Journal of Forest Economics 20 (2014) 1–16

Contents lists available at ScienceDirect

Journal of Forest Economics

journal homepage: www.elsevier.com/locate/jfe

The economic costs of avoided deforestation in the developing world: A meta-analysis

Thu-Ha Dang Phan [a,b,*], Roy Brouwer [b], Marc Davidson [a]

[a] Institute for Biodiversity and Ecosystem Dynamics, University of Amsterdam, The Netherlands
[b] Department of Environmental Economics, Institute for Environmental Studies, VU University Amsterdam, The Netherlands

ARTICLE INFO

Article history:
Received 30 August 2012
Accepted 19 June 2013

JEL classification:
Q23

Keywords:
Avoided deforestation
Opportunity costs
RED
Carbon storage
Climate change mitigation
Meta-analysis

ABSTRACT

This meta-analysis aims to identify the key factors governing the economic costs of avoided deforestation in developing countries. To this end, data were collected from 32 primary studies published between 1995 and 2012, yielding 277 observations. Results show that unit costs depend significantly on cost features like estimation methodology, inclusion or exclusion of cost components, carbon accounting method, area size, alternative land uses and beneficiaries, time horizon, and the continent in which the forest protection scheme is implemented, but also factors like the share of agriculture in a nation's economy play a significant role in explaining unit costs. In future studies, greater attention needs to be paid to additional cost components like transaction costs and the presence of the co-benefits of avoided deforestation.

Introduction

The avoidance of deforestation has major potential as a means of tackling global climate change (IPCC, 2000; Houghton, 2005; Stern, 2006; Nabuurs et al., 2007; Eliasch, 2008). The most important reason for this is that deforestation is one of the largest sources of anthropogenic greenhouse gas emissions (Nabuurs et al., 2007). According to Houghton (2005), deforestation accounts for a quarter of all such emissions. Secondly, deforestation can be avoided at relatively modest cost compared with alternative carbon emission abatement measures in other economic sectors. What makes avoided

* Corresponding author. Tel.: +31 020 525 7761.
E-mail address: d.t.h.phan@uva.nl (T.-H. Dang Phan).

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http://dx.doi.org/10.1016/j.jfe.2013.06.004

deforestation economically competitive is that no new technology is required to facilitate action and opportunity costs are likely to be low, since deforestation occurs mainly in tropical developing countries (Sedjo et al., 1995; van Kooten et al., 2004; Hope and Castilla-Rubio, 2008).

In his review of 29 regional empirical studies, Boucher (2008) found that the costs of reducing emissions from deforestation (RED) in developing countries compare favourably to parallel costs in fossil fuel sectors and are lower than current carbon prices in the European Union's Emissions Trading Scheme (ETS). Besides reducing carbon emissions, avoided deforestation also delivers other benefits, such as biodiversity conservation and watershed and soil quality protection (Sedjo et al., 1995; Chomitz and Kumari, 1998; Ebeling and Yasué, 2008; Stickler et al., 2009; World Bank, 2011; Strassburg et al., 2012). In this respect, RED avoids the drawbacks of other forestry-related options to reduce emissions, such as afforestation and reforestation, which tend to favour monoculture over the preservation of exotic species (Brown et al., 2008). In practice, however, taking these additional benefits into account may well increase transaction costs, while the extent to which RED can deliver co-benefits is very much context-dependent (Ebeling and Yasué, 2008; Strassburg et al., 2012).

Until now, the costs of reducing carbon emissions in the forestry sector have been systematically reviewed using mainly qualitative approaches (Sedjo et al., 1995; Chomitz and Kumari, 1998; van Kooten et al., 2004; Ebeling and Yasué, 2008; Stickler et al., 2009; World Bank, 2011). To our knowledge, there are only two studies in which such a review has been based on quantitative meta-regression models. van Kooten et al. (2004) initially reviewed 55 studies, followed by van Kooten et al. (2009), who examined 68 studies covering a wide range of literature published between 1989 and 2007. These meta-analyses are helpful in synthesizing the empirical findings of a large number of studies, as they quantify and explain the costs of various types of forestry activities on a global scale in developed and developing countries, including avoiding deforestation, afforestation, reforestation and more general forest management. Given the breadth of these two existing meta-analyses in both the developed and developing world, however, they allow for less detailed investigation of relevant issues in a specific context, for instance the costs and co-benefits of RED in developing countries.

The present study performs a new meta-analysis, the main objective of which is to assess and explain the relationships between the unit cost of avoided deforestation and its main driving factors in developing countries, which have continued to witness large-scale deforestation over the past decade (FAO, 2010). Besides presenting an update of existing studies up to and including 2012, the meta-analysis presented here builds on the two earlier meta-analyses by including new variables, with the aim of further explaining the observed variation in the cost estimates of avoided deforestation. These new variables relate to factors 'internal' to the studies themselves, such as inclusion of additional cost components like transaction costs, co-benefits of forest conservation, alternative land uses and beneficiaries of non-forested land uses, and 'external' factors taken from sources outside the studies, such as past and current deforestation rates in the study area and the share of agriculture in Gross Domestic Product (GDP), as an indicator of an economy's dependence on agriculture and corresponding influence on opportunity costs.

This article is structured as follows. Section "Methodology" presents the methodology of our meta-analysis. In Section "Data description" we describe in detail the data set employed in the meta-regression model. The main results derived from the meta-analysis and their economic implications are discussed in Section "Estimated meta-regression model". Section "Conclusion" concludes the article.

Methodology

Meta-analysis is the statistical evaluation of the findings of empirical studies, and is a useful tool for extracting information from large amounts of data in order to provide quantitative underpinning for a more comprehensive assessment (Glass et al., 1981). It is a means of synthesizing the results of multiple studies examining the same phenomenon through identification of a common effect, which is then explained using regression techniques in a meta-regression model (Nelson and Kennedy, 2009). It enables researchers to explain differences in the outcomes of individual studies in terms of differences in underlying assumptions and standards of design or measurement (Wolf, 1986). As such, meta-analysis is an important extension of and supplement to more qualitative analysis. It is