Journal of Environmental Management 132 (2014) 79–86

Contents lists available at ScienceDirect

Journal of Environmental Management

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

The physical, economic and policy drivers of land conversion to forestry in Ireland

Vincent Upton*, Cathal O'Donoghue, Mary Ryan

Rural Economy and Development Programme, Teagasc, Mellows Centre, Athenry, Co. Galway, Ireland

ARTICLE INFO

Article history:
Received 15 February 2013
Received in revised form
27 August 2013
Accepted 20 October 2013
Available online 27 November 2013

Keywords:
Afforestation
Land-use change
Policy conflicts
Spatial panel model

ABSTRACT

Land use change is fundamentally a product of the interaction of physical land characteristics, economic considerations and agricultural and environmental policies. Researchers are increasingly combining physical and socio-economic spatial data to investigate the drivers of land-use change in relation to policy and economic developments. Focusing on Ireland, this study develops a panel data set of annual afforestation over 2811 small-area boundaries between 1993 and 2007 from vector and raster data sources. Soil type and other physical characteristics are combined with the net returns of converting agricultural land to forestry, based on the micro-simulation of individual farm incomes, to investigate land conversion. A spatial econometric approach is adopted to model the data and a range of physical, economic and policy factors are identified as having a significant effect on afforestation rates. In addition to the financial returns, the availability and quality of land and the implementation of environmental protection policies are identified as important factors in land conversion. The implications of these factors for the goal of forest expansion are discussed in relation to conflicting current and future land use policies.

1. Introduction

Land-use change modelling requires combining both physical and economic spatial data if it is to be used to understand policy developments and predict future land-use changes (Seto and Kaufmann, 2003). In the absence of data concerning the economic implications of land-use decisions, interpreting historic change, particularly in relation to policy developments, poses a significant challenge (Bockstael, 1996). Although physical drivers of land conversion may be identified, the causal relationship between characteristics and change may be less clear (Irwin and Geoghegan, 2001). This is perhaps of most relevance in enterprises where state and regional policies have a defining and widespread impact, such as agriculture and forestry. Despite the recognition of the importance of including economic data in spatial models researchers may be constrained by the existence of data or the scale at which data are available. In agricultural research, spatial data on farm incomes at the individual or local level may be limited. One approach to overcoming this issue is to simulate individual farm data from broader regional or national data (O'Donoghue et al., 2012).

Increasing forest cover is a common goal internationally and has been supported within European agricultural policy for a number of decades (Nijnik and Bizikova, 2008). Land conversion to forestry is a complex issue that is influenced by social, economic and environmental factors that policy-makers should account for in the development of forest policy and the setting of targets (Beach et al., 2005). Thus, understanding afforestation requires combining multiple sources of data within a modelling approach that ideally accounts for both the spatial and temporal nature of the phenomenon. Spatial econometric models offer the potential to investigate and quantify the effects of these factors on land conversion while explicitly addressing the spatial nature of the data (Radeloff et al., 2012).

1.1. Land conversion to forestry

Afforestation is increasingly valued for its potential to enhance ecosystem services and is being actively promoted in many countries through state policy and support (Kanowski, 2010). Forest cover expansion is included as a source of carbon dioxide emission reduction under the Kyoto Protocol, which is a significant factor in the promotion of forest expansion policies (Nijnik and Bizikova, 2008). Similar to many countries, Ireland has sought to increase its forest cover for some time with rural employment and economic diversification benefits being important drivers in the 20th century and ecosystem services being increasingly recognised in modern forest policy (Department of Agriculture, Food and Forestry, 1996; OCarroll, 2004).

Ireland offers a particularly interesting example of forest expansion policy as it possesses one of the lowest areas of forest cover in

* Corresponding author. Tel.: +353 91 845238.
E-mail address: vupton@gmail.com (V. Upton).

0301-4797/$ – see front matter © 2013 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.jenvman.2013.10.017

Europe, despite possessing excellent growing conditions for commercial forestry, and a history of ambitious afforestation policies (OCarroll, 2004). Current forest cover stands at 10.9% with the majority of this area composed of plantation forests established in the last hundred years. The goal of state policy is to increase forest cover to 17% by the year 2030 through private planting (Department of Agriculture, Food and Forestry, 1996). Historical afforestation policies and establishment in Ireland have a distinctive locational bias defined by the quality of the underlying land (Upton et al., 2012). Initial efforts by the state to expand forest cover were enthusiastic but poorly planned and resulted in relatively low levels of planting (OCarroll, 2004). Planting was limited to sub-marginal land, often at higher elevations with peat soils. Although grants for planting by private landowners were available, private afforestation was limited until the late 1980s when annual premiums were introduced under the Western Package Scheme which was co-funded by the EU (EU Regulation No. 1820/80). These payments compensated private landowners, for a limited period of time, for lost agricultural income as forests developed. This resulted in a significant increase in afforestation by private landowners (Fig. 1). Supports for planting by state agencies were removed in the mid-1990s, which essentially saw the end of public planting. Initially policies for private planting specifically targeted agriculturally disadvantaged parts of Ireland. Since 1992 a consistent policy of grants and annual premiums for 20 years open to all private landowners, but with higher rates for farmers, has been in place. Ireland benefited from funding for afforestation by the EU under the Community aid scheme for afforestation from 1992 (Council Regulation (EEC) No 2080/92) and under support for rural development from 2000 (Council Regulation (EC) No 1257/1999). The availability of grants and premiums makes forestry a financially attractive enterprise for many farmers but particularly those engaged in extensive livestock rearing (Breen et al., 2010). However, annual afforestation rates have been variable and declining since 2005.

