APPENDIX TO: "Explaining underutilization of tax depreciation deductions. Empirical evidence from Norway," Karl Ove Aarbu and Jeffrey MacKie-Mason.

A. The Norwegian corporate tax system

A.1. Before 1992

The corporate tax system in Norway is quite similar to those found in most OECD countries, with a few important differences. The municipal tax rate is quite high, and before 1992 it was paid on a base somewhat different from the national tax. A substantial fraction of pre-tax earnings could be allocated to various tax-deferred accounts. And, as mentioned above, different from some but not all OECD countries, before 1992 there was uniform reporting, which required reconciliation between the tax and the accounting measures. We will describe some important details of the tax calculation.

The definition of accounting profit after tax is

$$\Pi - d^B - rB - (d^T - d^B) - F - T \tag{A.1}$$

where Π is operating profits, d^B is book depreciation, d^T is tax depreciation (and thus (d^T - d^B) is accelerated depreciation), F is fund allocations, T is corporate tax and rB is net interest cost where r is the interest rate and B is the net debt. The amount of accelerated depreciation, (d^T - d^B), can be either positive and negative. When the corporation has positive net investments accelerated depreciation will usually be positive, when net investments are negative accelerated depreciation will usually be negative. Only the declining balance method is used for tax depreciation on physical assets. This method is geometric: a given percentage of the remaining undepreciated value of the asset is deductible in each year. Book depreciation, d^B, which can be either linear or geometric, is intended to approximate economic depreciation, and may differ from tax depreciation.

The most important tax deferred fund allocation, F, was the so-called consolidation fund. Each year a corporation could allocate 23 percent of the pre-tax profit into this fund. There were no requirement to reverse these fund allocations, which meant that the corporation could defer taxes to infinity. The consolidation fund allocation can be defined as

$$F = \varphi \max(0, \Pi - d^B - rB - (d^T - d^B) - \Psi) \tag{A.2}$$

where φ is the consolidation fund allocation rate, 23 percent in 1991, and Ψ denotes tax loss carryforwards. We see from (A.2) that a corporation with a negative tax base after loss carryforwards could not allocate to the consolidation fund. For simplicity we will assume, however, that the tax base after loss carryforwards is positive.

Before 1992 corporations paid a municipal tax of 23 percent, and a national tax of 27.8 percent, for a total of 50.8 percent. The tax bases were different: dividends were deducted only for the national tax. We let η be the municipal tax rate and κ be the national tax rate, to write the total tax as

(A.3)

$$T = \eta(\Pi - d^B - rB - (d^T - d^B) - F - \Psi) + \kappa(\Pi - d^B - rB - (d^T - d^B) - F - \Psi - \max[0, D^*])$$

where

(A.4) $$D^* = \min[D, \Pi - d^B - rB - (d^T - d^B) - F - \Psi]$$

where D is dividends. Dividends are deductible in the national tax base only to the extent of positive current profit after loss carryforwards.[1]

Norwegian corporate tax law permits a corporation to pay dividends out of current profit plus free equity (accumulated retained earnings). Therefore as an accounting definition we have

(A.5) $$\Pi - d^B - rB - (d^T - d^B) - F - T + \Omega \equiv D + \quad R + (\Delta\Omega + \Omega)$$

where R is the allocation to the reserve fund, and Ω is the firm's free equity.[2] The residual, $\Delta\Omega$, can be positive or negative depending on the current profit.

One exogenous constraint on dividends is that under certain circumstances, some of the current profit must be allocated to the so-called reserve fund (R). The reserve fund is equity that must be retained to protect the creditors: it has no tax consequences but it cannot be used to finance dividends.[3] The reserve fund requirement is most often binding for new corporations, corporations that use debt as their primary financing source, and corporations that do not have enough return on their investment to build up the reserve fund (these will, of course, disappear in the long run).

If we use (A.2) and (A.3) to substitute for T and F in (A.5), assume that current profit after loss carryforwards is positive[4], and then solve for d^T and add the maximum allowable tax depreciation $d^{\max}$ on both sides to find the amount of underutilization we get:

(A.6)

$$d^{\max} - d \equiv d^{\max} + rB - \Pi - \frac{1}{(1-\varphi)(1-u)}[(\varphi + (1-\varphi)u)\Psi - D(1-\kappa) - (\Delta\Omega + \Omega) - \quad R]$$

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[1] Firms are also allowed to pay dividends out of their accumulated retained earnings, but these are not tax deductible. Equation (A.3) is a simplification of the Norwegian corporate tax function. There are several other deductions, but for our theoretical analysis these can be omitted without any loss of generality.

