other international cooperation scenarios only slightly reduce global cost, but show shifts in the regional cost incidence of emission reductions. These cost shifts can be traced back to direct welfare gains on the CO₂ market, hinging on prevailing CO₂ prices and abatement potential; and ambiguous terms-of-trade effects on fuel markets and non-fuel markets. In particular, we find an incidence shift from oil and gas to coal suppliers, as with increasing where-flexibility, more abatement is done via reduced coal consumption.

References

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