Nicaragua's Climate Mitigation Policy: Sectoral and Inter-Household Effects

By: Maksym Chepeliev, Alma Cortes Selva and Dominique van der Mensbrugghe

Abstract

The objective of this paper is to develop a CGE model for a developing country that disaggregates households and studies the impact of Nationally Determined Contributions (NDC) commitments. The model disaggregates the representative household into 20 representative households, 10 rural and 10 urban households. For the household disaggregation we have used the information from the Living Standards Measurement Study (LSMS) 2014 for Nicaragua. The households disaggregation allows to study the impact of achieving the NDC commitments for the country; and determine which households are expected to win and which households. Since Mitigation, Adaptation and New Technologies Applied General Equilibrium (MANAGE) model is a dynamic model we also model the evolution of the households to these shocks.

Keywords: CGE Modeling, Household Survey, Government Policy, Distributional Effects

JEL classification: C61, C68, D5, Q48, Q52

Extended abstract

Nicaragua is a late signatory to the Paris Agreement, having argued that the agreement did not have stringent enough commitments by developed countries (GoN, 2018). The country deposited its instrument of ratification to the Paris Agreement though it has not yet formally signed the Agreement.[1] According to a World Bank study (WB, 2013), Nicaragua is a "renewable energy paradise" with extensive solar, wind, geothermal and wave energy resources. Therefore, it has the potential to increase substantially its electricity generation from 'clean' energy sources, and to provide quality services to Nicaraguans that lack access to the national grid and reliable electricity supply.[2] A substantial share of the economy is also heavily reliant on natural resources as among the most important sectors are agriculture, manufacturing (especially apparel and textiles), and services (tourism industry – hotels and restaurants).

Nicaragua's greenhouse gas (GHG) emissions in 2010 were just over 15 $MtCO_2eq$[3], (around 2 tCO_2eq per capita), or 0.01 percent of the global GHG emissions. The main contributors to GHG emissions are land-use change and forestry (67.9 percent) and energy sector (29.4 percent). Though Nicaragua is a low emitter of greenhouse gases, it is ranked as the "world's fourth-most-affected country by extreme weather" according the 2017 Germanwatch Climate Risk Index (Kreft et al., 2017).

Nicaragua's vulnerability to climate change comes mainly from the fact that rural Nicaraguans, which make up 41 percent of the population, have at least half of their income coming from rain-fed agriculture (with less than 2 percent of the households using irrigation according to FAO (2020)). With such phenomena as El Niño and La Niña bringing draughts and floods, "25 percent of farming households experience chronic or temporary food insecurity" (FAO, 2020). Moreover, Nicaragua's mean annual temperature has increased by 0.9˚C since 1960, and it is expected to increase by 3.5 ˚C by 2100 (FAO, 2020). Frequency of hot days and hot nights has also been increasing every season. Furthermore, decreases in precipitation are already affecting the country - precipitation has decreased by 8.4 percent in 2010 relative to the mid-century levels and it is expected to decrease by 36.6 percent by 2100 (WB, 2009).

The purpose of this paper is to assess the economy-wide and distributional impacts (in terms of households' income) of Nicaragua's NDC, as well as more stringent policies to reduce GHG emissions. These scenarios would be considered under various modalities for implementing carbon policies, for example stand-alone country-based policies compared with entering an international carbon trading scheme. Nicaragua's NDC commitment to increase the share of electricity coming from renewable sources could be very regressive, "due to low-income households spending higher shares of their income on electricity and because of inelastic demand" (Claeys et al., 2018). Therefore, the analysis of distributional impacts of carbon reduction policies in Nicaragua is of a major importance.

---

[1] Source: UNFCCC NCD Registry. The unconditional target for Nicaragua is to continue to increase the share of renewables to 60 percent by 2030 as well as to maintain the country's carbon sink at current levels compared to the Business as Usual Scenario (BAU) by 2030. A commitment that it will very likely meet since the generation of electricity from renewable sources is already over 50 percent. The conditional target is to increase the national carbon sink by 20 percent as compared to the BAU scenario.

[2] 13.2 percent of the population still lack access to electricity according to the World Bank (2019a).

[3] Nicaragua's NDC: "Contribución Nacionalmente Determinada a la Mitigación del Cambio Climático (NDC) de la República de Nicaragua ante la Convención Marco de Naciones Unidas sobre Cambio Climático (CMNUCC)".

Government policies designed to fulfill NDC commitment to combat climate change are praiseworthy but they have the potential to harm the poorest households, hence the importance of using a model for a developing country that provides a mechanism to study these effects.

The model that we use for the analysis of climate mitigation policy of Nicaragua is the Mitigation, Adaptation and New Technologies Applied General Equilibrium (MANAGE). MANAGE is a single country recursive dynamic model that has been developed specifically to assess the economy-wide energy system and related greenhouse gas emissions. The model has been calibrated to a 2014 Social Accounting Matrix (SAM) of Nicaragua, the source table contains 118 commodities as well as factors of production such as capital, labor, land and natural resources. It also includes a disaggregation of households by deciles for both urban and rural groups. Nicaragua remains one of the poorest countries in Central America with very uneven income distribution within and across rural and urban regions[4], hence economy-wide policies such as carbon taxes are likely to have highly differential impacts across households.

The scenarios for this paper are the following:

i) A business-as-usual (BaU) scenario where the country maintains its 50 percent share of renewables while GDP grows by 4.6 percent on average for the 2014-2030 period;

ii) In scenario 2 Nicaragua meets its unconditional target of 60 percent of electricity generation coming from renewable sources by 2030, as well as maintains the country's carbon sink at current levels;

iii) Scenario 3 includes additional reduction in emissions consistent with keeping global warming below 2°C;

iv) Scenario 4 projects an increase in the share of renewables by 90 percent by 2030 (in line with the original commitment from Nicaragua); `

vi) In scenario 5, we project an increase in the share of electricity coming from nonrenewable sources due to lower growth given the political instability, which leads to greater emissions, and another lost decade for the country.

To model the scenarios with global collaboration in reaching the emission reduction targets, we link our single country MANAGE model with multi-region general equilibrium model ENVISAGE (van der Mensbrugghe, 2019). Within such linkage, we take global and sector-specific (e.g. emissions' trading in the energy-intensive and trade-exposed sectors) carbon prices from ENVISAGE and impose them within the MANAGE modelling framework.

[4] In 2018, an average per capita income was 5,157 $2011 PPP, with a 2014 Gini index of 46.2, the 29th highest in the world (World Bank, 2019b).