CROSS-SECTIONAL STATISTICAL ANALYSIS OF REGIONAL CLIMATE EFFECTS: RICARDIAN ANALYSIS AND EXTENSIONS

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1 Introduction

There is a growing consensus that greenhouse gas emissions will lead to higher temperature and precipitation levels. Not surprisingly, agriculture seems to be the most vulnerable economic sector to such changes. Therefore, it is of paramount importance to understand how climate affects agricultural productivity and profitability.

In the economic valuation of the effects of climate change on agriculture at the national scale, the Ricardian method tends to be the approach most frequently used. Opposed to controlled experiments and related agro-economic simulations, this approach lets the agricultural system itself to reveal its sensitivities and actual adaptive potential (MENDELSOHN ET AL. 1994, MENDELSOHN and DINAR 2009). In essence, the approach is based on empirical evidence: in order to anticipate how climate change might affect the agricultural economy in the future, we can benefit from understanding the impacts of past climate to the agricultural economy of today. This motivation can turn into a working hypothesis by comparing land values and land use structures between areas of different climatic settings.

2 General scope and objectives

Here, we present a DFG-funded project which aims at an economic analysis of the impacts of climate change on the German agriculture by means of the Ricardian approach. Subprojects focus on various empirical, methodological and analytical extensions. The overall output of the project will comprise (a) an identification of land value differentials due to climate differentials, (b) marginal implicit pricing of climate, (c) monetary estimations of future climate change impacts on regional agriculture, and (d) a probabilistic exploration of adaptation responses in terms of farm type choice. Points (a) through (c) have to some extent been examined in the past (e.g., by LANG 2007 and LIPPERT ET AL. 2009). For Germany, point (d) is expected to result in the first econometrics-based adaptation study with national coverage. Completion of the project is expected in the Fall of 2013.

3 Materials and methods

Through a contract with the Research Data Centers of the Federal Statistical Office and the statistical offices of the German states, agricultural data come from the official farm censuses of 1999, 2007 and 2010 (FDZ DER STATISTISCHEN ÄMTER DES BUNDES UND DER LÄNDER 2011). With the exception of the 2007 census, these data refer to all (>400,000) individual farms. Base data on climate come from the National Meteorological Service and refer to observed climatological normals (i.e., 30-year averages) for temperature and precipitation. Processed data on future climate from the regional model REMO (MPI on behalf of the UMWELTBUNDESAMT 2006) are used in simulation exercises. Additional data on socio-economic, topographic, and other characteristics are also used. Data undergo frequent processing that includes interpolation, aggregation, integration and grouping. Empirical assessments are pursued by means of ecological regressions at the county and community association levels.

The analytical framework for this project is multivariate regression. In attempting to explain the association of agricultural land values and land use patterns with climate, we employ both traditional as well as structural Ricardian models. We take explicit spatial econometric as well as limited dependent variable perspectives that allow us to account for potential interactions in land use decision making, and to investigate a spectrum of discrete adaptation responses. Analyses at the county level are performed at the guest scientist workstation of the Statistical Office of Stuttgart, and at the community association level through an iterative remote data system.

4 First results

One subproject examined the effects of different classifications of soil characteristics on the estimation results. In doing so, various soil databases were used. The results of spatial error models at the county level indicated that the climate coefficients remained qualitatively stable. Simulations for the 2011-2040 period showed that projected temperature and precipitation levels will lead to an increase in county-weighted land rents by about 20 percent. Overall, climate change in the near future will have a positive but spatially heterogeneous net effect on agricultural productivity. This conclusion is in accordance with the main finding in LIPPERT ET AL. (2009).

A second subproject had an analytical focus, and examined a number of specification and estimation issues. For example, a specification issue relates to the incorporation of spatial effects into the Ricardian function. This is of particular interest for any hedonic pricing application. An estimation issue, on the other hand, refers to the application of instrumental variable procedures to correct for errors-in-variables problems induced by interpolation. This is of high relevance for any Ricardian study that relies on interpolated climatological normals instead of satellite data. Overall, the study showed that explicit consideration of spatial-autoregressive processes and instrumentation of climatological normals, either distinctly or jointly, can improve the predictive and explanatory power of a Ricardian function.

Sources

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