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Forestry in the Republic of Ireland: Government policy, grant incentives and carbon sequestration value

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ABSTRACT

Recent decades have seen a rapid increase in the area of privately owned forest plantations in Ireland. This has been largely driven by grant aid and annual premium payments from the government and the European Union. These forests are significant carbon sinks and as such are delivering added benefit to the country by contributing to greenhouse gas reductions under the Kyoto Protocol.

The direct impact of government subvention on the net present value (NPV) for a defined forestry plantation is investigated. The added value of carbon sequestration to forestry investment is also examined using the Forestry Commission (Great Britain) carbon model. Extending the typical assumption of a constant carbon price for project appraisal purposes, this paper allows carbon prices to evolve randomly according to a flexible stochastic price process. The model chosen is an extended mean-reverting jump-diffusion with the flexibility to capture the higher order statistical features (i.e. skewness and kurtosis) of the carbon markets. This allows for an analysis of the risk and uncertainty around the NPV from exposure to stochastic carbon prices. It is shown that government grants and annual premiums for afforestation significantly improve the NPV on forestry investment. Carbon sequestration is shown to add further value.

Introduction

For many centuries the story of forest cover and forest use in Ireland was largely one of decline and exploitation with the result that at the turn of the twentieth century less than 1.5% of the land area was under forest (Pilcher and Mac an tSaoir, 1995). This situation has been reversed as a result of a succession of state afforestation programmes and by 2007 the total forest area was 737,446 ha or 10.2% of the land area (Duffy et al., 2012). Until the mid-1990s these areas were largely dominated by the state sector. However, since that time the situation has reversed with afforestation being almost totally dominated by the private sector and farmers in particular. A key factor stimulating the participation of farmers in afforestation has been the availability of government grants and annual premiums (Collier et al., 2002), which provide financial support to cover establishment costs and annual payments to compensate farmers for the income forgone when agricultural land is afforested. These policies have been very successful and the private forest area now accounts for 43% of the forest estate. The high rate of afforestation in the last 20 years is reflected in the age class structure, with approximately 62% of plantations being less than 20 years old. Coniferous species account for 74% of the total forest area, with broadleaf species comprising the balance.

In the initial decades of plantation forestry, the principal aim of afforestation was to provide timber and was the only use envisaged for forests (OCarroll and Joyce (2004)). Later, forests were seen to have a social role through the provision of employment in rural areas. This was then followed by recognition of the recreational role of forests. Other functions of forests have become increasingly recognised, such as wildlife and biodiversity conservation, water quality, and carbon sequestration. Since the 1990s, sustainable forest management has moved to centre stage (Farrell and Byrne, 2002) and criteria for sustainable forest management were put in place through the Irish National Forest Standard (Forest Service, 2000).

Climate change policy, particularly national commitments under the Kyoto Protocol, has stimulated interest in carbon sequestration in forests (Byrne, 2010). In the past decade, considerable advances have been made in the understanding of carbon dynamics in Irish forests and this research has supported the development of a national carbon accounting system for forests (Byrne, 2010). For example, Black et al. (2009) reported that carbon sequestration in first rotation Sitka spruce stands reaches a maximum of

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9 t C ha^{-1} yr^{-1} before the time of first thinning and subsequently declines to 2 t C ha^{-1} yr^{-1}. Similar values have been reported in the United Kingdom (7 t C ha^{-1} yr^{-1} at canopy closure to 3 t C ha^{-1} yr^{-1} in older stands) (Kowalski et al., 2004; Magnani et al., 2007), while values for coniferous stands across Europe tend to be lower (0.2 –6.5 t C ha^{-1} yr^{-1}) (Magnani et al., 2007).

As mentioned above, the Kyoto Protocol has been a key driver in relation to forestry and greenhouse gas emissions. As a party to the Protocol, Ireland committed to limiting its greenhouse gas emissions during 2008–2012 to 13% above 1990 levels. Under Article 3.3, carbon stock changes due to afforestation since 1990 can be used to offset emissions (Byrne, 2010). As a country with an active afforestation programme, Ireland was well placed to take advantage of this. For example, Hendrick and Black (2009) estimated that afforestation since 1990 sequesters some 2.0 million tonnes CO_2 per year. However, maintaining this carbon sink, and associated climate change mitigation benefits, requires a sustained afforestation programme. The problems associated with a falling afforestation rate have been demonstrated by Hendrick and Black (2009) who found that if the annual afforestation rate falls to about 7500 ha then by 2035 these forests will be net sources of carbon. The reason for this is that by this time forests planted during the afforestation peak in the mid-1990s will have entered the harvesting cycle, with consequent reductions in carbon stocks, and the areas of younger forests will not be sufficient to sequester enough carbon to negate these losses. In addition to carbon sequestration in biomass and soil, forests can deliver other greenhouse gas mitigation benefits including carbon sequestration in harvested wood products (Donlan et al., 2012), and substitution of fossil fuels and energy intensive materials such as steel and concrete with forest biomass (Poudel et al., 2011).

