A Cost-Benefit Analysis of Forestry in the British Isles: The Case of Northern Ireland

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Abstract: The British Isles are one of the most favourable locations for afforestation in Europe. Their mild and moist climate and soil types are ideal for tree growth. Despite their comparative advantage, however, the islands are the second baldest spot in Europe, with tree coverage only about 7 percent of the total land surface. The main reason for the neglect of forestry in the islands is that the ground rules laid down to evaluate public sector investments in the UK proved to be unsuitable for afforestation projects, which are mostly carried out by the government. Those rules, erroneously, made forestry a low return investment. In the face of recent developments in the theory of social time discounting, this paper reevaluates the worth of forestry projects in the UK with illustrations from the case of Northern Ireland.

Historical Background

Of all European countries, the British Isles have the best combination of climate and soil types for tree growth. Ironically, the islands are among the baldest spots in Europe, with tree coverage only about 7 percent of the total land surface, as opposed to over 15 percent in Greece, Turkey, and Spain; 20 percent in France; 29 percent in Germany and Norway; and 74 percent in Finland. Given the comparative advantage of the islands for the growth of forest trees, why are they the least forested area in Europe? The answer to that question lies in the history of the islands.

Until the 15th century, the British Isles were covered with thick forests. From then on, forests were steadily destroyed—for two main reasons. First, many of the forests located on fertile soils were cleared for agricultural expansion to support the growing population. Second, many of the forests were cleared to provide fuel for the iron smelting industry, especially in the 16th and 17th centuries. At the end of the 17th century, turf firing had to be introduced in many areas in place of wood. Around that period, a traveller to Scotland wrote that "...a tree in here is as rare as a horse in Venice" (Thompson, 1971). Anxiety prevailed among the naval experts; the country was eating too rapidly into its timber resources. At the time, wood was the most important raw material in shipbuilding, which was indispensable for a maritime nation like Britain. Towards the end of the 17th century, forests were reduced to a negligible area. Around that period, forests revived in many parts of the British Isles. The British aristocracy realized that woodlands were a desirable source of wealth and amenity, which led to extensive planting for commercial and ornamental purposes. Forests in private estates were retained generation after generation for sentiment and prestige. Selling trees was usually an indication of the decline of the family. The decline of private forests began around the middle of the 19th century, a time when landlords, for various reasons, were in financial difficulties. Travelling mills moved into many estates to clear the land. At the turn of this century, the destruction was complete, and the onetime forest-rich islands became the baldest spot in Europe. Forest coverage in Ireland and Scotland was less than 2 percent of the total area.

In 1903, an important year for forestry in the British Isles, a forestry branch of the Department of Agriculture was established in Ireland to train practical foresters. The Department also bought land in many parts of Ireland in order to establish forestry centres with a view to afforestation. Unfortunately, World War I put a stop to the expansion of forestry projects in Ireland. During the war, Britain suffered a severe shortage of timber. The German submarine campaign reduced timber imports to almost nothing, and domestic stocks were nearly exhausted. At the time, timber was a strategic commodity used for pit props in coal mines—the country's vital source of energy. In 1917, the Ackland Committee was appointed to examine the implications of inadequate supplies of home grown timber. It recommended establishing some kind of forestry authority to remedy the timber deficiency. On the basis of that recommendation, the Forestry Commission was established in 1918, and, in the 1920s, large scale plantation of trees took place in many parts of the British Isles, including Northern Ireland. In the 1930s, a strong anti-forestry lobby convinced the government that state forestry was not a profitable investment, and, as a result, many millions of young trees were destroyed. Then came World War II, which reminded the government of the reason why the Forestry Commission was established in the first place. After the war, further and quite extensive plantations were created in many parts of the country, and forests in general have enjoyed a period of growth under the protective policies of post-war governments.

