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Consequences of carbon offset payments for the global forest sector

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ABSTRACT

Long-term effects of policies to induce carbon storage in forests were projected with the Global Forest Products Model. Offset payments for carbon sequestered in forest biomass of \$15–\$50/t CO_2e applied in all countries increased CO_2 sequestration in world forests by 5–14 billion tons from 2009 to 2030. Limiting implementation to developed countries exported environmental damage from North to South, as developing countries harvested more, decreasing their stored CO_2e. Substantially more CO_2e was sequestered by allocating a given budget to all countries rather than to developed countries only. As offset payments increased wood prices relatively more than they decreased production, timber revenues generally increased. In the few countries with timber revenues losses they were more than compensated by the offset payments.

Introduction

The last decade has witnessed increasing evidence of global climate change from various observations, ranging from the recession of the snow cap of Kilimanjaro (Thompson et al., 2002) to permafrost and ecosystem changes in the arctic (Hinzman et al., 2005). Furthermore, research suggests a strong causal effect of carbon dioxide (CO_2) concentration in the atmosphere on climate change, marked in particular by a rise in global temperatures (IPCC, 2012; Zickfeld et al., 2012).

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Multiple international initiatives have been taken to reduce the amount of CO_2 present in the atmosphere, by lessening CO_2 emissions and stimulating carbon storage in terrestrial ecosystems. These proposals continue to give a central role to economic incentives and to the strengthening of international carbon markets. They also recognize the importance of initiatives at forest sector level, the need to involve developing countries, and to enhance the role of forestry related activities. In particular, the REDD and REDD+ programs, involving several United Nations agencies and numerous countries, is meant to stimulate "all activities that reduce emissions from deforestation and forest degradation and contribute to conservation, sustainable management of forests, and enhancement of forest carbon stocks" (World Bank, 2011). But, more unilateral policies, especially within developed countries, are also being advocated in the hope of achieving significant results quickly. For example, the EU is trying to extend its climate change law to stimulate remedial action within its member countries (Scott and Rajamani, 2012).

Early studies of the economics of carbon sequestration in forests include Parks and Hardie (1995) development of supply schedules for forests plantations to simulate a national carbon sequestration program. They determine that cost-effective actions should focus on softwood forests on pastureland. More recently, Murray et al. (2003) study the amount of carbon sequestration induced by a policy which is undermined by carbon releases elsewhere (a leakage according to which environmental improvements in regions reducing emissions would be offset by an increased in economic activity and attendant pollution in regions maintaining the status quo). Their results with combined econometric and sector models suggest that leakage cannot be ignored in accounting for the effects of CO_2 mitigation activities in forestry. Latta et al. (2011) use an inter temporal optimization model to study voluntary and mandatory carbon offset programs, with results indicating that sequestration costs are substantially higher than previously estimated. Based on simulations of the French forest sector model Lecocq et al. (2011) find that a policy of payments for carbon sequestration *in situ* is the only one that performs better than no intervention, compared to policies that substitute wood products for other energy sources. Among the international studies, Sohngen and Mendelsohn (2005) use an optimal control model of carbon sequestration and energy abatement to determine the potential role of forests in greenhouse gas mitigation. They find that although carbon sequestration is costly, forests can sequester about one-third of total carbon abatement, over two-thirds of which in tropical forests. van Kooten et al. (2004) present a meta analysis of published costs of carbon offsets in forests and conclude that "forest sink projects are competitive with other means of reducing atmospheric CO_2".

The objective of this study was to project the long-term effects of economic policies to induce carbon storage in forests, for the world and for major regions and countries. The projections dealt with the effects on the quantity of carbon dioxide equivalent (CO_2e) sequestered in forests and with the effects on forest product markets. The projections were done for different levels of offset payments, thus yielding supply curves for carbon sequestration, and for policies that applied offset payments in all countries or in developed countries only, with estimates of the attendant leakages and inefficiencies.

Methods

Theoretical framework

Fig. 1 illustrates the principle of the simulations carried out to project the consequences of offset payments for CO_2e sequestered in forests. For simplicity, the figure refers to one single product, wood, supplied and demanded in two world regions. Before any offset payment, the excess supply in region 1, S_1 minus D_1, matches the excess demand in the other region, D_2 minus S_2. The equilibrium price is P (for simplicity we ignore the transport cost which does not affect the argument). The effect of the offset payment for carbon sequestered in forest biomass is to increase the marginal cost of harvesting wood by an amount equal to the offset payment per unit of harvested volume, c, that could be earned by not harvesting. This payment can be envisioned as an annual rent per unit of increase in permanently stored wood, equal to cr, where r is the interest rate.

Consequently, the supply curve with offset payments shifts from A to B. This leads to a new equilibrium indicated by the dashed lines in Fig. 1. The world price increases to P'. However, the price increase is less than the offset payment, c, as the system reacts in a direction that tends to restore