Forest Policy and Economics 34 (2013) 41–46

Contents lists available at SciVerse ScienceDirect

Forest Policy and Economics

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

The Alternative Test in forestry

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ARTICLE INFO

Article history:
Received 20 April 2011
Received in revised form 22 December 2012
Accepted 27 February 2013
Available online 11 May 2013

Keywords:
Faustmann
Hartman
Cash flow analysis
Forest investment
Sustainable forestry
Monitoring and evaluation

ABSTRACT

The Faustmann theory of discounted cash flow analysis remains relevant in our modern dynamic environment in which periodic reassessment of various alternatives to ongoing forest investments is necessary. The periodic reassessment can be done using the Alternative Test (ALT) approach, which simply compares the net present value of forest investments with new price and cost data and abandonment values. This monitoring approach ignores sunk costs but accounts for the new stream of benefits, the most likely future expenditures, and especially abandonment values, and is useful to readjust forest investment and management decisions any time after the initial investments are made. This approach is used here to explain recent changes in forest policy and investment decisions in America, Asia, and Europe.

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1. Introduction

The Faustmann (1849) approach to forest valuation, as all classic master pieces, stays as relevant today as it was in the mid of the nineteen century. This is true in forestry as in other sectors of the economy where cash flow analysis has become the standard by which the efficiency of public and private projects, programs, and policies is monitored and judged. To the extent that social and ecological aspects are included, this analysis duly incorporates the economic with the environmental and social concerns of sustainable forestry.

Decision-making in forest investments nowadays differs from that in the 1850s as our biophysical, socio-economic, and political contexts might change more rapidly. A simple periodic revision of the cash flow estimates to monitor forest investments using the Alternative Test (ALT) was proposed by Harou. This approach can be used in either deterministic or probabilistic fashion (Harou, 1985). For the latter, Monte–Carlo simulations show that ALT could be used to lower the risk inherent to forest investments when compared with a purely static analysis that does not envisaged possible changes of forest regime, the alternative use of the land, or the abandonment of the land itself.

Following Faustmann (1849) and Samuelson (1976), many authors have discussed the assumptions of the Soil Expectation Value (SEV) to value forest lands and to optimize forest management decisions. The literature on forest economics has pursued this topic with evolving panoply of mathematical optimization tools for different types of forest management, socio-economic contexts, and forest policies such as regulations, subsidies, and taxes. In the last forty years, the environmental (initially water and biodiversity) and social (recreation and community forestry) values of forests were introduced into the modelling (e.g. Hartman, 1976). More recently, authors have extended its application to the more resilient continuous forest cover management in the wake of climate change and carbon sequestration. Newman (2002) provides a review of Faustmann–Hartman literature up to 2000. The ALT approach presented here adds to this literature by incorporating non-systematic changes in all possible parameters as well as possible structural changes affecting forest management.

The purposes of this article are to demonstrate that the ALT approach is consistent with the Faustmann–Hartman approach with an explicit recognition and addition of possible abandonment of an investment and to use the ALT approach to explain and forecast changes in forest policy and investment decisions. This article contributes to the forest investment literature (e.g. Gregersen, 1975, 1979; Bare and Waggener, 1980; Michie, 1985; Straka, 2007) and the monitoring of forest investments, programs and policies (Harou, 1987). Our main conclusion is that the ALT approach is analogous to the Faustmann–Hartman approach and relates well to the forest land use literature as it incorporates the concept of changing non-forestry land values (Haley, 1966; Ledyard and Moses, 1976; Hardie, 1984; Harou and Essmann, 1990; Parks and Burgess, 1998; Klemperer and Farkas, 2001). Further, the ATL approach is readily useful to explain various forest policy changes and forest investment decisions, such as the rise of institutional timberland ownership and the demise of industrial ownership in the U.S. and elsewhere.

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1389-9341/$ – see front matter © 2013 Published by Elsevier B.V.
http://dx.doi.org/10.1016/j.forpol.2013.02.008

The next section briefly reviews the modern cash flows of sustainable forest investments, followed by a summary of the ALT as it relates to the Faustmann–Hartman formula. The final sections apply the ALT to forest management and investment decisions as well as forest policy changes using recent examples from Asia, North America, and Europe.

2. Modern forest cash flows

The investment analysis pioneered by Faustmann has been developed using a perpetually recurring cash flow assumption to determine the maximum willingness to pay for bare forest land, the value a forest stand, and, classically, the optimal rotation age. Faustmann (1849) provides three different ways to obtain this maximum willingness to pay: compounding costs, compounding or discounting annuities, and discounting future cash flows. In our ever changing world, discounting future cash-flows is more appropriate.

Assuming the constancy in forest cash flows today is unrealistic given changes in technology, prices and costs, macro-economic policies affecting inflation, exchange rates, and the discount rate, and emerging global markets for forest goods and services. Further, one needs to consider more inputs and outputs in forest investments today than in the 1850s as many environmental and social impacts are now entering forest investment cash flows. This occurs more often in public investments but increasingly in private investments as well. Thus, the analysis of forestry investments under today's environmental awareness becomes more elaborate (Markandya et al., 2002).

