Scandinavian Forest Economics
No. 44, 2012

Proceedings of the Biennial Meeting of the Scandinavian Society of Forest Economics
Hyytiälä, Finland, May 2012

Anne Toppinen, Heimo Karppinen & Kati Kleemola (eds.)

Normal forest structures and the costs of age-class transformation: an extended summary

Price, C.

It is sometimes suggested that, because transformation of uneven-aged stands into an even-aged structure reduces profit, even-aged stands should be transformed to uneven-aged structure. The argument is false, because transformation *in either direction* incurs opportunity costs of felling trees before and/or after their optimal rotations. This effect can be demonstrated, without the complicating factors of interaction between trees within a stand, by modelling transformations and reverse transformations between a single-aged forest and a forest containing a normal age-class series of even-aged stands.

The model used has the normal revenue characteristics: the first positive revenue is achieved at 20 years, rising rapidly at first but eventually approaching an asymptote. For ease of computation, the stands are taken to be unthinned, but it is expected that the results would remain similar for thinned stands. Only timber revenues are considered as benefits in this treatment. (Even though other factors have an important influence on rotation, they would not fundamentally change the results either, except as noted.) A 3% discount rate is used.

Each transformation process starts from either a single-aged forest or a forest with a normal age-class structure of stands. Each ends with either a forest whose age-class structure is optimised with respect to rotation, or one that is single-aged across all stands. The results in outline are as follows.

The most desirable stand structure to receive, as a gift, is composed of stands grown on the rotation of maximum forest rent (mean annual net revenue). This is invariably longer, often considerably longer, than the Faustmann rotation: 97 years as opposed to 56 years in the example taken.

Pukkala et al. (2010) raise this question: "which structure of uneven-sized forest stand would I *least* wish to clear fell and transform to even-aged"? This question embodies not just the future cash flows forgone from this crop and its uneven-sized successors, but the current standing value of the crop and future cash flows of its even-aged successors. In the context of even-aged stands in our sample normal forest, the answer is: the normal forest structure I would least wish to sacrifice would be one with a rotation of 49 years. Furthermore, any normal forest with a rotation less than 27 years or more than 77 years should be converted, with net gain, to a single-aged forest on a Faustmann rotation.

Any normal forest on an other-than-Faustmann rotation is worth transforming to a normal forest on a Faustmann rotation, by an accelerated or retarded programme of felling. But, because of the prolonged transformation period, any normal forest on a rotation longer than 88 years would be better transformed in one period to a single-aged Faustmann rotation.

But the optimal Faustmann rotation is unlikely to be the best rotation to transform to, either for a normal forest or a single-aged one. This is because of the effects of target age-class structure on the degree of deviation from optimal rotation required during the transformation period. Only with very low discount rate, when long-term effects of optimal structure overwhelm the short-term costs of transformation, is the Faustmann rotation approached as the ideal target structure.

The best rotation to create from bare land is one of 53 years. This is slightly shorter than the Faustmann rotation, because of the desirability of launching a profitable crop sooner rather than later. A rotation as short as 35 years would give no profit at all, so delay would not be an issue.

If an existing single-aged forest on a Faustmann rotation is to be transformed to a normal forest, the most profitable target rotation is 44 years. This is shorter than the Faustmann rotation, in order to reduce the degree of felling before and after the optimal age.

In all cases considered, there are opportunity costs in transforming from one age-class structure to another, whether from normal to single-aged forest, or *vice versa*. This might theoretically be offset if cost savings can be achieved. For example, major reduction in regeneration cost in mixed-age forests could justify transformation from an existing single-aged forest. An unrealistically large gain in scale economies would be needed to justify transformation from a normal to a single-aged forest. A very low discount rate would be needed to make these arguments persuasive in favour of a theoretically ideal structure to be achieved in the long term.

Thus transformation of even-aged to uneven-aged *stands* would probably have to rely on some other justifications than those applying to a normal series of even-aged stands, such as the assortment of tree sizes that can be cut by using a single-tree selection system, or the environmental gains of diverse tree sizes within a stand (Price and Price, 2009).

Keywords: optimal age-class structure, optimal rotation

A full electronic version of the working document from which this summary is derived may be obtained from the author at c.price@bangor.ac.uk.

References

Price, C. and Price, M. 2009. Cost–benefit analysis of continuous cover forestry. Scandinavian Forest Economics 42: 36-65.

Pukkala, T., Lähde, E. and Laiho, O. 2010. Optimizing the structure and management of uneven-sized stands of Finland. Forestry 83: 129-42.