[2] We have ignored one additional complication that does not affect the qualitative implications. For the purpose of paying dividends, a firm can add the accumulated consolidation fund net of the value of taxes deferred to its free equity.

[3] The firm must allocate 10 percent of current year profit after tax to the reserve fund if the accumulated reserve fund is: i) less then 20 percent of the book share value, or; ii) the reserve fund plus revaluation fund plus book share value (we call this amount X) is less than total debt. (The revaluation fund is where the firm accumulates periodic book value adjustments due to significant changes in the market value for assets). In addition, if the corporation chooses to pay more dividends than 10 percent of X, it must also allocate the same amount to the reserve fund as the difference between dividend paid out and 10 percent of X.

[4] This assumption is for expository ease; the qualitative results do not depend on it.

where $u = \eta + \kappa$.[5]

A.2. After 1992

The 1992 tax reform changed the corporate tax system radically. The corporate tax rate (combined municipal and national) was reduced from 50.8 percent to 28 percent. This reduction was offset by an increase in the tax base. Allocations to tax-exempt funds (e.g., the consolidation fund) were abolished and tax depreciation rates were decreased. If a corporation had owners who worked in the corporation (active owners) and who collectively controlled more than 2/3 of the shares (or dividends), the corporation had to pay an additional tax, called personal tax, on corporate profits. This tax is a function of the owners' income, but the corporation pays the tax. The accounting rules were also changed, to replace uniform reporting with separate reporting.

Before the reform the difference between tax and accounting depreciation was deducted from accounting profit, and registered as an increase in long-term debt; after the reform accounting profit is only reduced by the tax value of the difference. That is, the deferred tax due to accelerated depreciation is deducted from current profits, which cancels out the effect of tax depreciation on the dividend constraint. To see this, we can write the accounting profit after the tax reform as:

$$\Pi - d^B - rB - S + \Omega \equiv D + \quad R + (\Delta\Omega + \Omega) \tag{A.7}$$

where S is the tax cost. Equation (A.7) tells us that current profit after tax plus free equity can be used to pay dividends, increase the reserve fund or increase owners' equity. The tax cost is the sum of the currently payable tax, T, and the deferred (postponed) tax, P, i.e. $S = T + P$. A simplified corporate tax function for the payable tax can be written as:

$$T = \tau(\Pi - d^T - rB - \Psi) + \tau_w(\Pi - d^T - \rho K - W) \tag{A.8}$$

where τ is the corporate tax rate and τ_w is the personal tax rate. The tax base for the personal tax is operating profits minus depreciation, an imputed capital return (ρK) and a wage deduction.[6] The imputed capital return is calculated as a fraction of the corporation's tangible assets (16 percent in 1992). Only the first term on the right hand side applies when the corporation is not obliged to pay personal tax.

The deferred tax can be written as:

$$P = \tau(d^T - d^B) \tag{A.9}$$

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[5] To calculate the amount of the dividend that is deductible from the national tax base (see equation (3)), we have assumed that the dividend itself is less than current pre-tax net income net of loss carryforwards (and thus is fully deductible, and the coefficient on D becomes $1[(1-\varphi)(1-u)]$. If the net income measure is negative, no dividend is deductible, and the coefficient on D becomes $1[(1-\varphi)(1-\eta)]$. Obviously, the qualitative relationship between underutilization of tax depreciation and the payable dividend is unaffected by which of these three cases is in effect.

[6] The "lønnsfradrag" or supplemental wage deduction is intended to account for a return to managerial human capital. It is calculated as a percentage of the difference between the firm's total wages and the wages of the active owners. The current percentage is 20 percent.

which is simplified because assets other than depreciable capital will contribute to P. These other deferrals have no effect on our analysis, however. If we substitute for T and P in (A.7) we get

(A.10)
$$(1-\tau-\tau_w)\Pi-(1-\tau)(rB+d^B)+\tau_w(d^T+\rho K+W)+\tau\Psi+\Omega\equiv D+\quad R+(\Delta\Omega+\Omega)$$

For $\tau_w = 0$, equation (A.10) will be reduced to:

