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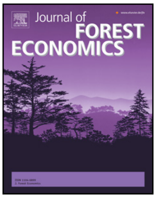

Is forest carbon sequestration at the expense of bioenergy and forest products cost-efficient in EU climate policy to 2050?

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ABSTRACT

Forest management affects the quantity of CO_2 emissions in the atmosphere through carbon sequestration in standing biomass, carbon storage in forest products and production of bioenergy. The main question studied in this paper is whether forest carbon sequestration is worth increasing at the expense of bioenergy and forest products to achieve the EU emissions reduction target for 2050 in a cost-efficient manner. A dynamic cost minimisation model is used to find the optimal combination of carbon abatement strategies to meet annual emissions targets between 2010 and 2050. The results indicate that forest carbon sequestration is a low-cost abatement method. With sequestration, the net present costs of meeting EU carbon targets can be reduced by 23%.

Introduction

Forests are important from a climate perspective because they allow carbon to be sequestered in standing biomass or stored in forest products. Alternatively, forests can produce bioenergy to replace

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fossil fuels. Several studies show that sequestration accounts for 10–50% of emissions reductions globally in a cost-efficient climate policy (Bosetti et al., 2009; Murray et al., 2009; Sohngen, 2009). It is therefore important to recognise the abatement potential of forests in climate policy. Despite the high potential and relatively low cost of sequestration, it has only partially been included in international climate agreements such as the Kyoto Protocol.

The EU climate policy framework does not recognise emissions reductions in the forest sector, apart from bioenergy. The main reasons put forward are lack of appropriate and harmonised data due to measuring and monitoring problems and non-harmonisation of reporting methods across EU countries (European Commission, 2012a). However, forest carbon sequestration can be a more effective method for reducing emissions than bioenergy (e.g. Johnson, 2009; Hudiburg et al., 2011; Holtsmark, 2012; Lundgren and Marklund, 2012; Schulze et al., 2012), as bioenergy is not carbon neutral in the short term, although it may be in the long term (European Union, 2003; Petersen and Solberg, 2005; Bright and Strømman, 2009; Sjølie et al., 2010). There are two explanations for the lack of carbon neutrality: (i) There is a long time-lag between biomass combustion, when emissions are emitted to the atmosphere, and forest regrowth, when emissions are sequestered; and (ii) a certain amount of carbon is emitted to the atmosphere from harvesting, transporting and processing biomass. As long as forest carbon sequestration is not accounted for in EU climate policy, there is a risk that European forests will become a carbon emissions source rather than a sink in the future (Böttcher et al., 2012; Kallio et al., 2013).

In a long-term perspective, the European Commission (2011) has proposed a roadmap for moving to a competitive, low-carbon economy by 2050. This roadmap proposes reductions in greenhouse gases in the range of 80–95% by 2050 compared with the level in 1990. It focuses on achieving this range cost-efficiently, implying that the inclusion of low-cost abatement options such as forest carbon sequestration needs to be evaluated.

The main purpose of this study is to assess whether it is worth increasing the amount of forest carbon sequestration at the expense of bioenergy and forest products to cost-efficiently achieve the EU carbon emissions reduction target for 2050. The topic of interest is thus the additional sequestration achieved when forest harvesting rate is reduced compared with the current level. Standing biomass, forest products and bioenergy are closely connected in physical terms, but their impacts on carbon release and uptake differ. Deployment of one of these abatement methods means an equivalent change in one or both of the other two. Moreover, policies need to consider the relative costs of sequestration and fossil fuel reductions. Therefore, abatement in the fossil fuel sector is also part of the model. For the assessment, a dynamic programming model is used in which abatement costs are minimised subject to the achievement of an 80% reduction in CO_2 emissions by 2050 compared with the level in 1990. The benefit of using a dynamic model is that the non-linear natural growth of forests can be accommodated.

Our modelling approach derives from previous work in the field of cost-efficient abatement strategies to reduce greenhouse gas emissions in land use sectors and our empirical application relates to choices between abatement methods in the forest sector. When modelling cost-efficient abatement strategies, many studies take a static perspective (e.g. Dixon et al., 2008; Eliasch, 2008; Gren et al., 2012), while Van der Werf and Peterson (2009) highlight the importance of covering several decades to accommodate the dynamic effects because forest biomass follows a non-linear growth path at stand level. Dynamic optimisation models covering different geographical areas and levels of aggregation are presented by Adams et al. (1996, 1999), Alig et al. (1997), Van Kooten (1999), Gielen et al. (2002), Sohngen and Mendelsohn (2003), Van't Veld and Plantinga (2004), Lee et al. (2005), Sathaye et al. (2005), Rokityanskiy et al. (2007), Tavoni et al. (2007), Schneider et al. (2008), Latta et al. (2013) and Eriksson (2015). These models incorporate forest carbon sequestration by means of a non-linear forest biomass growth function, which varies between models with regard to functional form and accompanying parameter values. We follow Van Kooten (1999) by using an exponential function for biomass volume that reflects natural growth. At any point in time, the level of sequestration in forests then depends on forest biomass growth and endogenously determined harvests, i.e. harvests quantified within the model. Most of the models presented in the studies cited above have endogenously determined harvests, although Gielen et al. (2002) and Sathaye et al. (2005) do not provide any details on how harvests are modelled. Our specification of abatement costs follows Adams et al. (1996, 1999)