FOREST AS A CAPITAL ASSET

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INTRODUCTION

In this article we will discuss certain aspects of the capital management of forest assets. These aspects are of importance when one wants to consider what means to use to influence the capital management on both small and big forest properties.

When quantifying the effects of different uses of capital, one must necessarily have a scale. The rate of return is for this purpose the usual measure of profitability. We will first discuss the differences between nominal and real rate of return, and point out the assumptions which are often implicit in analyses of the profitability of investments in forestry. We will then discuss certain liquidity and risk aspects of capital investments in forestry, and at the end deal with certain consequences of taxation.

CAPITAL YIELD

It is a common opinion that the return on invested capital in forestry is low. Especially calculations of the rate of return on investments in silviculture give rather low values.

NOMINAL AND REAL RATE OF RETURN

We will in this paragraph analyse the concepts 'nominal and real rate of return' and show the connection between these two concepts in a biennial investment calculation. We will first go through a more technical description. The following symbols will be used:

A = cost price at point
a_1 = cash flow at the end of year 1
a_2 = cash flow at the end of year 2
p = nominal rate of return
p_r = real rate of return
j = price increase

NOMINAL RATE OF RETURN

Both the cost price A and the cash flows a_1 and a_2 are here measured in nominal prices at times 0, 1 and 2. We can then formulate the following investment calculation:

$$(1)\ A = \frac{a_1}{1+p} + \frac{a_2}{(1+p)^2}$$

Since the cost price A and the cash flows in equation (1) are measured in nominal prices, the interest rate given by the equation is called the nominal rate of return.

REAL RATE OF RETURN

The next step is to calculate A, a_1, and a_2 in real prices. We choose to calculate the cash flows measured in prices at time 0. The real rate of return can then be calculated on the basis of the following equation:

$$(2)\ A = \frac{\dfrac{a_1}{1+j}}{1+p_r} + \frac{\dfrac{a_2}{(1+j)^2}}{(1+p_r)^2}$$

From (1) and (2) we can define the following relation:

$$(3)\ 1+p = (1+p_r)(1+j)$$

THE CONNECTION BETWEEN NOMINAL AND REAL RATE OF RETURN

Equation (3) shows the connection between the nominal rate of return, the real rate of return, and the price increase. First we solve equation (3) with regard to the real rate of return:

$$(4)\ p_r = \frac{p-j}{1+j}$$

Equation (4) shows that the real rate of return roughly equals the nominal rate of return minus the price increase. This is a well-known conclusion, which is often used in evaluation of financial investments or loan transactions.

PERIODS OF DEFLATION

A special effect is experienced when prices are going down. The real rate of return will in this situation be higher than the nominal rate of return. This happened in many countries in the 1920's and 1930's.

In Norway prices went down approximately 5.5 per cent in the period 1920–1933.

The interest rate for long term loans in this period averaged about 6 per cent. This shows that the real rate of return was approximately 11–12 per cent for a rather long period, and this is, at least for Norwegian conditions, a very high real rate of return.

REAL INVESTMENT

We can also solve equation (3) with regard to the nominal rate of return:

$$(5)\ p = p_r(1+j) + j$$

Equation (5) shows that the nominal rate of return is equal to the real rate of return plus the price increase. Equation (5) is the best way of representing the equation for evaluation of investments in real capital. The conditions that must be met in order to realise the real interest are best shown in this equation. Equation (5) shows that if one is to obtain the real rate of return, one has to add the price increase. This implies that the cash flow must keep up with the price increase. We will show this in a concrete example.

