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TITLE: REGIONAL, ECONOMIC, AND ENVIRONMENTAL IMPLICATIONS OF DUAL ETHANOL TECHNOLOGIES IN BRAZIL

AUTHORS: GUERRERO COMPEAN, ROBERTO ; POLENSKE, KAREN R; BIDERMAN, CIRO

EMAIL: rgc@mit.edu

COUNTRY: UNITED STATES

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ABSTRACT:

Much controversy surrounds the future of ethanol. Some environmentalists are adamant that sugarcane ethanol epitomizes a green, effective antidote to climate change that can contribute greatly to global energy independence and agricultural renaissance. Others believe it is an environmental fiasco that not only is socially expensive, but also limits economic development, impairs food security, and presents negative impacts on biodiversity. Brazil is the world's largest producer of sugarcane ethanol. Despite a burgeoning literature on the economic and ecological impacts of Brazil's ethanol industry, analysts have not conducted extensive empirical spatial research to characterize the indirect and regional economic and environmental effects associated with this biofuel's linkages to the rest of the economy. In this paper, we account for the regional differences in the ethanol-making process by relaxing the strong assumption that the ethanol industry is a monolithic manufacturing system devoid of spatial variations in technologies. We investigate how beneficial sugarcane ethanol is as a sustainable form of transport fuel and study the role of geography in innovation in order to determine the reasons behind the coexistence of two contrasting ethanol production technologies. In doing this study, we determine the extent to which the primitive artisanal ethanol production of Northern Brazil differs from the fully automated mechanical manufacture technologies of the South in terms of economic development, income and employment generation, energy consumption, and greenhouse gas emissions. To conduct this study, we construct an economic-environmental model based on a 375-industry interregional input-output system for the Brazilian regions. Based on this approach, we quantify the direct and indirect effects of the regional technology gap in terms of output, jobs, and carbon-dioxide emissions; estimate whether the implementation of labor-intensive ethanol production technologies provides greater output, employment, and income than relatively more capital-intensive technologies; examine which regions benefit the most from a hypothetical expansion of the ethanol sector and which technology alleviates income disparities; establish whether or not ethanol is a more sustainable fuel than gasoline; and determine which technology is more carbon- and energy-efficient. We show that modern ethanol production technologies permeated with

biotechnological innovations provide greater output and employment and lower environmental and energy costs than more traditional technologies and, in contrast, that the implementation of the traditional technology reduces income inequality by increasing the income received by households in economically deprived regions. Also, we determine that ethanol produced with modern technologies generates lower CO2 emissions than gasoline and that, conversely, traditional technologies may produce more CO2 than petrochemical products.