Petroleum tax reform proposals in Norway and Denmark*

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Abstract
During the past two years similar petroleum tax reforms have been proposed in Norway and Denmark. Both were based on results on neutral taxation derived by Boadway and Bruce (1984) and Fane (1987). Main features of the proposals are presented, and important problems of implementation are highlighted. Topics for further research are pointed out. While the risk characteristics of tax deductions caused major disagreements between experts and oil companies, the after-tax cost of capital for risk free cash flows is a less clearly resolved question within the economics literature. Another topic for disagreement is value additivity, disputed by the companies.

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1. Introduction

In October 1999 the government of Norway appointed a commission to look into the country’s petroleum taxation and propose reforms. In March 2001 the government of Denmark did likewise. Only a few elements of the Norwegian commission's proposal of June 2000 were finally passed by the Storting (the Norwegian parliament) a year later. At the time of writing, the destiny of the Danish proposal of October 2001 is not known.

Both commissions were guided in their work by mandates worked out by the respective ministries. Both mandates asked for proposals for neutral tax systems, explicitly justified by an objective of economic efficiency. Apart from this there were several minor differences between the two countries, reflected also in the reports from the two commissions. The major difference is the scope of the proposals. While the Norwegian ministry asked for a reform for the whole Norwegian petroleum sector, the Danish ministry only asked for a reform for future licenses. This reluctance to tax existing licenses efficiently is not viewed as a legal necessity. Legally Denmark might impose a new tax system on existing licenses as well. But it is probably regarded as precaution in order not to destroy Denmark’s relation to the oil companies, in particular the current licensees.

Several specific concerns were mentioned in the mandates. In both countries the ministries suspected that investment-based deductions were too generous for companies with incomes subject to tax. In Norway there was also a consideration about encouraging new firms without taxable income, and a concern for a too generous rule for interest deduction for companies which also have substantial activity in other sectors and countries.

In both countries, all resources are found offshore. Norway has a large petroleum sector, in particular in relation to its small population of 4.5 million people. Proved reserves at the end of year 2000 were 1.2 billion tonnes of crude oil and 1.25 trillion Sm³ of natural gas.¹ Denmark has about the same population, but only about one tenth of the reserves of

¹ BP (2001).
Norway. The smaller size of the sector, and also of the average field, may explain some of the reluctance to impose unexpected tax reforms on the companies.

Both countries have relied on discretionary licensing, without high up-front payments for licenses. This leaves the potential of significant rents. In order to capture parts of the rent, these countries have introduced royalties and special petroleum taxes on top of ordinary corporate income taxes. The royalties were levied on gross production value and have been phased out since they were seen as having distortionary effects. The special petroleum taxes have investment-related deductions, known as uplift, to protect a “normal” rate of return from the tax.

The current paper\textsuperscript{2} presents some main features of the proposed reforms, including also a brief review of the underlying theory. Space does not allow a full presentation, so I concentrate on issues having to do with implementation of the theory of neutral taxes. The paper is a survey, with no new theoretical results.

Section 2 discusses the principles and implementation of a neutral tax, based on the standard assumption of value additivity. Separate subsections discuss whether there should be risk adjustments and/or tax adjustments in the discount rate. This is done first for the case of equity financing, while debt financing is considered in section 3. Section 4 discusses developments after the commissions’ proposals. Section 5 concludes.

\textbf{2. Neutral rent taxation under uncertainty}

The concept of neutral taxation of companies, not affecting behavior compared with some relevant benchmark, can only be meaningfully applied if one has a theory of how companies behave. The mandates' explicit mention of neutrality to achieve efficiency clearly implies a neo-classical economic theory.\textsuperscript{3} This explains why the commissions based their work on that theory. This section reviews parts of the standard theory, consistent with, for example, Bradley (1998).

\textsuperscript{2} This author was a member of both commissions.
Decisions on undertaking investment projects are of particular interest. Investments in petroleum are made in stages, such as exploration, then possibly development, operation, and decommissioning of a field. The theory of real options is relevant. The following fairly simple theory of neutral taxation under uncertainty from Fane (1987) and Bond and Devereux (1995), which underlies the commissions’ proposals, does not specify the options, but is valid also when decisions have such a character.

In year 0 the company attaches a value \( V(\tilde{X}_t) \) (a real number) to an uncertain future cash flow \( \tilde{X}_t \) to be received in a later year \( t \). The cash flow may have a positive probability both for positive and negative outcomes. All magnitudes are nominal, not corrected for general inflation. In this section we assume that the company is fully equity financed.

The valuation function \( V \) is assumed to have the following two properties:

1. When \( a \) and \( b \) are constants, and \( \tilde{Y}_t \) is another uncertain cash flow, then
   \[
   V(a\tilde{X}_t + b\tilde{Y}_t) = aV(\tilde{X}_t) + bV(\tilde{Y}_t),
   \]
   known as value additivity. This holds for any valuation model in financial theory, such as the CAPM, the APT, and option valuation models.