Unfortunately, history seems to be repeating itself. Recently, a campaign was launched by the Institute of Economic Affairs, a London based research group, to terminate state and state aided private forestry in the UK. In its analysis, the Institute pursues two basic themes: first that, in the UK, forestry in general, and particularly that practised by government, is unprofitable; and second, whatever forestry is appropriate will be furnished by decisions of private landlords without state encouragement and control. The timing of its publication (Miller, 1981) seemed to worry many foresters because the Institute and the present conservative government share the same political ideology: both dislike immensely state economic ventures and subsidies.

Economics of Forestry in the UK

In 1983, the UK spent £4000 million on timber imports, most of which came from Canada, Scandinavia, and the USSR. To grow coniferous timber in the British Isles takes 35-55 years, depending on the location. The gestation period for the same quality of wood is 65-90 years in Canada, Scandinavia, and the USSR. So, if forestry is unprofitable in the UK, then it must be even more so in those major exporting countries. The real reason behind the hostility towards forestry projects in the UK is that forestry is a special case in the public sector investment portfolio.

A 1961 white paper, "The Financial and Economic Obligations of Nationalised Industries," strongly argued that, in the UK, publicly owned industries should operate in such a manner as to earn a sufficient rate of return on their capital investments. In that respect, a 1967 white paper, "Nationalised Industries, a Review of Economic and Financial Objectives," suggested that the discounted cash flow method together with a 8 percent test rate of discount should be used in evaluation. In August 1969, that rate was increased to 10 percent. In 1972, the rate was reviewed but not changed. At the time, many economists argued against the magnitude as well as the foundation of that test discount rate. The strongest objection came from the proforestry lobby as Thompson (1971), Price (1973), and Helliwell (1975) argued that the high test rate ended the hope of an economic rationale for forestry investments in the UK.

Public investment in forestry is similar to public investment in nationalized industries such as steel, coal, and electricity, in a number of ways. First, the money comes from public funds. For example, the Forestry Commission received about £87 million grant-in-aid from the government in 1982/83, £12.3 million of which was given in grants to the private sector. Second, and more important, forestry's main output, timber, is a marketable commodity just like steel, coal, and electricity. The consensus among most economists is, therefore, that the ground rules for nationalized industries should apply to forestry to ensure that forestry, too, earns a reasonable return on the money invested. Using the discounted cash flow method with an interest rate as high as 10 percent, forestry fails to qualify as a viable investment. The criticisms of the test discount rate turned out to be fruitful.

A 1978 white paper, "Nationalised Industries," recommended a much lower discount rate, 5 percent, which is called the required rate of return for the investments of public sector trading bodies (state businesses that are not formally nationalized) and the nationalized industries overall; i.e., average as opposed to marginal projects. Even a 5 percent discount rate was not low enough to justify the UK's forestry programme. Following a cost-benefit analysis by the treasury, the Forestry Commission was given a target rate of return of 3 percent, which is well below the required rate of return (H.M. Treasury, 1972). Obviously, that makes the UK's forestry a special case, which is not a desirable policy in the sense that it may open the flood gates for other special cases. Moreover, a policy that permits different rates of interest for different projects will misallocate resources in the public sector. No rationally-minded economist is likely to be happy with the current government policy that allows at least three rates of interest to prevail in the public sector. Foresters, in order to justify their investments, have always advocated low discount rates (Price, 1973 and 1976; and Helliwell, 1974 and 1975). Although the magnitude of the social rate of discount is very important in public sector investment evaluation, the real issue is the choice of the project evaluation method. The traditional criterion, the discounted cash flow method, systematically discriminates against future generations in public sector investment evaluation, especially in long-term projects such as forestry (see Kula, 1980, 1984a, and 1984b). In order to avoid discrimination, a different project appraisal method, called "the sum of discounted consumption flow," is recommended, in which the ordinary discounting practice is modified, making long-term projects, such as forestry, more credible

propositions. A cost-benefit analysis is carried out below with reference to Northern Ireland's projects, using both discounting methods.