(A.11) $\quad (1-\tau)(\Pi-d^B-rB)+\tau\Psi+\Omega\equiv D+\quad R+(\Delta\Omega+\Omega)$

B. The asymmetry between tax depreciation and loss carryforwards

It may be useful to discuss optimal strategies in the use of tax depreciation in the Norwegian tax system. If the corporate tax system consist of a constant tax rate in an infinite time horizon and the tax system is approximately symmetric i.e. losses can be carried forward, the optimal strategy is to minimize taxes every year. Even if a corporation have a negative operating result the best strategy is to minimize (negative) taxes through a maximal use of tax depreciation. The reason for this is that there is an asymmetry between tax depreciation and loss carryforwards. A loss carryforward can be increased through the use of tax depreciation, and deducted from the result in the next period. On the other hand, if a corporation do not utilize all the possible tax depreciation one year, the corporation cannot claim more tax depreciation than the maximal rate multiplied with the depreciation base. To see this clearer we can illustrate this point with some equations.

Consider a corporation tax base in two periods. We assume that the tax rate is equal in both periods and linear. Let the corporation have a profit before tax depreciation equal to Π_1 the first period, further we assume that the depreciation base is K with a depreciation on $\rho_m K$ the first period if the corporation uses the maximum rate. If the corporation uses a lower rate the depreciation is just ρK. The tax base after the tax deprecation in these two cases are

(B.1)
$$N_{1m}=\Pi_1-\rho_m K<0$$
$$N_1=\Pi_1-\rho K=0$$

Where N_{1m} is the tax base when full tax depreciation is used and N_1 is the tax base with a lower depreciation. We have assumed, in making the example interesting, that use of full tax depreciation and the lower rate ρ both gives zero tax in period 1. In period 2 we assume that the tax base before tax depreciation is sufficiently large to cover maximal tax depreciation. The corporation can carryforward loss to the second period. Thus, the tax base in period 2 given full tax depreciation in period 1 becomes

(B.2) $\quad N_{2m}=\Pi_2-N_{1m}-\rho_m^2 K$

The tax base in period 2 given that the corporation used a lower depreciation rate in period 1 generally becomes

(B.3) $N_2 = \Pi_2 - N_1 - \rho_m (1-\rho) K$

We notice that there is no difference in the tax payment in period 1. The difference between the tax bases in period 2 are

(B.4) $N_2 - N_{2m} = K(\rho_m - \rho)(1-\rho_m) > 0$

which is clearly positive. This means that the tax payment in period 2 is higher if the corporation uses a tax depreciation rate lower than ρ_m in the first period, even if the tax payment in the first period is the same (zero in our example). This effect is due to the asymmetric treatment of tax depreciation and loss carryforwards. Our example will exaggerate the difference between the to strategies compared to the Norwegian tax system, because we have implicitly assumed that the corporation can carry the losses forward with interest. This is not true in the Norwegian tax system, but as we see from equation (B.4), a discount rate cannot change our result.

C. Construction of underutilization data

The underutilization of tax depreciation allowances is calculated as maximum depreciation minus actually claimed depreciation. Every corporation has to fill in a tax depreciation form for every asset it owns. Every type of asset has a certain maximum percentage of depreciation that allows us to find the maximal depreciation for every single corporation within each year. The actually claimed depreciation is given on the form. It is then quite easy to calculate the difference between maximum and actual depreciation. In 1991 there were twelve different types of asset groups with different maximum allowed depreciation rates. In two of the asset groups there is not a unique maximum depreciation rate. Some of the assets in these groups have in general a maximum depreciation rate of ρ, while other have a maximum depreciation rate of ρ/2. This makes it difficult to know the maximum rate for these assets. We have controlled for this in using the low rate if the corporation has used the low rate, and using the high rate if the corporation has used a rate higher rate than the low rate. This solution is not perfect, but is the best we can achieve given the data, and it implies that we do not exaggerate the underutilization.

Some corporations can both have negative and positive depreciation bases within one asset group. Unfortunately the asset forms are aggregated within every asset group, and the depreciation base we observe is therefore not necessarily the correct base, in fact we can in many cases observe negative bases and positive depreciation. We have, however, been able to control for this because we have the sum of the negative bases within every asset group for every corporation, but the uncertainty is greater in these cases.

The maximum and actual depreciation are calculated precisely as follows:

Maximum depreciation = (observed base-sum of negative bases)*max. depr. rate

Actual depreciation = observed depreciation