EX-POST CALCULATION

We will here discuss an ex-post calculation of investment in afforestation. The forest stand was established around the year 1900. It was thinned in 1940 and in 1960. Final cutting took place in 1975. One can then calculate the nominal rate of return of the afforestation by using the same symbols as before:

$$(6)\ A = \frac{a_{40}}{(1+p)^{40}} + \frac{a_{60}}{(1+p)^{60}} + \frac{a_{75}}{(1+p)^{75}}$$

A, represents the cost of establishing the stand in 1900. The cost is put to 100 kr per hectare. According to official statistics, this represents the pay for approximately 40 days' work in 1900. The calculation is further based on certain assumptions concerning thinning and final cutting. The estimation of stumpage value is based on official statistics for timber prices and logging costs. The assumptions are shown in the following table:

Year	Cut m³ per hectare	Stumpage value kr/m³	Kr per hectare
1940	30	5	150
1960	60	25	1,500
1975	280	100	28,000

Yearly mean increment over the 75 years is 5 m³ per hectare. The calculation for the total stand is shown in:

$$(7)\ 100 = \frac{150}{(1+p)^{40}} + \frac{1,500}{(1+p)^{60}} + \frac{28,000}{(1+p)^{75}}$$

Cash flows are measured in nominal prices, and the nominal rate of return is calculated to 8,2 per cent. The special development of the cash flows will be discussed below. To calculate the real rate of return, we must know the price increase for the period 1900–1975 in Norway. This price increase was approximately 3.5 per cent per year measured by the consumer's price index. The real rate of return can be arrived at on the basis of the following equation:

$$(8)\ p_r = \frac{0.082-0.35}{1.035} = 0.046$$

The real rate of return of this afforestation is approximately 4.6 per cent.

This calculation of a realised investment shows that the investment really can defray an 8.2 per cent interest rate for a loan of 100 kr per hectare in 1900. The loan could, however, not have been repaid before 1975. In practice this would have created financial problems, because the assumption that the loan carries neither interest nor instalment obligations for a 75-year period is unrealistic.

EX-ANTE CALCULATIONS

In investment calculations we normally use real prices. In our calculation this means prices in 1975. The cost of establishig a stand in 1975 is 1,500 kr per hectare, the stumpage value for thinning in a 40 year old stand is put to 50 kr/m³, and in a 60 year old stand to 75 kr/m³. Stumpage value per m³ in final cuttings is estimated to 100 kr per m³. We use the same production figures as in the previous calculation:

$$(9) \quad 1,500 = \frac{30 \cdot 50}{(1+p)^{40}} + \frac{60 \cdot 75}{(1+p)^{60}} + \frac{280 \cdot 100}{(1+p)^{75}}$$

$$= \frac{1,500}{(1+p)^{40}} + \frac{4,500}{(1+p)^{60}} + \frac{28,000}{(1+p)^{75}}$$

The interest rate is 4.5 per cent. Is this a nominal or a real rate of return? If the net price per m³ is the same in nominal prices in 2050 as in 1975, the formula (9) gives us nominal rate of return. If the general price increase in the same period has been 4.5 per cent, the real rate of return of this investment equals 0:

$$(10) \quad p_r = \frac{p-j}{1+j} = \frac{0.045-0.045}{1.045} = 0$$

Such a development is not very likely. It would imply that the stumpage value of timber in the future will increase by 4.5 per cent less per unit than the general price level. An assumption that is very often made in such calculations, is that the net price per m³ changes in accordance with the general price development. The following equation yields the real rate of return:

$$(11) \quad 1,500 = \frac{1,500\ (1+j)^{40}}{(1+p_r)^{40}\ (1+j)^{40}} +$$

$$\frac{4,500\ (1+j)^{60}}{(1+p_r)^{60}\ (1+j)^{60}} = \frac{28,000\ (1+j)^{75}}{(1+p_r)^{75}\ (1+j)^{75}}$$

The price increase, j, can be eliminated and one sees that the real rate of return is calculated automatically.

If we include a price increase of 4 per cent in the calculation, i.e. $j = 0.04$, then the cash flow will increase substantially, and the calculation of the nominal rate of return will be as follows:

$$(12) \quad 1,500 = \frac{6,000}{(1+p)^{40}} + \frac{47,350}{(1+p)^{60}} + \frac{530,320}{(1+p)^{75}}$$

The equation places the nominal rate of return at 8,7 per cent. Equation (5) yields the same result. It is this rate of return that should be compared with the rate of interest on loans in evaluations of investments in silviculture. From a financial point of view, it is especially the development of cash flows in nominal prices that is of intrest. No loan can be repaid before the final cutting has taken place.