A Cost-Benefit Analysis of Ulster Forestry with Ordinary Discounting

The Forestry Division of the Ministry of Agriculture in Ulster puts land in nine groups: *A* (high quality), *B1* (medium sandy), *B2* (medium clay), *B3* (medium with adverse factors), *B4* (medium with high adverse factors), *C1* (poor marginal hill-land), *C2* (poor marginal lowland), *D1* (very poor mountain land), and *D2* (very poor lowland). According to the 1970 white paper, "Forestry in Northern Ireland," 67 percent of the forest estate was in *B* groups, *B4* being the largest category, constituting 25 percent of the entire estate in Ulster.

A cost-benefit analysis is carried out on the basis of a one acre, class *B4* plantation, in which the most common alternative use of land is sheep and cattle rearing. Clear felling is assumed to take place 45 years after planting. Table 1 illustrates the cost stream of one acre planting on the basis of a single rotation. Costs vary widely depending on terrain, soil, method of work, and weather

Table 1—Total Costs of Afforestation of One Acre per Year in Ulster

	Years	Low	Average	High
		(£/acre in 1981/82 prices)		
Ground preparation	0			
Scrub cutting		48	*120	192
Hand turfing		26	*32	38
Ploughing (shallow)		38	*51	64
Draining by machine	0	19	*24	29
Planting on ploughed ground	1	27	*41	54
Fencing (60 metres)	1			
Rabbit fencing			189	
Rabbit and sheep fencing			*243	
Stock fencing			324	
Deer fencing			540	
Weeding	2-3			
By hand		29	36	43
By chemicals		18	22	25
By machine		11	*15	18
Brashing (Sitka Spruce)	10	37	*49	61
Pruning and cleaning	15		*46	
Road construction	13	19	*42	64
Maintenance, drains, and fencing	2-45		*15	
Rent	0-45	0	*19	38

[*Used in the cost-benefit calculations.]

Table 2—Output and Money Benefits, Sitka Spruce, Class 20, One Acre

Years→	15	20	25	30	35	40	45
Yield classes (cmtd)*							
			Output (M^3)				
7	5	29	29	29	29	29	116
18	0	1	3	7	16	21	141
24	0	0	0	0	4	9	133
Total	5	30	32	36	49	59	440
			Revenue (£)				
7	26	151	151	151	151	151	863
18	0	6	19	43	99	130	674
24	0	0	0	0	39	87	1290
Total	6	157	170	194	289	368	3027

[*Centimetre top diametre. Note: Output at 15-40 years is from thinning, output at 45 years is from felling.]

conditions. However, an average level of expenditure can be estimated from those figures. In that respect, the figures with asterisks are employed in the calculations. Table 2 shows the output details resulting from thinning and felling of Sitka Spruce, an evergreen species, which is the typical variety planted in Ulster as well as in many other parts of the British Isles. Yield classes are expressed as cmtd (centimetre top diametre) around 7, around 18, and over 24. Prices for the classes in 1981/82 were £7.2, £8.2, and £11.7, respectively, minus £2 haulage cost. The output is converted into money benefits using those prices. Long-term world prices are used in the analysis. Timber is one of the few natural-resource-based commodities that has increased in price by about 2 percent in real terms in this century, until the beginning of the current economic recession (Barnett and Morse, 1963; and Williams, 1981). That trend is likely to continue as more and more natural forests become worked out, and more reliance has to be placed on plantations. Prices for home grown timber are dominated by the supply of sawn timber from overseas, which is constantly available to end users throughout the British Isles. The precise discounted cash flow calculations are carried out using three different discount rates (10 percent test discount rate, 5 percent required rate of return, and 3 percent forestry target rate) under two assumptions—(1) all prices will remain constant over time and (2) the price of timber will increase by 2 percent per year. The results (for the discounted cash flow method) are as follows:

