The Income Approach Combined with Market Prices in Forest Property Valuation

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Key words: Comparison Approach, Faustmann's formula, Forest, Income Approach, Hyperbolic time preference, Market Value, Valuation.

SUMMARY

The aim of this paper is to find out the suitability of the income approach combined with market prices in forest property valuation, the subjects are fairly large (at least 10 hectares).

The paper includes a short description of the traditional methods used in forest property valuation and their applications in Finland and the most recent empirical results on forest property valuation based on calculated expected incomes combined with market prices.

Valuation of forest properties is possible using either comparison or income approaches. Both these methods can also be combined as a hybrid, which uses price information of the market and cash flow based on growth and yield models of forests. This enables you to solve the discounting rates by equaling net present values to the market prices. Such market oriented discounting rates, as investors' subjective or hyperbolic time preferences, can be used as a basis in the valuation of all forest growing areas.

When using the income approach the main results show that the discounting rate depends on the expectation time. The longer the expectation time, the lower the discounting rate, is applied in the income approach. The paper introduces a plan devised in Finland for developing an expert system for forest property valuation based on the income approach and the utilization of market information.

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1. INTRODUCTION

Non-industrial forest ownership is important in Finland from the viewpoint of national economy. It also affects the real property markets. Non-industrial owners form the largest group of forest landowners: they own 53 percent of the area. Since most of the private land is situated in the southern part of the country, the forest owners' share of the growing stock volume is 64 percent and nearly 73 percent of the annual growth. About 90 percent of round wood for the forest industry is offered by private holdings. The state and forest companies are the second largest owners, and these areas are mainly situated in the northern and eastern parts of the country. Municipalities, parishes, etc. have a total of 5 percent of the area.

Some 440,000 families own forest properties, over 2 hectares, which means that close to a million Finns have a connection with the forest. The average private forest owner has 26 hectares. Forests have conventionally been owned by families and the large majority, about 85 percent of forest holdings, are acquired as inheritance or donation. Wood production is the most important mode of forest utilization. The amount forest companies purchase round wood from private owners is annually about 60, 000.

Sales at stumpage price are most common and involve payment by timber assortments per solid cubic meter including bark. Thus the buyer is provided with the right to harvest stands. The Forest Act obliges the forest owner to implement and pay the costs of forest reforestation after the final cutting. This ensures sustainable forestry.

The sale of properties in sparsely populated areas generally involves several forms of land-use, for instance agriculture and forestry, land for building and recreational areas at the sea side. Statistics of purchased properties have been compiled since the early 1980s. Sales of representative forest properties of at least 2 hectares, involving only forest land, have increased since the compiling started. The register and statistics held by the National Land Survey have also been used as a source for empirical studies represented in this paper. In recent years, the number of sales has been about 2 500 - 3 000 annually. Almost all sales offers and buyers come from private people. Donations and sales between families and relatives are, however, the most common form of exchange ownership between private people and they amount to 15 000 – 20 000 transactions per annum. The state has increased its purchases with the intention of getting involved in forestry and in order to implement nature conservation programmes in the early 2000s.

The supply of forest properties is found all over Finland. Properties offered for sale are typically dominated by seedlings and the low possibilities to carry out immediate large

cuttings are rare after the transactions. More than half of the sold properties are small, under 10 hectares. On the other hand properties larger than 50 hectares are seldom for sale. The average price in Finland during the last years of the 2000s has been around 2 000 € per hectare. The average stand volume per hectare of sold properties is 5-45 % lower than in private forests depending on the province.

The Finnish Forest Act was renewed in 1997. At present, it emphasizes sustainability - both economically, ecologically, socially and culturally. The practical impact of the renewal has been that timber is not harvested from biologically and ecologically unique, so-called key biotopes. In the final cuttings, a few cubic metres of rotted trees are left standing in areas to be regenerated to ensure that the forest species living off the trees can survive (certification in forestry). Such constraints signify that the cutting potential is somewhat reduced. According to the Forest Act, stands may be cut either as thinning or final cutting. The forest income is taxed according to the net principle and capital tax (28 %). The same tax percentage is also applied when the forest holding is realized (difference between purchase and sales price). The buyer of the property also has to pay a 4 percent tax on the purchase price, when the legal ownership is registered.

2. FINNISH TRADITION OF FOREST PROPERTY VALUATION

The forest sector and industry have conventionally played a key role in the Finnish economy. It still covers 22 percent (2005) of the country's export income, although its role is decreasing. An internationally competitive forest industry has ensured the continuous demand for round wood and stumpage prices, which are among the highest in the world. Since wood production is the most important economical mode of utilizing forests, the factors affecting the value of forest properties can be derived from the forestry income and related expectations. The situation is similar in Sweden.

