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Towards a low carbon growth in Mexico: Is a double dividend possible? A dynamic general equilibrium assessment

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HIGHLIGHTS

- A model is designed to evaluate transitional effects of climate policy in Mexico.
- The level of the carbon tax is computed to meet national emissions targets in 2050.
- Distribution of the carbon tax revenues is a key element to get a double dividend.
- Magnitude of benefits depends on the flexibility of production/consumption structure.
- A double dividend is possible even when carbon tax is implemented unilaterally.

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ABSTRACT

This paper simulates the medium- and long-term impact of proposed and expected energy policy on the environment and on the Mexican economy. The analysis has been conducted with a Multi-sector Macroeconomic Model for the Evaluation of Environmental and Energy policy (Three-ME). This model is well suited for policy assessment purposes in the context of developing economies as it indicates the transitional effects of policy intervention. Three-ME estimates the carbon tax required to meet emissions reduction targets within the Mexican "Climate Change Law", and assesses alternative policy scenarios, each reflecting a different strategy for the recycling of tax revenues. With no compensation, the taxation policy would reduce CO_2 emissions by more than 75% by 2050 with respect to Business as Usual (BAU), but at high economic costs. Under full redistribution of carbon tax revenues, a double dividend arises: the policy appears beneficial both in terms of GDP and CO_2 emissions reduction.

1. Introduction

Policy advocacy for urgent transition in the energy system, away from traditional fossil fuel based technology, is becoming increasingly intense in the view of both the economic and environmental implications of traditional energy industry using fossil energy sources like coal, gas and oil. Concerning the former, the exposure to external price-making power of oil producers along with threatening geopolitical instability is impelling oil importing countries to curtail dependency on oil and other fossil fuels and to commit to energy transition. Oil exporting countries on the other hand are facing the recent drop in oil prices; some more than others, like Mexico, Venezuela and Ecuador. As for the latter, the urgent need for cutting down carbon emissions has spurred massive transition of the energy system worldwide towards low-carbon development, with potentially high environmental external benefits both at the local (e.g. air pollution control) and the global (e.g. climate change mitigation) scale. Thus it is in the interest of developing and emerging countries to implement national strategies and reforms for energy transition, which involve improved efficiency and security of the energy system, and especially in that concerning electricity production and distribution.

This is especially the case of Mexico, which alone among the developing countries has undertaken very significant steps towards energy transition for climate change mitigation. In 2012,

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Mexico defined the transition process for achieving a lower carbon growth with the General Law on Climate Change. This law establishes long term Green-House Gas (GHG) emission mitigation targets in two steps: emissions must be reduced by 30% below the business-as-usual trend level by 2020 and by 50% below the 2000 level by 2050. Three years after the General Law was passed and despite a new Administration, these targets remain the national commitments pledged under the UN Framework Convention on Climate Change. This is one of the strengths of the Mexican climate change policy: the transition towards a low carbon growth is today a consensual objective in the political arena and the key point of the discussions is only on the ways and means to reach a lower carbon growth.

Among the drivers of this political awareness is the depletion of the nation's oil resources. It is worth noting that the peak oil attained in 2004 is resulting in many challenges as economic growth and State revenues are significantly dependent on oil production levels and oil prices. This is the reason why the energy reform launched in 2013 aims at reducing the national consumption of fossil resources. Regarding the power sector, the reform creates economic incentives for renewable energy in order to get 35% of electricity generation from renewable sources by 2024. The reform also aims to improve energy efficiency in residential and industrial sectors where the energy-saving potential is estimated as 39 TWh until 2027 (CONUEE, 2014) (for an annual power production of 250 TWh today) (Secretaría de Energía, 2013a). Establishing energy-efficiency targets is all the more relevant in view of the expected increasing energy consumption from the transportation and building sectors as a consequence of growing urbanization. With their 46% and 19% respectively of the total energy demand, the potential for energy savings in these sectors is considerable.

