Geography and Growth: The Role of a Geotec Index on Agricultural Regional Income Convergence

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Regional income convergence has been subject of extensive research over the last decades. A seminal work on income convergence and growth was done by Solow (1956). After that, several papers had examined the characteristics and nature of the convergence process across countries and states, such as Baumol (1986), Barro and Sala-I-Martin (1992, 1997), Mankiw, Weil and Romer (1992), Quah (1996), among others. In Brazil, Azzoni (1997), Ellery Jr. and Ferreira (1996) and Ferreira (1999) have studied income convergence among Brazilian states.

More recently, economic growth models have incorporated geographic variables in their econometric estimations. Variables such as latitude, temperature, rainfall, climate zone and distance from the coast are often used as proxies for geographic variables in growth models. Sachs et al. (2001) had emphasized the distance from sea trade and temperate climate zones as important geographic variables that affect economic growth. Coastal

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regions have easier acess to the sea and are richer. Regions in temperate climate zone have lower rates of infectious diseases and higher rates of agricultural productivity.

Masters and McMillan (2001) introduced new data on climate conditions and found that since 1960 temperate countries have converged towards high levels of income in comparison to tropical nations. Sica (2005) also analysed the relationship between climate and growth in Italian provinces and concluded that some of the climatic variables affected the level of Italian provincial income.

All of the variables used in these studies are called geographic variables without any distinction. However, Fontes (2001) introduced a new concept when dealing with geographic variables, which is to separate them into *active* and *passive* variables. Latitude, temperature, rainfall and climate, normally utilized in growth models, are examples of *passive* geographic variables, since they cannot be modified or controlled by human action. *Active* geographic variables, on the other hand, can be technically changed through time, having, therefore, a significant role in inducing growth and development.

Soils are examples of *active* geographic variables, since technology can modify their use and management. As dynamic components of the environment, the soils can be agriculturally improved with the support of public policies. By doing so, an increase in their production and productivity can be achieved and, consequently, higher agricultural income and growth. This is especially true for less developed regions of the world.

Based on these premises, the objective of this paper is to develop a Geographical-Technological (Geotec) Index for Minas Gerais State, Brazil as an improvement of the geographic variable proxy often used in growth models. The Geotec Index is composed of 3 subindexes, which are Technological Index (based on use of electric power, diseases control, percentage of farms with technical assistance, fertilizer use and irrigation), Land

Suitability Index (based on environmental characteristics, soil chemical and physical properties and possibility of improving natural fertility, water, erosion and agricultural equipments) and Hydric Index (based on excess or deficit of annual rainfall).

The Geographical-Technological Index is an *active* geographic variable, since it can be modified and it can contribute to a convergent or divergent agricultural income behavior in Minas Gerais State, Brazil, diminishing or increasing its regional inequality.

The Barro and Sala-I-Martin (1992) growth model is estimated here with the Geotec Index as a geographic proxy to look at regional agriculture income convergence and growth in Minas Gerais State. County data is used from 66 counties and 853 towns in Minas Gerais State from 1990 to 2001.

The Geotec Index was highly significant to explain Minas Gerais agricultural growth. Results suggest that there is a strong positive relationship between the Geotec Index and high agricultural income and growth in Minas Gerais counties. The highest Geotec Index values are located at West, Northwest, Central, Southeast and South of Minas Gerais State, while the state counties at North, Northeast and East locations had the lowest values. The Geotec Index, on the other hand, is negatively related to poverty in Minas Gerais counties. The paper reveals the importance of the Technological Index , since it can be changed in the lower agricultural income and growth counties to reduce regional disparity in Minas Gerais.The Technological Index components, such as technical assistance to farmers, fertilizers use, diseases control, utilization of irrigation and presence of electric power, can be modified through public policies, increasing productivity and agricultural income in Minas Gerais poor counties.

The absolute convergence hypohesis is rejected and there is evidence of conditional convergence for Minas Gerais counties. Minas Gerais State seems to have two spatial

patterns with respect to agricultural income and they did not change substantially in the analysed period, suggesting the need for public policies.

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