Using Markets to Balance Agricultural Expansion and Forest Conservation

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HOW CAN we balance agricultural expansion and forest conservation in developing countries? Brazil has a productive agricultural sector with potential for expansion and a rich endowment of natural vegetation resources located on private land. According to the last Agricultural Census, Brazilian farms possessed about 98.5 million hectares of forestland (IBGE 2006), a little less than the combined land area of France and Germany. In 1975, when agricultural production was concentrated in southeast Brazil (Figure 1), about 60 percent of farmland was native vegetation. However, since then, technological change and market reforms have enabled national agricultural expansion. By 2006, the share of native vegetation within private properties had decreased to 46 percent (IBGE 1975; 2006).

In this study, we assess Brazil’s application of transferable development rights (TDR), a tradable allowance for the conversion of one hectare of natural vegetation into agriculture and a promising market-based instrument that supports both the conservation of natural vegetation and agricultural expansion. By 2006, the share of native vegetation within private properties had decreased to 46 percent (IBGE 1975; 2006).

The New Brazilian Forestry Code and TDRs
The forestry code, which regulates private property land use in Brazil, aims to preserve the endowment of natural vegetation inside farms given the value of biodiversity and ecosystem services such as freshwater protection and carbon sequestration. The code specifies two land diversion requirements, the legal reserve and the areas of permanent preservation. The legal reserve requirement specifies, at the biome level, the proportion of farmland that must be preserved in the original natural vegetation. The reserve requirement is 80 percent in the Amazon, 35 percent in the Savanna, and 20 percent in the remaining biomes.

The new Brazilian forestry code, approved in 2012 (Law 12.651/2012), allows TDR trading to ensure compliance with land diversion requirements. For example, a farmer with a reforestation gap of 100 hectares could meet his or her obligations either by converting 100 hectares of his or her farm into natural vegetation or by purchasing 100 TDRs in the market. TDR implementation depends on the regulation of the Brazilian TDR market and completion of a national registry of rural properties. All Brazilian farmers must complete their registration by December 31, 2018.

Soares-Filho et al. (2014) integrate multiple data sources at the watershed level to analyze changes to the Brazilian forestry code and estimate the resulting reforestation gap by biome and state. Our analysis extends their work by simulating the potential of the TDR instrument for forestry conservation using farm-level census data. We also estimate the savings in compliance costs using TDRs.

Supply of Forestland
The gains from trading in the TDR market depend on differences in the opportunity cost of forestland; that is, the foregone agricultural profits from keeping land as natural vegetation. We model the opportunity cost of forestland by estimating a land-use model for Brazil using census data and then simulate the share of forestland within each farm at different TDR prices. The result is the supply function of forestland in Brazil. Figure 2 shows the simulated supply functions of forestland for the entire Savanna biome (solid line).
line) and the Savanna biome within the state of Mato Grosso (dotted-and-dashed line). Mato Grosso is important because it is the largest producer of soy and corn in Brazil. The solid line assumes one TDR market for the entire Savanna biome, whereas the dotted-and-dashed line models a TDR market only for Mato Grosso. The dotted line represents a TDR model for Mato Grosso with supply restricted based on the reserve requirements. In such a restricted market, farmers can only sell TDRs for acreage above the required 35 percent share of natural vegetation.

For example, a TDR price of $100 would incentivize Savanna farmers to reforest 17 percent of farmland. The lowest productivity land is reforested first, and the supply function becomes more inelastic as we move to highly productive farmland. The vertical dashed line represents the reforestation gap for Mato Grosso. Soares-Filho et al. (2014) estimate a reforestation gap of 1.6 million hectares in Mato Grosso and 3.7 million hectares in the entire Savanna. This reforestation gap captures demand for forestland implicit in the forestry code. We estimate equilibrium TDR prices of $24, $96, and $156 for the Savanna, Mato Grosso, and Mato Grosso restricted TDR markets, respectively. Without a TDR market, each farmer would have to reforest up to the 35 percent requirement level. We estimate a compliance cost of $1.7 billion for Mato Grosso without TDRs, using median land prices. With a TDR market, the compliance cost reduces to approximately $250 million based on the Mato Grosso restricted market, the most likely design. Implementing a TDR market within a large geographical scope (i.e., crossing state boundaries) is operationally and politically challenging because monitoring and enforcement capabilities vary across states and there is potential for the concentration of agricultural production in a few locations. The implementation of a TDR market at the state/biome level would thus reduce compliance costs by 75 percent in Mato Grosso.

The TDR mechanism incorporates the value of agricultural expansion into an environmental policy to balance environmental and development objectives. Further, the market for TDRs can be extended to incorporate the additional benefits of reforestation such as carbon sequestration and the development of biodiversity corridors.

References