Environmental values, which may be obtained using various valuation techniques can complicate the decision-making process (Hartman, 1976; Zhang and Pearse, 2011). When these valuations are repeated over time in different settings and for different environmental goods and services, a meta-analysis of these values can provide a more plausible range of values that can be transferred into the cash flows of similar forest investments (Stenger et al., 2009). As will be illustrated in one of our examples, however, for the most important forest goods and services, a market will eventually appear, making these valuation methods less necessary.

On social grounds adding or changing some inputs or outputs of forest investments maybe required. For instance, it has become standard procedure to incorporate the shadow price of unemployed workers in an economic analysis. A forest investment involving resettlement, as could happen in many countries, should ensure that the displaced people are at least as well off as before. This may force the considerations in the cash flows of a series of new physical inputs and outputs to be integrated into the forest investment analysis. A supplementary analysis may separate the costs and benefits by stakeholders and calculate the cost/benefit for each. More rarely the values may be modified according to those who benefits and who bear the costs for equity considerations (Harou, 1982).

The considerations of the environmental and social aspects of projects proposed in an annual budget allocation allow implementing incrementally sustainable development policies (Harou et al., 1994). Increasing the sophistication of the analysis will most likely increase the number of variables to monitor when implementing forest investments. In times of rapid changes, the economic, environmental, and social values could change rapidly and are more likely to force the reconsideration of some forest investments.

3. The Alternative Test

The ALT is the final step in the Forestry Project Monitoring Cycle in monitoring forest investments (Harou, 1979). From the pre-implementation appraisal, periodic comparisons with the actual cash flows need to be made, discrepancies identified and explained, and changes incorporated in new estimated costs and benefits if trends have been identified. Once a new forecast of the cash flows is made and past costs and benefits are treated as sunk, one may use the ALT to decide whether to continue the project in its present form or to find new alternatives.

The ALT calculates the best estimated Net Present Worth (NPW) for the remaining years of a forest project including a possible future Abandonment Value (AV), considering all possible future alternatives for managing the forest or for using the forest land that can be foreseen at the moment of the review. AV is the net benefit estimated today of a possible modified forest management plan or of the sale of the land in the future. If the land stays in forestry, only in rare instances AV could be identical in the remaining rotations as in the first rotation. The ALT compares this NPW (with a possible future abandonment) with the abandonment value (AV_0) at the time of the investment review (time $= 0$) to decide whether to continue the project as initially conceived, or to modify it, or to sell the forest land. The test is run every control period based upon expectation at that time.

As there may be various possible alternatives, different abandonment values should be considered over the long life of a forest investment. Estimating them is not a simple task in a dynamic world. However, if this information is available, the decision regarding whether to continue a forest investment can be readily made, as the ALT calls for possible abandonment of an investment in the first year when one of the abandonment values (AV) exceed the NPW of the remaining expected cash flows. In other words, one must choose the NPWa with abandonment in year "a" which includes the highest sum of future cash flows and future abandonment value AV_a (AV_a is the abandonment value in year a; see Eq. (1) in the next section). Otherwise, continuing the investment or abandoning the project later on can result in a suboptimal decision.

Since this analysis is full of uncertainty for forestry investments, for a forest project to continue as initially envisioned, one has to find at least one stream of cash flow that yields an expected NPW_a that is greater than the abandonment value today (AV_0, which is, again, the abandonment value at the time of evaluation, year 0). If $NPW_a > AV_0$, repeat the comparison with $a = n - 1, n - 2, \ldots$, where n is the foreseen duration of the investment. At the end of this iterative process, either $NPW_a > AV_0$ and one continues the project, or $NPW_a < AV_0$ and the project is abandoned before it ends.

The NPW_a obtained in this way is the best estimate of combined cash flows and abandonment values over the life of the forest project and can be compared with other mutually exclusive alternatives for the land or abandonment, i.e., selling of the forest land for other uses. Hence the name, the Alternative Test. An example of the calculation mechanics is provided in Harou (1987).

4. An analogy with the Faustmann–Hartman formula

A simple analogy of the ALT approach with the classical Faustmann–Hartman formula can be made. The abandonment value in a classical Faustmann approach would just be the Soil Expectation Value of the following rotations.

As stated earlier, the ALT approach seeks to find the highest Net Present Worth (NPW_a) which includes the highest possible Abandonment Value in a certain year a, AV_a, before or at the furthest foreseeable year n of the forest investment. It is defined as follows:

$$NPW_a = \sum_{t=0}^{a} \frac{C_t}{(1+r)^t} + \frac{AV_a}{(1+r)^a} \quad (1)$$

where C_t is the expected cash flow in year t ($t = 0, 1, \ldots a$; 0 is the evaluation year), AV_a is the expected abandonment value in any period "a" before or at the end of the project year n, and r is the discount rate. When $a = 0$, the first term in Eq. (1) disappears ($NPW_a = NPW_0 = AV_0$), which implies a land sale or change forest management regime at the time of evaluation.

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