Computable General Equilibrium Modeling of Climate Change Impacts on Agriculture in Latin America

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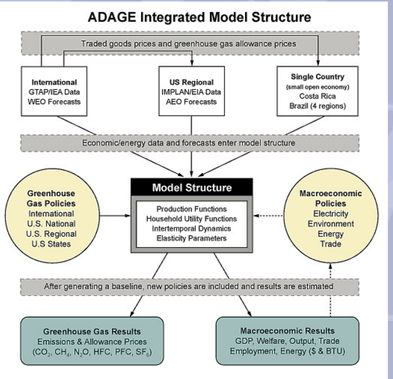


Potential for Impact: Building model to quantify economic impacts, international trade flows, and net GHG emissions under alternative climate scenarios within a global dynamic CGE framework with detailed characterization of agriculture.

1. Background

Climate change is expected to have substantial effects on agricultural productivity worldwide. However, these impacts will vary between commodities as well as across time and space. Therefore, landowners will experience changes in relative returns that are likely to lead them to change land allocation and production practices. In addition, regional variations in impacts can alter relative competiveness across countries and lead to adjustments in global trade patterns.

In this study, we investigate the impacts of climate change on Latin American agricultural production and markets at a macroeconomic level, accounting for climate change impacts on the rest of the world.

2. Methods

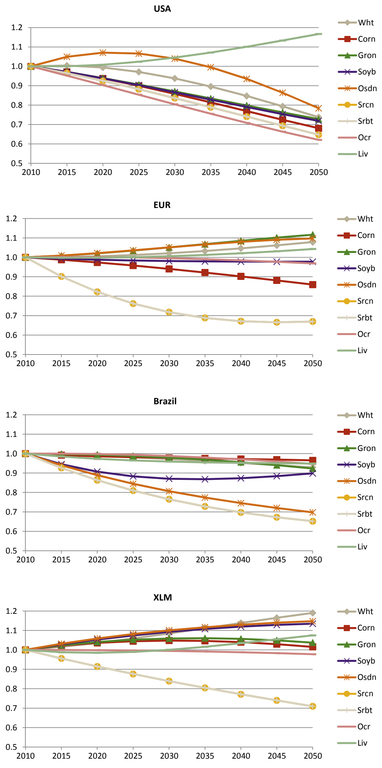
We employ a recursive dynamic version of the Applied Dynamic Analysis of the Global Economy (ADAGE) model with the following key modifications:

- Split out key agricultural sectors from the GTAP v7.1 database where possible and added new sectors where necessary
- Meticulously updated and rebalanced our augmented database to represent a 2010 base year using secondary data sources (IEA, EIA, FAO, and others)
- Updated baseline projections for macroeconomic variables, demand for energy and biofuels, and technical change in agriculture
- Augmented production and consumption structures to include interactions of crops, livestock, forestry, land use, and bioenergy
- Disaggregated world into 27 regions, including Argentina, Brazil, Colombia, Mexico, Uruguay, and Rest of Latin America

3. Climate Impacts Scenario

We use yield effects simulated for 8 different crops and managed pasture under the RCP8.5 scenario using the Hadley GCM and global EPIC crop process model. The simulations were conducted for a global grid, then aggregated to a regional level consistent with the ADAGE regions.

Figure 1. Relative Change in Yields under Climate Scenario for Selected Regions

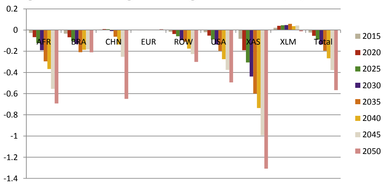


Note: Wht = Wheat, Corn = Maize, Gron = Other Grains, Soyb = Soybeans, Osdn = Other Oilseeds, Srcn = Sugarcane, Srbt = Sugarbeets, Ocr = Other Crops, Liv = Pasture

4. Preliminary Results

- Aggregating to 8 regions for presentation, climate change reduces GDP in all regions in our scenario except for the Rest of Latin America (other than Brazil) region

Figure 2. Change in Regional GDP (%)



- Crop production is generally declining globally for major crops while crop prices increase

Figure 3. Change in Crop Production (%)

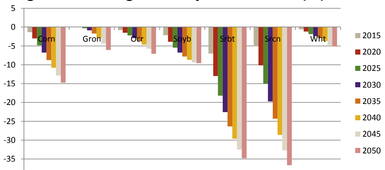
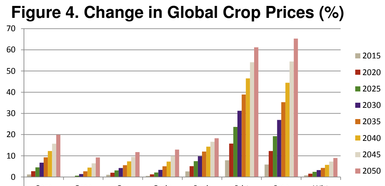


Figure 4. Change in Global Crop Prices (%)



4. Preliminary Results - continued

- However, effects on production vary across regions

Figure 5. Change in Production, Brazil (%)

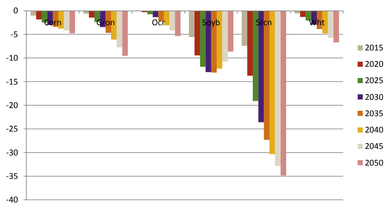


Figure 6. Change in Production, Rest of Latin America (%)

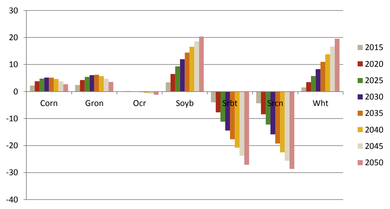


Figure 7. Change in Land Cover, Brazil (%)

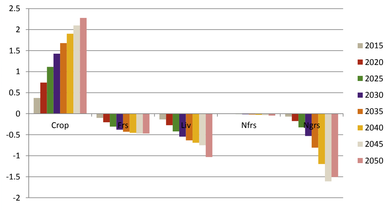
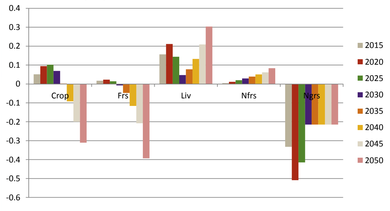


Figure 8. Change in Land Cover, Rest of Latin America (%)



5. Conclusions and Next Steps

- Initial findings indicate important distributional effects as some regions are expected to be more heavily impacted than others
- Different crops within a region face different impacts depending how sensitive they are to changes in temperature and precipitation
- Variations in productivity impacts lead to substantial shifts in production, markets, and trade in Latin America
- Additional research on model dynamics, land conversion costs, GHG accounting, and representation of interactions with global energy and climate policies is ongoing

More Information

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