THE ROLE OF THE INTEREST RATE IN CALCULATIONS OF FINANCIAL MATURITY

In calculations of financial maturity we estimate the real rate of return by means of the increase in real value of different stands each year. This value is in most cases used for estimating the relative maturity of the different stands. But when the stands are evaluated as a source of capital, it is the nominal rate of return that the stands gives over short and somewhat longer periods that is of special interest.

What is the nominal rate of return from such a stand? According to equation (5) the nominal rate of return equals the real rate of return plus the price increase. We will look at this in a maturity age calculation. The value of the landarea is put at 0. H_0 is said to equal the stumpage value of the stand at point 0. The increase in real value of the stand is v. The change in net prices of timber is j_t. The calculation for estimating the nominal rate of return can then be written as follows:

$$(13) \quad H_0 = \frac{H_0\ (1+v)\ (1+j_t)}{1+p}$$

This equation yields:

$$(14) \quad p = v+j_t + j_t \cdot v = v\ (1+j_t) + j_t =$$

$$p_r\ (1+j_t) + j_t$$

If we assume that the net price of timber follows the general price development ($j_t = j$), we get, naturally enough, the same relationship as in equation (5). When this assumption is met, the real rate of return in a long term calculation of investments in silviculture can be compared with the real rate of return in a calculation of maturity age. This real rate of return can be compared with real interest on loans and real interest on savings accounts.

The net price of timber will not vary in the same way as the general price level, however, since it is more sensitive to the ups and downs of business in general, the shorter the period, the more sensitive it is. Thus the result will vary considerably from one year to an other; one year the rate of return can be negative and the next year positive. This indicates that calculations of financial maturity should be based on periods of 5–10 years. Decisions whether or not to reduce the forest capital should be made against such a background. The nominal rate of return that this forest capital gives must be compared with the interest rate on medium-long loans.

INTEREST RATE — LIQUIDITY

The interest rate goes down when the amount of money increases in society. This can be explained by traditional capital theories and is caused by different motives (demands for cash or security, a wish to speculate). In forestry, mature forest consitutes a liquid asset if the transportation system is well developed. A forest owner can then realise a small or a substantial part of the standing timber over a rather short period. An area of production forest is much less liquid. The value of the area is based on future increments, and the value can not be realised unless the whole area is sold. Many forest owners therefore charge a higher rate of interest on their long term investments in silviculture than on short term savings bound to liquid wood capital. The forest owners can accept a lower rate of return if they refrain from cutting mature forests (speculation motive). The acceptable reduction of the interest rate will probably be higher for owners with a low income and few assets. The liquidity aspect is closely tied to risk conditions and the taxation system in forestry.

RISK AND INFLATION

There are risk factors and uncertainties associated with forestry calculations. These can be ascribed to biological, technological and economic variables. Such calculations are therefore necessarily complex. We will mention only one aspect, which has to do with financial factors.

A forest owner can nowadays borrow money at an interest rate of 10–12 per cent (nominal) in Norway. He can invest the money in silviculture, which gives an expected rate of return of 3–4 per cent. Let us assume that this rate of return is fixed no matter what the general price increase will be in the future.

The condition is that the net price of timber will follow the general price level. When a forest owner borrows money at an interest rate of 10 per cent, and invests at 4 per cent in today's prices, the forest owner bases his investment on rate of inflation of at least 6 per cent. If the future general price increase is 4 per cent, the forest owner in reality pays a real interest rate of 6 per cent when the interest on loans is 10 per cent.

Even if the rate of interest on loans decreases in the future, the forest owner will have paid higher real rate of interest in advance than his investment in silviculture

gives. This suggests that the forest owner might expect a higher rate of return on investments in silviculture in a period of a hight nominal interest level, even if the net price of timber follows the general price level. Investments in silviculture are more risky in periods of substantial price increase and stiff rates of interest.

What has been said above also applies to mature forest stands, but the risk of insect damage, drying, rotting, and windfelling will be more important.

TAXATION – LIQUIDITY – RISK

In this paragraph we will discuss certain consequences of the taxation system. In Norway as in most other countries, investments costs in silviculture are deductible from the gross income. In Norway it is the net value of the timber cut which is taxable. Interest paid on loans is also deductible. These rules are of great importance for the profitability of long range investments in silviculture.