The intangible values accumulate with the increasing population especially in central European countries. These values are obviously higher than the plain value of forestry. The countries most in need of valuation guidance are those where private ownership is largest; where forestry can be practiced as an entrepreneurship, where free transaction of property is not restricted by any Acts and where no other restrictions of free market oriented price formation exists. In this respect Finland fulfils the requirements.

The summation approach, an application of the long-term income approach, has been used to value forest properties since the 1920's in Finland. It is based on the formula for calculating what is known as the bare land value (Faustmann 1849), where 1-5 percent interest rates in discounting factors are used. The lowest rates are applied to get a positive value for the calculated bare land. It is assumed that wood production is managed by even-aged stands and that the time horizon is eternal.

In the summation approach, the value of a forest property is calculated from stand-specific sub values. These values indicate the bare land after the final cutting, the expectation value of the seedlings and young stands and cutting value. The cutting value is calculated on the basis

of timber volume and their wood assortments and the stumpage prices. By the summation of these four sub values we arrive at the sum total. The cutting value is the most significant sub value of the forest property. Stand specific sub values, as norms to be applied in the valuation process, are calculated by Forestry Development Centre Tapio, the official organisation subordinated to the Ministry of Agriculture and Forestry, to promote private forestry.

The more barren the forest land site is and the lower the area's temperature sum, the longer the rotation in wood production becomes. The longer the rotation, the lower the possible discounting rate in calculating the bare land positive value. Rotation periods used in forestry are in the southern part 50-100 years and in northern Finland 100-140 years. One key factor in calculating, according to Faustmann´s formula, is to adapt the interest rate sufficiently to provide the land with a positive value, almost like the markets. On the other hand, if the lowered rate has also been applied in the calculation of expected values of seedlings and young stands, their values become unrealistically high compared to the market values. In the last recommendation (2009) provided by Tapio, the discounting rates were 3,0-4,0 % in southern Finland, 2,5-3,9 % in the middle of the country and 1,0-2,4 % in the north.

The actual market prices have been compared with the results of the summation method in joint studies by the National Land Survey of Finland and the Finnish Forest Research Institute. They showed that such calculated values are more than double compared to the actual market values. In practical valuations, a bulk discount based on subjective deliberation has been applied. It has ranged from 20 to 50 percent depending on province, case, valuer's skills and expertise.

3. EMPIRICAL APPROACH

One idea in the empirical studies is to create an expert system for practical valuations. The main issue is the income approach method, which is in line with Heyer's (1887) suggestion, where the discount rates are decided (or calculated afterwards) on the basis of market prices and the estimated cash flow as expected net income series during one rotation.

The purpose of this study was to find an application for offering discount in connection with the income approach. How should the discount rate be used in forest property valuation? The question has been analysed using the internal rate of the return method. The investments were the transaction prices of forest properties and the income series was estimated using the cutting budget for a desirable growing stock (Kuusela & Nyyssönen 1962).

Calculations have been made on the basis of actual prices; the results of the internal rates are real percentages. The idea to classify properties by the average volume means that the lower the average growing stock on the property is the longer the expectation time of incomes becomes.

3.1 Empirical material

The material of year 1995 consists of 250 forest property transactions of at least 10 hectares in southern Finland, excluding the two northern counties. Nearly all of the buyers and sellers were private persons. Site quality and growing stock characteristics of each sold forest property was inventoried separately. Every forest property consisted of several stands. It is quite normal that many forest properties offered for sale have more or less been overcut. The average growing stock volume per hectare is 30 percent lower than in other privately owned properties among forest inventories (Finnish Statistical Yearbook of Forestry 1999). The study material is presented in table 3.

Table 3. Empirical study material of 250 sales of forest properties in southern Finland in 1995 classified using the average amount of growing volume.

Volume of growing stock, m^3/ha	Total area ha	Forest land ha	Number of transactions	Average size, ha
under 40	987	965	40	25
41-80	1 848	1 836	68	27
81-120	1 836	1 808	73	25
121-160	745	740	36	21
161-200	356	345	18	20
over 200	236	231	15	16
Total/average	6 008	5 925	250	24

New empirical study material of forest transactions (years 2006-2007) has also been collected. The material provides a possibility to analyze ratios between the net present values and the market prices for the estimation of market-based discount rates in conditions of the years mentioned. The material consists of 197 sales of forest properties. The study material is presented in table 4.

