The General Equilibrium Effects of Environmental Regulations

in the Electricity Generation.

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Introducing electricity-detailed disaggregation from electricity generation into computable general equilibrium analysis requires a general equilibrium consistent database with disaggregated electricity generating technologies and secondly. A mechanism to address substitutability of generating technologies (Peters, 2016). Peters (2016) with base of information of Electricity production by sectors, disaggregated the electricity generation sector in GTAP to account for Nuclear, Coal, Gas, Oil, Hydro, Wind, and Solar. He used the International Energy Agency (IEA) Energy Balances (Peters, 2016). Then he distributed the generation allocated to base and peak load power for each technology based on minimized O&M and fuel cost in the United States. Thus, the disaggregation of the data allows for the analysis of environmental regulations to power plants that target specific energy generation sources.

The advantage of using a GTAP model is to allow for the possibility of calibrating the model with real data in such a way that it reflects actual transactions and trades between countries or regions. For this study, we will consider performing three main tasks. First, an update of the trade elasticities presented in GTAP 9a database. To do so we rely on COMTRADE data and econometric estimation of gravity models to compute the trade elasticities for the 57 grouping of goods in the database, specially electricity, and energy-intensive industries. To match the sectors in GTAP, we aggregated the products using the concordances file maps to the six-digit Harmonized System (2007) sectors to the original 57-sector GTAP sectoral classification[3]. This update guarantees that the parameters for the calibration have been chosen in such a way that they resemble current trade relations between countries.

The second step is to include another greenhouses gases emissions to the electricity generation sector, especially from coal power plants. The primary emissions sources of emissions from power plants are sulfur dioxide (SO2), and nitrogen oxides (NOX)[4]. The emissions data was obtained from the Joint Research Data from the European Commission[5],which reports emissions from diverse sources and sectors for most of the countries included in GTAP.

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[3] See https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=5111
[4] See Czilger et al. 2012
[55] See http://edgar.jrc.ec.europa.eu/archived_datasets.php. We use EDGARv4.3.1 database.

The last step is to research in a computable general equilibrium model which regulations are the best regarding maximizing welfare, for this purpose we use GTAPinGAMS model developed by (Britz et al., 2017) and we include two kinds of different regulations of emissions. Emissions per output or intensity standards (e.g., for units of electricity generated) and a limit of emissions for the generation of power plants (a cap on emissions). Even though, we use the main structure of GTAPinGAMS, we alter the model to obtain a recursive dynamic structure (2011-2050) which is compose of a sequence of several static equilibria. The first equilibrium in the sequence is given by the benchmark year. In each period, the model is solved for an equilibrium given the exogenous conditions assumed for each period. For the benchmarking case, we assume that the economy is on a steady-state growth path, where all quantity variables grow at the same rate and all prices are unaltered.

To better understand the policies that we compare in this study we can think about a simple model where firms maximize net profits with the basic production factors, capital and labor. The production function associated with energy-intensive industries, which uses electricity generation coming from the most contaminating sources, is constrained to the production of certain amount of emissions (cap). Alternatively, we constrain the production of emissions for the same industries to meet a ratio of emissions per output (intensity standard regulation). Even though, the regulations targets are exogenously determined, we conduct sensitivity analysis of the exogenously determined measures to test our conclusions about welfare effects.

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