Plantation forests can achieve high productivity rates even on poorly drained mineral soils (Farrelly et al., 2011), giving forestry a greater competitive advantage on poorer quality soils. Nonetheless, farmers have been reluctant to plant forestry due to a range of factors, including the non-pecuniary costs, related to a change in land use and lifestyle. Although the Irish public support and value afforestation greatly, farmers may view forestry as a less desirable land use (Upton et al., 2012). Land conversion to forest by private landowners is a complex issue with multiple underlying causes, including, but not limited to, the incentives and restrictions of state policies (Beach et al., 2005). The effects of policy changes and market conditions on afforestation rates in Ireland have been explored using time-series and panel data (McKillop and Kula, 1987; McCarthy et al., 2003). In general such studies find that the profitability of agriculture and forestry are significant factors in determining afforestation rates. Researchers have examined afforestation in Ireland on the county level but failed to account for the spatial nature of the data in the modelling process or the physical characteristics of the land (McCarthy et al., 2003). Examinations of private afforestation in Ireland have shown that land quality is a defining aspect of the decision-making process by farmers (Ní Dhubháin and Gardiner, 1994; Howley et al., 2012). Land quality underlies the productivity and profitability of alternative land uses, making it an essential element in understanding land conversion. In addition, forestry has been recognised as an enterprise only "suitable" for the worst quality land by landowners (O'Leary et al., 2000). This may be driven by the belief that land should be used for the production of food if at all possible rather than an aversion to forestry per se (McDonagh et al., 2010). However, strong negative views of afforestation have been identified in parts of Ireland, particularly those that saw a rapid expansion of forest cover over a relatively short time-period (O'Leary et al., 2000).

It has been suggested that conservation policies related to protected habitats or species have reduced annual afforestation rates and discouraged applications from relevant areas (Collier et al., 2002). The EU habitats (92/43/EEC) and birds (79/409/EEC) directives resulted in the identification of special areas of conservation and special protection areas, which complemented the Irish specification of natural heritage areas. Habitats and species related to these areas are given legal protection and applications for afforestation funding within these areas require approval from the Irish National Parks and Wildlife Service. Forests can increase soil acidity through their capacity of trees to scavenge industrial air pollutants or sea-salts (Dunford et al., 2012). Where this occurs on soils with poor buffering capacity adjacent water-ways may become acidified. The Forest Service in Ireland has identified areas that are considered at risk of acidification due to the poor buffering capacity of the soil and afforestation is controlled in these areas.

1.2. Spatial models of land conversion

Spatial models of land-use change are employed to gain greater insight into the drivers of change, the effectiveness of policies and

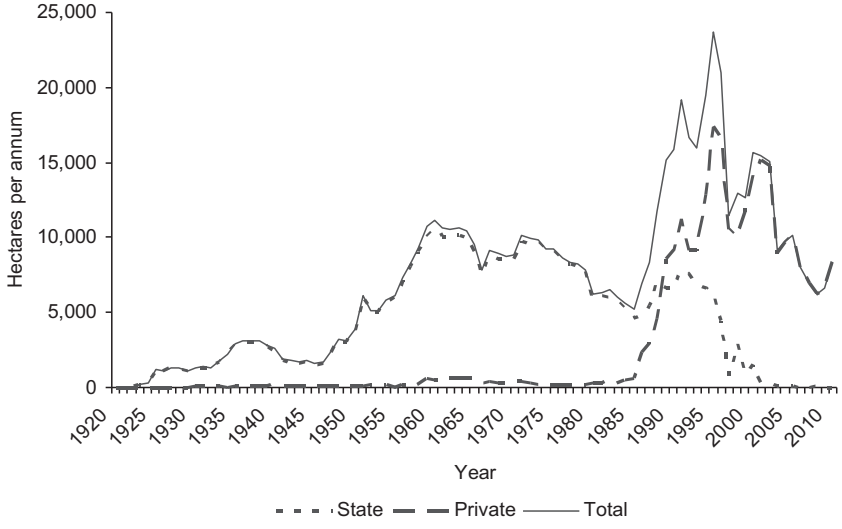

Fig. 1. Annual afforestation rates in Ireland 1923–2010.