Table 4. Empirical study material of 197 sales of forest properties in southern Finland in 2006-2007 classified using the average amount of growing volume.

Volume of growing stock, m^3/ha	Total area ha	Forest land ha	Number of transactions	Average size, ha
under 40	1 021	969	40	19
41-80	2 135	1 925	67	27
81-120	1 829	1 785	61	24
121-160	530	524	16	21
161-200	261	260	10	22
over 200	41	40	3	10
Total/average	5 818	5 503	197	23

3.2 The rate of return on the forest property investment

The income series was calculated using the average stumpage prices of round wood assortments for pricing the drain. The market price material was used to calculate possible returns based on the long-term income approach when investing in forest properties of different growing stock volumes (Kuusela & Nyyssönen 1962).

The indicator of profitability, the internal real interest rate, depends on the volume of growing stock, as shown in table 5. In southern Finland forest properties below the average 40 m^3/ha volume can be expected to produce 4-6 percent of the rate of return over a long period. Forest properties with an average volume of 100 m^3/ha produce 5-8 percent and more wooded forest properties over 150 m^3/ha, about 8-13 percent.

Calculations show that the profitability of a forest investment at the market price grows as the average volume of the property increases. When the immediate cuttings are used just after investing, such a possibility makes the project more profitable. The results also indicate that the investor's rate of return depends on the length of the waiting period. The longer the wait for income, the lower the rate of return the investors are willing to accept.

Table 5. The average hectare prices (€/ha) of forest properties in growing volume groups and the rate of return percentage. Observation material of years 1995 and 2006-2007.

Southern part of Finland						
Year	1995			2006-2007		
Volume of growing stock, m^3/ha	Obs, n	Price, €/ha	Rate of return, %	Obs, n	Price, €/ha	Rate of return, %
under 40	40	700	5,7	40	1 742	3,6
41-80	68	1 029	8,5	67	2 241	5,0
81-120	73	1 408	8,1	61	2 812	5,4
121-160	36	2 059	8,4	16	3 363	6,2
161-200	18	2 609	10,6	10	3 678	7,5
over 200	15	3 451	13,l	3	7 081	8,8

4. DISCUSSION AND CONCLUSIONS

What the recommendation for the income approach in forest property valuation means is to use a high discount rate for the first years, or decades, and then lowered rates for more distant periods. The Swedish Land Survey (Lantmäteriverket 2006) instructs valuers in the same way to use a higher discount rate when valuating older stands than for bare land and younger stands. Also, macro market-based empirical data was analysed in this way. The analysis showed that in the southern part of Finland higher internal rates can be reached than in the northern part, in long rotations (Hyytiäinen et. al. 2007).

The classical discounting methods using a constant rate do not determine the market price of forest properties. Then again, the subjective rate of the investors seems to depend on the time horizon. Portney & Weyant (1999) have discussed the same issue in discounting intergenerational equity.

For example, Manley (2001) in New Zealand has surveyed discount rates used to estimate the market value of forest. According to Manley “Valuers apply a discount rate ranging from 7.5 to 9.5 % (average 8.6 %) in post-tax cash flows or a discount rate ranging from 9 to 13 % (average 10.0 %) in pre-tax cash flows”. The rates are approximately at the same level as in the Finnish data, where also no taxes were taking in to account (see table 5).

Empirical results show that the real world behaves differently compared with the perfect capital markets, where Faustmann´s formula should be used. This explains why Faustmann´s summation approach as used in Finland does not explain human behaviour in valuation situations. The results can be explained more comprehensible using neuroeconomics and hyperbolic time preferences.

5. DEVELOPMENT OF AN EXPERT SYSTEM FOR FOREST PROPERTY VALUATION

It has been suggested that the income approach is more practical than the price models based on forest data, since it provides realistic results also in the case of separate seedlings as well as young and middle-aged stands where market based data is not available. Such results are also needed especially in the assessment of compensations and damages in forestry.

An expert system in line with Heyer's (1887) idea will be developed to solve the problems in forest property valuation. The income approach method will be based on inventoried forest stand characteristics, simulated growth models by sites and the main tree species, estimated stumpage prices and the costs of civil culture. In this connection the method has similarities to the Swedish Stands method (*Beståndsmetoden*, Lantmäteriverket et. al. 1992). An expert system for valuing the most probable value of a forest property will be created, where the market prices for forest properties and expected values, calculated using market oriented discount rates, become equal as shown in appendix 1 (Hannelius, S. 2000).