Discount Rate (%)	Assumption 1 (£/acre)	Assumption 2 (£/acre)
10	-786	-689
5	-632	93
3	-195	1,344

With a 10 percent rate, the forestry project fails to qualify as a viable investment even with a 2 percent sustained increase in timber prices. However, it does qualify with a 5 percent rate provided that the price of timber goes up at a 2 percent rate over time, for which historical evidence exists. The internal rate of return on the project is 5.2 percent, which is well above the target figure for forestry projects in the rest of the UK. Some studies estimated much lower figures; e.g., 2-3 percent for forestry projects in the rest of the UK (Hampson, 1972; and Walker, 1958). The difference can be attributed mainly to the short gestation periods in Ulster. The results indicate that, even within the

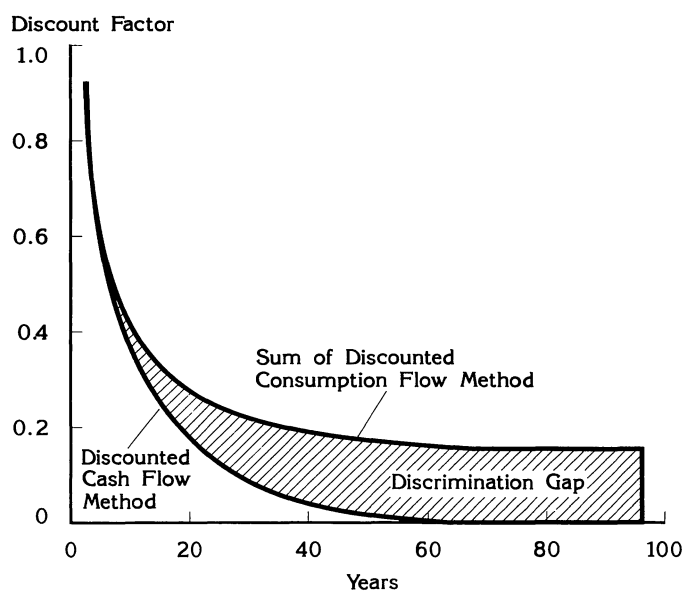
British Isles, locations like Ireland (north and south) are better suited to afforestation than, say, northeastern England and Scotland.

Cost-Benefit Analysis with Modified Discounting

Forestry is an excellent example of a public sector project that distributes income between generations. Forestry's long gestation periods necessitate involving more than one generation. When felling takes place, individuals reap the benefits of a plantation established by earlier generations. Alternatively, when planting takes place now, the resulting benefits will be captured by future generations. That phenomenon, however, is not confined to forestry. Almost all public sector investment projects exhibit that phenomenon to varying degrees, depending on the gestation period involved. Also, the nature of public sector investment is such that it provides fixed and unalterable streams of consumption benefits to society, the constituent members of which change over time. No market exists for the shareholders, who are the general public, to exchange their share of returns resulting from those projects. They can only wait to acquire whatever benefits or costs are going to come to them (Brussalian, 1971). Curiously enough, the discounted cash flow method completely ignores that fact and treats society as a single individual who lives forever, a practice that leads to a systematic discrimination against future generations. In order to avoid discrimination, a different project evaluation method is suggested—the sum of discounted consumption flow—in which all generations are treated absolutely equally. Figure 1 illustrates the behaviour of discount factor curves at a 10 percent interest rate by means of the discounted cash flow and sum of discounted consumption flow method. The distance between the two curves is the "discrimination gap." Using the sum of discounted consumption flow method on the forestry project results in the following:

Discount Rate (%)	Assumption 1 (£/acre)	Assumption 2 (£/acre)
10	-392	390
5	43	1,582
3	357	2,911

Figure 1—Discrimination Gap Between Methods



The project qualifies, even with a 10 percent interest rate, provided that the price of timber goes up over time, which is a very strong possibility. In other words, if the sum of the discounted consumption flow method were used to evaluate the value of public sector projects, fiddling about with discount rate in order to make forestry a special case would not be necessary—not that forestry projects in the UK must go ahead at all costs. The sum of discounted consumption flow method may also make some other long-term projects look good. Although forestry in the UK has a much better chance to qualify as a viable venture by means of the sum of discounted consumption flow method, it should not replace more beneficial projects in the public sector portfolio.