Currently the financial incentives for afforestation do not include any specific consideration of the economic value of carbon sequestration. Given the pressures on public finances, there is a need to reconsider mechanisms to fund afforestation. Also, as currently stands, forest owners do not own the credits accruing from carbon sequestration in their forests. However, if emissions offsetting schemes are introduced to agriculture in the future, farm forests may have a key role in determining the carbon footprint of agricultural enterprises. Furthermore, if it becomes permissible to trade removal units (RMUs) issued against forest carbon sink activity within the European Union Emissions Trading Scheme then it will become especially necessary to factor in carbon sink value as part of appraising investment in afforestation. To the best of our knowledge the only study of this to date has been that of Kula (2010) who used a cost–benefit analysis of an afforestation project in Northern Ireland to assess the impact of carbon sequestration on the economic rate of return. It is against this background that this study was conducted, with the following objectives:

1. To examine the direct impact of government subvention on the net present value (NPV) for a defined afforestation project over one rotation under the following three key scenarios: (i) farmer without grant and premiums; (ii) farmer with grant and premiums; and (iii) non-farmer with grant and premiums.
2. To examine the added value of carbon credits for the above scenarios using the Forestry Commission (Great Britain) model (Morison et al., 2011) to simulate carbon sequestration in Irish forests.
3. To extend the related paper of Kula (2010), which investigates the Internal Rate of Return (IRR) of a forestry plantation in Northern Ireland. Whereas Kula (2010) assumes a constant carbon price over the project appraisal period, this paper relaxes this constraint and allows the carbon price to evolve randomly, according to a flexible stochastic price model. An extended mean-reverting jump-diffusion model is considered, with the flexibility to capture the statistical features of carbon prices, including the higher order effects of skewness and kurtosis. This allows for an analysis of the risk and uncertainty around the project NPV resulting from exposure to stochastic carbon prices.

Table 1
Establishment and management costs.

Year	Details	Cost ha^{-1} (€)
0	Establishment	2500
4	Cleaning/filling	750
5–20	Insurance (per annum)	10
15	Inspection path	350
16	Roading	275
1–47	Management fees (per annum)	5

Table 2
Establishment grants.

Year	Amount ha^{-1} (€)
1	2500
5	750

Materials and methods

Afforestation costs and inputs

Costs were included for establishment, vegetation management and filling-in, insurance, installation of inspection paths, roading and management fees (Table 1). Grants are administered through the afforestation scheme of the Department of Agriculture Food and the Marine with the payment of an afforestation grant (Table 2) on successful establishment of the plantation and an annual premium for 15 or 20 years depending on the status of the applicant (farmer or non-farmer; Table 3) and land status (enclosed or non-enclosed) (see Department of Agriculture Food and the Marine, 2012).

A plantation of 10 ha is assumed with Sitka spruce (*Picea sitchensis* (Bong.) Carr.) planted on 9 ha and ash (*Fraxinus excelsior* L.) on 1 ha. The soil type is assumed to be surface water gley as these are considered representative of mineral soils afforested post 1990 (Black et al., 2009). According to biodiversity requirements, 10% of each area must remain unplanted, with roads assumed to be constructed on this area. Therefore, the productive forest area will be 8.1 ha for Sitka spruce, and 0.9 ha for ash. The yield class for Sitka spruce and ash is 22 m^3 ha^{-1} a^{-1} and 8 m^3 ha^{-1} a^{-1} respectively. The yield class for Sitka spruce used here is similar to that reported by Black et al. (2009) for Sitka spruce plantation on surface water gley soils in central Ireland. Regular thinning is also assumed to be in place along with clearfell, which will be followed by two years of fallow before replanting. Tables 4 and 5 present the thinning, clearfell and replanting cash flows for Sitka spruce and ash respectively. The assumption of replanting is made as this is mandatory under the Forestry Act, 1946.

Carbon flow modelling

Stand level carbon flow was simulated using the Forestry Commission (Great Britain) model (hereafter referred to as the FC model). This model is developed from the forestry yield tables

Table 3
Annual premiums.

Year	Status	Amount ha^{-1} (€)
1–20	Farmer	427
1–15	Non-farmer	181