The Effects of Technological Change in Agriculture on Tropical Deforestation: An Economy-wide Analysis of Brazil

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Area expansion in soybean cultivation and beef cattle production are the primary causes of deforestation and land clearing in the Amazon and Savannah regions of Brazil. The environmental damage associated with this process is large and largely irrecoverable, but, as one of two remaining agricultural frontier areas on the planet, the international community increasingly looks to the Amazon/Savannah as sources for meeting future food needs. To help manage this trade-off, policymakers often look to technological change, but what types of product- and perhaps region-specific technological change will likely be most effective in reducing the encroachment of agriculture into frontier areas while still helping to meet global food/feed/biofuel needs is not known. We develop an multi-regional Computable General Equilibrium (CGE) macroeconomic model to estimate the effects of alternative types (e.g., labor-saving versus land-saving) of product-specific technological change for four macro-regional in Brazil. The core of the CGE model is an agriculturally disaggregated and multi-regional Social Accounting Matrix, which links agriculture to other economic sectors within and across macro-regions. Preliminary results suggest that, if short-term capital and labor flows are constrained spatially and across production activities, a 25% increase in total factor productivity (TFP) in agricultural in the Amazon will have a muted response, e.g., output of sugarcane and soybeans will increase by approximately 0.6% and 0.5%, respectively. However, once labor, capital and other inputs are allowed to freely move spatially and across economic activities, responses within the Amazon to the same 25% increase in TRF are much more significant, e.g., coffee production increases by 163% and soybean production increases by 15.6%. Yet, owing to the competitive disadvantage of beef production vis-à-vis other agricultural alternatives, beef output is expected to decline by 28%. A 25% in TFP of all agricultural activities within the Amazon will increase the demand for cultivable land and hence deforestation by approximately 40% in the factor-mobility-constrained short-run and by approximately 130% in the factor-mobility-unconstrained long-run. TFP increases in regions outside of the Amazon region may reduce the demand for the deforested land in the Amazon, but factor mobility will also govern the extent to which and the location of effects. One key policy message is the need for focus on institutional and other impediments to the flows factors of production across all economic activities (not just across agricultural activities) and across macro-regions.