An appropriate interest rate has been applied in ordinary present value computations. The expert system does not actually consider the rate of interest, but arrives at a decision on the basis of market prices. Known factors include expected net yields and waiting periods. The market price is adjusted to correspond to the result of calculation - that is the present value. Simulation is used so that the discount factors are dependent on waiting time (subjective rate of interest). It is also based on the empirical data of market prices that has been studied. As the discount factors have been estimated from market prices, they can be applied in all expected incomes of any forest property (forest stand) to estimate the probable market price of the whole property.

The method meets the requirements of the comparison approach in the sense that the internal logic of price formation is sought from reference material and the interest solution corresponds to the recommendations of *The International Valuation Standards* (IVS 2007).

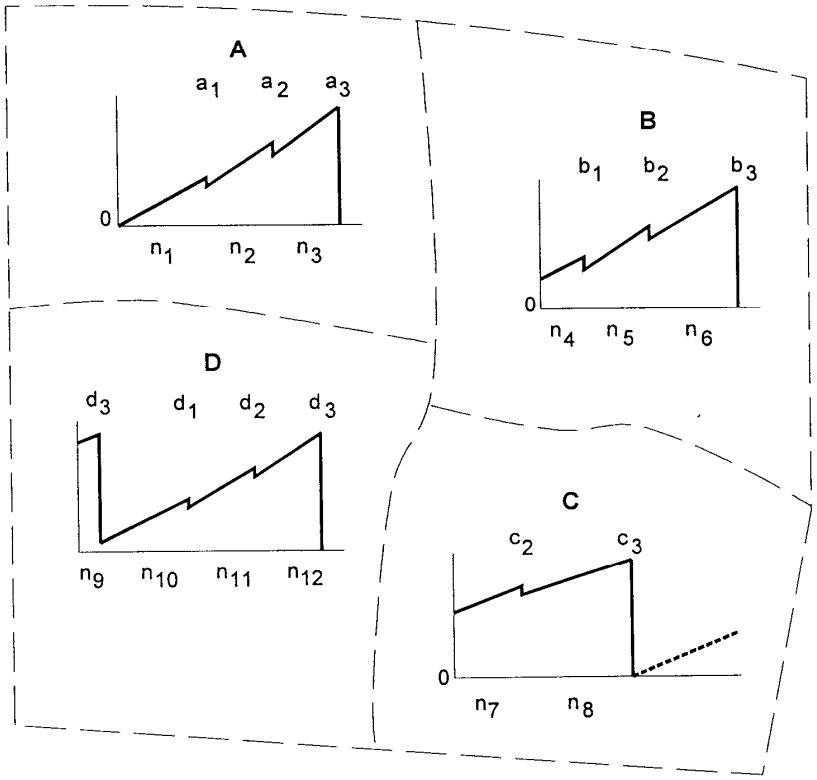
The system is built to be transparent in order to ensure reliability and to utilize and monitor the market information available in the property market price register maintained by the National Land Survey. An entity based on the same valuation principles can be transferred to countries where the value of forest properties is primarily based on wood production and where information about property deals are available.

A prerequisite for the development of the method is that the growth and yield models of the main tree species for various sites are available. Finland already has a program that simulates forest stands for the valuation of all expected incomes (MOTTI stand-level analysis tool). MOTTI facilitates assessing the effects of alternative forest management practices on stand development and the profitability of forest management.