2. If a cash flow \( Z_t \) will be received with certainty in year \( t \), then
   \[
   V(Z_t) = \frac{Z_t}{(1 + r_s)^t},
   \]
   where \( r_s \) is known as the company’s nominal “after-tax cost of capital.” For simplicity, assume this is the same for all periods.

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3 When there are externalities, neutral taxes in the standard sense will not achieve efficiency. Even though the topic is important, it is neglected here because it was not a major issue in these reforms.

4 See Brennan and Schwartz (1985), McDonald and Siegel (1986), Paddock, Siegel and Smith (1988), and Laughton (1998).

5 For simplicity this notation assumes that the scalar argument of the \( V \) function has a time subscript, which gives the necessary indication of when the cash flow will appear.
Together these two properties imply that one can find exact valuations, as seen from year zero, of risk free elements of the cash flow in any year, even if $V$ is not more closely specified. Let $\tilde{X}_i$ be cash flows from a project in the years from 0 to $T$. By definition the project is exactly marginal for a company if

$$\sum_{i=0}^{T} V(\tilde{X}_i) = 0.$$  \hspace{1cm} (1)

2.1. A true cash flow tax

A neutral tax system is taken to mean a tax system such that a project which has positive value before the tax, also has a positive value after the tax, and a project which has negative value before the tax, also has a negative value after the tax. By a true cash flow tax we mean a proportional tax on the company's cash flow, with payouts from the government (“negative taxes”) in years with negative cash flow.\(^6\) This mainly theoretical construct is a good starting point for the discussion of neutral taxes.\(^7\)

If a cash flow tax is levied with the same rate, $\tau^k$, in every year, the project will still be marginal, since value additivity implies,

$$\sum_{i=0}^{T} V(\tilde{X}_i) > 0 \iff \sum_{i=0}^{T} V(\tilde{X}_i(1-\tau^k)) \equiv (1-\tau^k) \sum_{i=0}^{T} V(\tilde{X}_i) < 0.$$  \hspace{1cm} (2)

Thus the tax system is neutral. This conclusion rests on an assumption that the valuation function itself is not affected by the tax. In a general equilibrium model one could expect something else, such as income effects, or substitution effects via the rates of return on alternative investments. Such effects are neglected here, which means that I use a partial equilibrium model. This could be seen as a simplification, but also as realistic if the tax

\(^6\) This is often called a Brown tax, after the seminal paper by Brown (1948).

\(^7\) Cash flow taxes may be based on cash flow to equity or total cash flow. For now we assume that the company is fully equity financed, so the distinction is irrelevant here.
system applies only in a small open economy or in a small sector of a large economy. Sandmo (1979) shows that the assumption that the rate is constant over time, is crucial.

If a project contains real options, the cash flow tax is still neutral, given the standard method for valuation of these. The method is based on financial theory, and value additivity holds.

The actual objective of both commissions was to avoid affecting investment decisions compared with a situation with only a corporate income tax in effect. In both countries a corporate income tax is in place alongside the special petroleum tax, and both commissions proposed to maintain it. This implies a reinterpretation of the model, in which $\tilde{X}_t$ is the cash flow after the corporate income tax, which would also be imposed. The cash flow tax is then most easily applied to that cash flow, that is, the corporate income tax is deductible in the base for the cash flow tax. With this reinterpretation of $\tilde{X}_t$, the cash flow tax is neutral in the new sense, comparing with a situation with only a corporate income tax.

There are some questions regarding the relation to the corporate income tax. One is the normative one, whether it would have been better to try to obtain neutrality compared with a no-tax situation, that is, a situation with no tax in the own country's petroleum sector. One justification for the proposals is to achieve efficiency vis-a-vis other sectors, that is, the before-tax marginal rate of return should be the same in all sectors. Another justification is to avoid incentives to transfer costs into the petroleum sector. There would have to be substantial deduction possibilities to counteract the tax wedge imposed by the corporate income tax.

A second question has to do with the discount rate of companies. In a closed economy it may be essential to know the system for taxation of corporate and capital income in the

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8 The Norwegian commission proposed something which is formally different, but shown to result in the same tax payments.
rest of the economy in order to determine the company’s discount rate. In an open economy, however, this is less relevant.

2.2. A modified cash flow tax
Neither the Norwegian nor the Danish commission proposed true cash flow taxes. There may be several reasons why a government does not want to pay out negative taxes. In the economics literature the most prominent reasons are the liquidity constraint and the reluctance to take on risk.¹ These may be more relevant for poorer countries. In Norway, however, the government has taken large (non-carried) equity stakes for more than twenty years, and Denmark has also taken twenty percent in later licensing rounds.