Note

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Discussion Opening – *B. Colby Saliba*

The three papers all demonstrate the importance of agricultural and natural resources in economic systems. In Ghodake and Kshirsagar's paper, the actual effects of the new technology would be highly dependent on farmer access to fertilizer and credit markets and on shifts in the costs of those inputs that could result from widespread adoption of the new technology. If large farmers could receive managerial training, credit, fertilizer, and other inputs needed to support the improved technology on more favourable terms than small farmers, the distributional impacts would be quite different than the authors project. I encourage the authors to further expand upon the implications of their findings for income distribution, linkages to the nonagricultural economy, and government farm credit and technical assistance programmes.

Van Rooyen and Fényes document, to some extent, official and unofficial cooperation in agricultural marketing and trade between the RSA and other southern African nations. While that type of economic cooperation may provide a counterweight to forces for political confrontation, trade and marketing agreements are most likely to benefit all parties involved when each can negotiate from a position of strength. The SADCC alliance provides member states with more bargaining power in negotiating agreements with the RSA than individual states would have acting independently. Investment in the agricultural development of the SADCC states by the international community could help them develop wider access to markets, imports, and technology and to bargain effectively with the economically-dominant RSA.

Kula's in-depth discussion of the history of forestry in the British Isles is followed by a comparison of ordinary versus modified discounting techniques for evaluating government projects. While the traditional method undeniably gives less weight to future benefits than to current benefits, Kula does not describe his method nor explain how it overcomes a bias towards early occurring benefits while using a discount rate greater than zero. The author also does not elaborate on the policy implications of his analysis. Should his discounting method be used to evaluate *all* public sector projects; does he mean *only* those projects with long gestation periods or *only* forestry projects? Most economists would ardently support proposals that eliminate "fiddling about with the discount rate" for special projects. However, using Kula's method *only* for forestry or other long-term projects seems little different than allowing low discount rates for such projects.

General Discussion – *Consuelo Varela-Ortega*, Rapporteur

The discussion of Ghodake and Kshirsagar's paper focussed mainly on the different access large and small farm owners have to factors of production. Special emphasis was placed on access to credit and machine operation knowledge. Ghodake stressed that as large farmers have *immediate* access to those factors, small farmers have just *potential* access through development programmes and extension agencies. That situation creates a time lag in the adoption of new technologies for the small farmers and thus further increases the differences between the two types of farms.

The discussion of van Rooyen and Fényes' paper focussed on the unlimited supply of cheap black labour coexisting with production surpluses. The authors pointed out that government programmes encourage the farmers to keep workers and their families living on the large farms, the industrialization process not being capable of absorbing a rural population with a high growth rate (3 percent). The authors emphasized the importance of multilateral agreements with other African countries for countervailing power, as was pointed out by the discussion opener. Farmers should be encouraged to influence politicians through cooperatives, unions, and research activities.

The discussion on Kula's paper focussed first on the *use* of the new discounting method presented (sum of discounted consumption flows). The author said the new method was meant to be used for *public sector* investment projects—short or long term—but not for private individuals. The discount rate used in the method was also questioned, as well as its relationship to real consumption growth. The author commented that the rate used in his method was the "social time preference rate." The ability of the model presented to account for justice and efficiency was also discussed. The author referred to previous publications to support his viewpoint. Application of this new method to optimization in a multiperiod situation was finally suggested to the author.

Participants in the discussion included K.M. Azam, J. Berthelot, D. Etherington, L. Martens, K.V. Pihkala, and U.K. Srivastava.