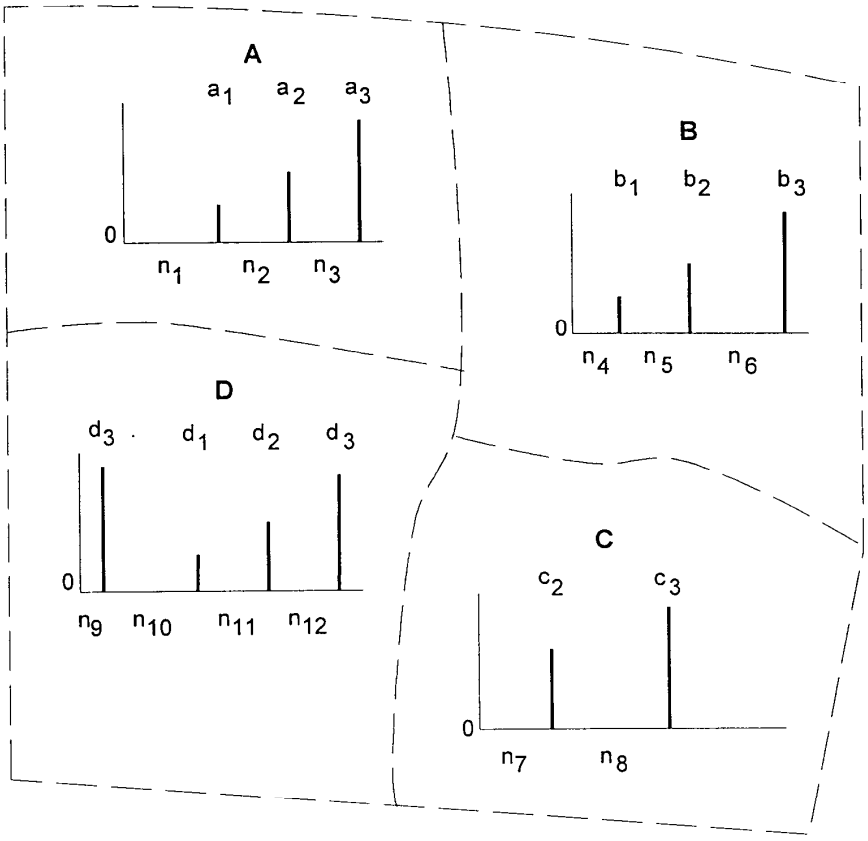
The core of MOTTI is a stand-level simulator, which includes growth and yield models for e.g. natural regeneration, growth and mortality. It is designed to simulate stand development

under alternative management regimes, growth and temperature conditions in Finland (Salminen et al. 2005).

Appendix 1. Forest real estate, its stands A, B, C and D and production models and expected incomes over time. The market price is equal to the calculated present value of expected income when the investors' subjective rate of return, is known.



Forest real estate, its stands A, B, C and D and their expected income series.



Market price = A x $(a_1/1,0p^{n1} + a_2/1,0p^{n1+n2} + a_3/1,0p^{n1+n2+n3}) +$

B x $(b_1/1,0p^{n_4}+...)$ + C x (...) + D x (...)

A, B, C, D = Areas of the stands A, B, C, D
a_1, a_2, a_3 = Expected incomes in stand A at period n_1, n_1+n_2, $n_1+n_2+n_3$
b_1, b_2, b_3 = Expected incomes in stand B at period n_4, n_4+n_5, $n_4+n_5+n_6$
n_1, n_2, n_3 = Expected incomes in years
$1/1,0p^n$ = Discount rate (depending on time period)

REFERENCES

Faustmann, M. 1849. Berechnung des Wertes welchen Waldboden sowie noch nicht haubare Holzbestände für die Waldwirtschaft besitzen. Allgemeine Forst und Jagd Zeitung 25 p. 441-455 (In English: Journal of Forest Economics 1, p. 7-44).

Finnish Forest Research Institute. Finnish Statistical Yearbook of Forestry 1999.

Hannelius, S. 2000. Kiinteistöarviointimenetelmät ja niiden soveltaminen metsäomaisuuden arviointiin. Metsäntutkimuslaitoksen tiedonantoja 762. 101 p.

Heyer, G. 1887. Manual of Forest Valuation. St.-Petersburg. (Russian translation by D. Kravchinskiy).

Hyytiäinen, K. & Hannelius, S. & Salminen, O. 2007. Yksityismetsien arvo tuottoarvolaskelmien ja markkina-arvojen mukaan. Maanmittaustieteiden aikakauskirja n:o 2. p. 28-44.

International Valuation Standards, 8th edition (2007) The International Valuation Standards Committee (IVSC). London.

Kuusela, K. & Nyyssönen, A. 1962. Tavoitehakkuulaskelma. The cutting budget for a desirable growing stock. Acta Forestalia Fennica 74. p.1-30.

Lantmäteriverket & Jordbruksverket. 1992. Beståndsmetoden. Gävle.

Lantmäteriverket. 2006. Riktlinjer för skogsvärdering. Gävle.

Manley, B.2001. Discount rates used for forest valuation. N.Z Journal of Forestry, November 2001. p. 14-15.

Portney, P.R. & Weyant, J.P. Editors. 1999. Discounting and Intergenerational Equity. Washington D.C.

Price, C. 1993. Time, Discounting and Value. Blackwell Publishers. Oxford. 386 p.

Salminen, H., Lehtonen, M. & Hynynen, J. 2005. Reusing legacy FORTRAN in the MOTTI growth and yield simulator. Computers and Electronics in Agriculture 49(1):103-113.

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