This paper aims at assessing the economic link between the targets stated within the energy transition strategy of Mexico, and the key challenges for its long-term economic development. To do so, it has developed a dynamic, computable general equilibrium model of the Mexican economy. The starting point is the Multi-sectorial Macroeconomic Model for the Evaluation of Energy and Environmental Policy: Three-ME (OFCE/ADEME/TNO, 2013). By relying upon a neo-Keynesian approach to investments, economic growth and distribution mechanisms, Three-ME addresses the dynamics of global economic activity, energy system development and carbon emissions causing climate change. The Three-Me model is well suited for policy assessment purposes in the context of developing economies as it shows the transitional effects of policy intervention. In particular, disequilibrium can arise in the form of involuntary unemployment, the inertia of technical systems and the rigidity of the labor and energy markets, as a result of delayed market-clearing in the goods, capital or labor markets and slow adjustment between prices and quantities over the simulation time path.

The Three-Me-Mexico model is used to gauge the economic and environmental effects of energy fiscal policy measures in Mexico that are included in the energy transition strategy, namely the phasing out of energy subsidies and the implementation of a carbon tax. Different policy scenarios are assessed, each reflecting a different strategy of fiscal revenue recycling. The level of the carbon tax is computed to meet national emissions reduction targets in 2050, as stated in the Mexican “Climate Change Law”. In line with INECC's “IDEAL scenario”, we are considering emission cuts of 40% in 2030 and 50% in 2050 as compared with the baseline and the 2000 levels respectively. First, we evaluate the case of no-tax compensation and assess the policy effectiveness in terms of its efficiency in achieving CO_2 emissions reduction targets with respect to business-as-usual (BAU). Then we test the hypothesis of full redistribution of carbon tax revenues among consumers (through reducing household income taxes) and producers (through compensating for social security payroll taxes), which appears as a way to reconcile environmental and economic goals. The underlying idea of our analysis is to provide quantitative insights in the context of the debate over possible convergence between carbon tax implementation and improved economic performance. In this sense we aim to add to the ongoing scientific debate on the double dividend of energy fiscal policy and its operationalization in regard to economic development.

The paper is organized as follows: Section 2 provides a short description of the Three-ME model and its calibration over the Mexican energy and economic systems. Section 3 presents the simulation results. Section 4 concludes.

2. Three-ME for Mexico

2.1. The generic modeling setting

Three-ME is a *country-generic* and *open source model* developed since 2008 by the ADEME (French Environment and Energy Management Agency), the OFCE (French Economic Observatory) and TNO (Netherlands Organization for Applied Scientific Research). Initially developed to support the energy/environment/climate debate in France, Three-ME is now been applied to other national contexts such as Mexico and Indonesia.

The model is specially designed to evaluate the medium- and long-term impact of environmental and energy policies at the macroeconomic and sector levels. For this, Three-ME (OFCE/ADEME/TNO, 2013) combines several important features:

- Its sectorial disaggregation allows for the analysis of the effect of transfer of activities from one sector to another in particular in terms of employment, investment, energy consumption or trade balance.
- The energy disaggregation allows for the analysis of the energy behavior of economic agents. Sectors can arbitrate between different energy investments: substitution between capital and energy when the relative energy price increases; substitution between energy sources. Consumers can substitute between energy sources, between transports or between goods.
- Three-ME is a CGEM (Computable General Equilibrium Model). It therefore takes into account the interaction and feedbacks between supply and demand (see Fig. 1). The demand (consumption, investment) defines the supply (production). The supply defines in return the demand through the incomes generated by the production factors (labor, capital, etc.). Compared to bottom-up energy models such as MARKAL (Fishbone and Abilock, 1981) or LEAP (Heaps, 2008), Three-ME goes beyond a mere description of the sectoral/technological dimensions by linking them with the global economic system.
- Three-ME is a *neo-Keynesian model*. Compared to a standard Walrasian-type CGEM, prices do not instantaneously clear supply and demand. Instead, the model is dynamic and prices and quantities adjust with friction. This has the advantage to allow for situations of disequilibrium between supply and demand (in particular the presence of involuntary unemployment). This framework is better suited for policy purposes because it provides information regarding the transition phase of a particular policy (not only about the long term).

2.2. Main characteristics of the Mexican version of Three-ME

The Mexican version of the Three-ME model follows a generic architecture as used in the French version. The choice of sectors is specific to Mexico and they are shown in Table 1. The model has 24 commodities (including 3 energy sources: refined oil, gas and