Let us introduce taxation in equation (12) and assume; somewhat unrealistically, that the tax level stays at 60 per cent, at the times of investment, thinning and final cutting. This is done to elucidate the effect of taxation as clearly as possible. It can be shown by modifying our previous example as follows:

$$(15) \quad 1,500(1-0.60) = \frac{6,000(1-0.60)}{(1+p)^{40}} +$$

$$\frac{47,350(1-0.60)}{(1+p)^{60}} + \frac{530,320(1-0.60)}{(1+p)^{75}}$$

All the sums are given in nominal prices. The value in nominal prices forms the basis for taxation. This goes for both the deduction of the investment in silviculture, the net value of thinnings, and the final cutting. If we compare equation (15) with equation (12), we see that the nominal rate of return remains uninfluenced by taxation given a constant tax level. The nominal rate of return on investments in silviculture is the same both before and after tax. The nominal rate of return after tax in silviculture can be compared with the interest on loans after tax. The marginal tax rate is of importance in this comparison. Since interest on loans can be deducted from gross income, a 10 per cent interest rate will be reduced to 4 per cent given a tax rate of 60 per cent. This nominal rate of return after tax should be related to investments in silviculture. In the example we discussed above the nominal rate of return was 8.7 per cent. The stand could defray an interest rate of 8.7 per cent before tax. If taxation is taken into consideration, the stand can defray an interest rate of more than 20 per cent before tax if the tax rate is 60 per cent. One effect of taxation is, therefore, to reduce the risk in borrowing money.

So far we discussed the effects of taxation on profitability, but we have also shown that the financing of investments is made much easier because of the favourable effects of our tax rules. Since investments can be deducted from taxable income, a great part of the cash outlay can be financed indirectly since the amount of tax paid is reduced considerably. In our example, with a tax rate of 60 per cent, the reduction is 900 kr. The amount which the forest owner puts into silviculture per hectare is then 600 kr. If the investment is financed through loans, 600 kr is the amount he must borrow.

In calculations of maturity age the effect of taxation will be the same. The rate of return before tax equals the rate of return after tax in these calculations as well. This is shown in the following equation:

$$(16) \quad H_0(1-s) = \frac{H_0 \ (1-s) \ (1+v) \ (1+j_t)}{1+p}$$

In this calculation the tax rate is s, and we see that profitability in the maturity age calculation is not influenced by taxation if the tax rate is constant.

In this way the tax can increase the maturity age of the stand when the alternative rate of return is the borrowing rate, and the amount of interest paid can be deducted from taxable income. The calculation also shows that an important part of capital vested in forest must be paid in tax at the time of cutting. The taxation system can therefore reduce the risk both of investments and of keeping wood capital both from a profitability and from a financial point of view. On the other hand, the forest plays a minor role as a source of capital if the marginal tax is high. Especially on smaller properties this might be an important factor.

CONCLUDING REMARKS

In this article we have shown that taxation to a great extent can influence capital management in forestry. The taxation system can increase the rotation period in forestry and stimulate investments in silviculture. But this depends on the rate of return after tax that the forest owner more or less deliberately bases his decision on concerning cutting and investments. The rate of return the forest owner hopes to realize is shown by his marginal investments in silviculture and in his cutting policy. The real rate of return charged by the forest owner will be influenced by several conditions – the interest rate on loans, the development of the price level, liquidity, risk factors and tax. Especially the tax rate and the price increase will be of great importance when the borrowing rate is used as discount rate in investment decions. The effect is that the rate of return charged on any cash outlay made will vary with the level of the tax rate. Forest owners with a high income and a high marginal tax rate will, therefore, manage their forests more intensively than forest owners with a low income, and a low marginal tax rate.

The rate of interest on private capital invested in forest properties will also be of importance. Investments in forest assets will depend on the profitability of alternative investment possibilities. But a forest owner can also choose a certain discount rate and do business according to that. In Norway the Ministry of Finance has indicated a real discount rate of 7 per cent, which is to be used for all public projects. If this interest rate were to be used for investments in state-owned forests, the result would be an increase in the total cut and a drop in investments in silviculture.