The Impact of Regionally Differentiated Climate Change on Agricultural Markets in Ethiopia: Combining Climate and Economic Models

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Content

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1 Introduction

Though most current climate models agree that the impact of climate change will be most severe in Africa, there is little agreement on the magnitude and spatial patterns of temperature and precipitation shifts. Analysing the full range of available scenarios, however, indicates that the risk of severe climate change impact is highest in the Sahel, East Africa and Southern Africa. In this paper we use yield effects of several climate change scenarios generated by the Potsdam Institute of Climate Impact Research generated with the vegetation model LPJ and map them to agricultural production activities in a single country CGE model for Ethiopia with a regionalized supply structure. Climate change/LPJ projections include various scenarios, such that regions can be identified which are negatively affected by many scenarios and thus vulnerable to climate change.

2 Research questions

What are the likely effects of climate change on agricultural supply in the different agro-ecological zones of Ethiopia?

What are the likely effects of these supply changes on domestic Ethiopian prices, demand, trade, macroeconomic variables and welfare?

3 Methodology

The Lund-Potsdam-Jena Dynamic Global Vegetation Model (LPJmL) combines process-based, large scale representations of terrestrial vegetation dynamics and land-atmosphere carbon and water exchanges in a modular framework (Bondeau et al. 2007). It forms the basis for simulating yield changes under different climate change scenarios based on global circulation models.

The CGE model applied in this paper is based on the STAGE model developed by Scott McDonald (2007) and a 2005 SAM of Ethiopia. The STAGE model is characterised by several distinctive features. First, the model allows for a generalised treatment of trade relationships by incorporating non-traded commodities as well as imperfect transformability between production for the domestic market and export. Second, the model allows for multiple product activities through an assumption of fixed proportions of commodity outputs by activities with commodities differentiated by the activities that produce them. Hence the numbers of commodity and activity accounts are not necessarily the same. Value added production technologies are specified as nested Constant Elasticity of Substitution (CES). Household consumption expenditure is modelled using Stone-Geary utility functions.

Domestic production uses a two-stage production process. In the first stage aggregate intermediate and aggregate value added (primary inputs) are combined using Leontief technologies. At the second level aggregate intermediate inputs are generated using Leontief technology so that intermediate input demands are in fixed proportions for each activity. Primary inputs are combined to form aggregate value added using CES technology, with the optimal ratios of primary inputs being determined by relative factor prices.

4 Scenarios

The IPCC established the so called SRES emission scenarios (*Special Report on Emissions Scenarios*) in order to account for different potential developments in the 21st century regarding population growth, economic and social developments, technological inventions, environmental management as well as use of resources. Those SRES scenarios are broadly categorized in 4 families, each assuming different socio-economic developments which in turn build the base for potential future green house gas emissions and hence different future climate forecasts (IPCC, 2007). For this paper, the underlying assumption of socio-economic developments from the A1B and B1 scenarios are used. The macro data in the CGE model such as population and income growth are adjusted accordingly. The vegetation model LPJ in turn uses climate input data from the global circulation model ECHAM and the respective Co2-concentration.

Two baseline scenarios, one for each SRES scenario, serve as the so called „no climate change" reference scenarios. Whereby, the A1B scenario is distinguished by a higher income growth compared to the B1 scenario. For both scenarios, however, population growth is equal. In both baseline scenarios, the productivity shifters of the supply functions of all depicted crops are based on yield trend analysis from FAOSTAT data.

5 Anticipated results

We expect results on the effects of climate change on domestic Ethiopian prices, supply, demand, trade, macroeconomic variables and welfare. Due to regional disaggregation of supply and household disaggregation we envisage a disaggregated welfare analysis and the identification of regions and population groups which are at high risk of being negatively affected by climate change scenarios.

6 References

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