Mexico's Energy Prospects: Gains from Renewable Sources over a Fossil Fuel-dominated Environment

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1. Motivations underlying the research

Following the energy reform in December 2013, Mexico set its priorities by pushing a more competitive electricity market and pursuing specific greenhouse gases emissions and renewable penetration goals. However, with the arrival of the new administration to the federal government on December 1, 2018, the a-priori promising future of a cleaner environment in Mexico has been seriously compromised. Specifically, the current administration aims to increase revenue from the national power company and gain control of the electricity market at the expense of consumer welfare and the environment. In the medium- and long-term (that is, within the next 10 to 30 years), however, renewable energies should become competitive and marketable energy sources due to significant technological advancements, including battery storage infrastructure. Because of this, it is interesting to analyze, and to quantify as much as possible, the potential benefits of an energy system based primarily on renewable energy compared to another scenario dominated by fossil fuels. Therefore, our analysis uses a baseline scenario that follows the energy policy agenda of the current administration which is popularly known as the "Fourth Transformation" or "4T". Throughout the paper, we contrast the 4T scenario to an alternative "green scenario". Based on our model, we can deduce the implications of changes in energy supply and demand on the rest of the economy, such as impacts on economic activity, air pollution, and, more generally, economic welfare.

2. A short account of the research performed

We develop a mathematical programming, economic equilibrium model for the fuel and electricity sectors in Mexico. The model includes imports of fuels from the rest of the world and employs the economic surplus maximization approach first introduced by Samuelson (1952) and later developed by Takayama and Judge (1964, 1971). We follow the modeling strategy of larger and well-known sectoral, partial equilibrium models (e.g., Beach et. al, 2012; Chen et al., 2012; Lapan and Moschini, 2012; and Núñez, 2021). Technically, we develop a static endogenous-price, mathematical programming model, emphasizing the Mexican energy sectors, which are embedded in a multi-region, multi-product, spatial partial equilibrium model of the Mexican economy.

Our partial equilibrium model has the clear advantage of focusing on an accurate representation of the energy sector. In contrast, computable general equilibrium (CGE) models could be used to analyze further effects in other sectors of the economy at the expense of a less accurate fitting in the energy sector. However, even without relying on a CGE model, we adapt the energy-elasticity approach to perform complementarity calculations and assess the changes in employment and production under the two alternative scenarios. Correspondingly, we evaluate the impact that the different mixes of energy generation, and various levels of electrification in the transportation and manufacturing sectors would have on gross domestic product and the national employment level.

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3. Main conclusions and policy implications of the work

The main result is that maintaining the status quo energy policy will only benefit the government-owned electricity company revenues for a limited period. Yet, an alternative green strategy will boost economic growth, reduce emissions, and ultimately benefit social welfare in a substantial way. In particular, most electricity generated under the 4T scenario will come from fossil fuels (mainly natural gas for combined cycle technology) representing 78 % of total generation in 2035 and 77 % in 2050, while the primarily renewable source will be hydropower in this context. By contrast, under the green scenario, renewables will predominate (68% in 2035 and 80% in 2050), primarily from solar and wind sources while hydropower will decline over time. As well as increasing the use of renewable energy, the green scenario will lead to a higher demand for electricity since the cost of electricity will go down, and manufacturing and transportation will become more electrified. As a result, under the green scenario which implies a larger share of renewables and higher amounts of electricity consumed, most economic sectors are better off. The economic surplus of the domestic sectors in the green scenario will be 11% (respectively, 82%) higher in 2035 (2050) than in the 4T scenario. For the projected years 2035 and 2050, GHG emissions in the green scenario will be 56% and 71% lower than in the 4T scenario, respectively. Finally, the benefits of the green scenario will translate into an increase of 1% percent in annualized GDP growth and employment level in 2035 and 1.2% in 2050.