A different, seemingly technical reason given by the commissions is the existing treaties to prevent international double taxation. These are not designed for true cash flow taxes, but for the more traditional corporate income taxes. It is not clear whether foreign governments (for example, the U.S.) would tax a payout from a cash flow tax system, or whether they would regard cash flow tax payments as creditable under the treaties. Such implementation problems are often neglected in theoretical discussions.

The commissions therefore proposed modified cash flow taxes with postponed deductions, reducing or avoiding the need to pay out. Boadway and Bruce (1984) showed how deductions may be given in order to preserve the neutrality property of the cash flow tax. Fane (1987) extended the result to a setting of uncertainty, under the assumption that the deductions would be effective, sooner or later, with full certainty. In that case one needs no further assumptions than those given above to give the condition for neutrality, namely that the present value of deductions is maintained as compared with a cash flow tax. Many schedules for deductions satisfy this condition.

The modification which is best known in the natural resource economics literature is the Resource Rent Tax (RRT) proposed by Garnaut and Clunies Ross (1975). The system

¹ On risk see Garnaut and Clunies Ross (1975), p. 284. On p. 282 both arguments are applied to the relation between the RRT and the corporate income tax. They apply a fortiori to a true cash flow tax.
does not rely on any specification of depreciation schedules. Investments are expensed, so that the yearly tax base is the cash flow. If the cash flow is negative, however, there is no payout from the tax system. Instead the balance is carried forward one year, and it accumulates interest. Next year this negative balance, with interest, is added to (algebraically, that is, subtracted from) the year's cash flow (which may perhaps also be negative). If the sum is negative, this balance is again carried forward with interest, and so on. When negative cash flows precede positive cash flows in time, this system has the property that taxes are first paid when the activity has realized an internal rate of return equal to the interest rate used in the accumulation, and then in any subsequent year. If the activity does not realize that rate of return, no tax is paid. If a tax is paid in some years, and in particular in the final year, the tax is equivalent on a present value basis to a cash flow tax.

The Resource Rent Tax was also recommended by the Institute for Fiscal Studies (1981), and has been adopted in some countries and regions, most recently by the Faroe Islands, an autonomous region within Denmark. Compared with a true cash flow tax, the system is in a sense the minimum deviation without payouts, since deductions are taken as soon as allowed by positive cash flows. Even this system was rejected by the commissions, however. The main reason is again technical, namely the wish to conform to a corporate income tax system as closely as possible. The main reason for this is again the international tax treaties. Already Garnaut and Clunies Ross (1975) were worried that their system, with low tax payments early in a project and higher tax payments later, compared with a corporate income tax, would mean that companies had to pay taxes in their home countries early, with no compensation later.

Thus the commissions proposed that an investment not be expensed immediately, but written off according to some depreciation schedule. The deductions given for an

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10 The possibility of a negative accumulated tax base in the final year, possibly after tax payments in previous years, is considered below.

11 Actual, similar cases have been tried in court in the U.S., concerning the creditability of the British Petroleum Revenue Tax, which allows deduction for standardized capital costs instead of reported interest expenses. At least one case is unsettled, see NOU (2000), p. 124 and p. 282.
investment must have a present value, when discounted at the rate $r_s$, equal to the investment itself. This was discussed in a full-certainty framework by Boadway and Bruce (1984). Any schedule for depreciation deductions over time gives the same effect if these deductions add to one hundred percent and are accompanied by deductions for the rate of return on the remaining tax value of the investment. The latter kind of deduction was termed an Allowance for Corporate Equity by Institute for Fiscal Studies (1991). The Norwegian commission proposed it for the whole investment, not only the equity financed part, and named it a Capital Return Allowance.\(^{12}\)

As shown by Fane (1987) the same works under uncertainty, provided that the tax value of the deductions is received with full certainty by the company. This is crucial in order to use the rate $r_s$, which is supposed to make the company indifferent towards postponement only under that condition. The two assumptions made about the valuation function are then sufficient to arrive at a neutrality result.

### 2.3. Risk adjustment in the discount rate?

The systems — both the RRT and the one based on depreciation schedules — are often explained by saying that the tax system should allow deductions for a normal rate of return on investment, and only tax the supranormal rate of return. This language is to the point if one assumes full certainty. Under uncertainty it is somewhat misleading, since it is no longer clear what is meant by a normal rate of return. The theory reviewed and referred to above clearly shows that there is no need for the required expected rate of return for the project as a whole when the tax system is designed. If there should be a risk adjustment in the rate of return, this should refer to the risk which is specific to the deduction cash flow, not the project’s before-tax cash flow. There may be a discussion over the riskiness of the deductions, but even in a standard corporate tax system, these are much less risky than before-tax cash flows, see Summers (1987).

\(^{12}\) The commission proposed that reported interest expenses should not be deductible, and instead this allowance should be proportional to the whole investment.
Both in Norway and Denmark the taxable entity would be a company, possibly with activities in many licenses. This reduces the riskiness compared with project-by-project taxation, since negative cash flows in some licenses may be deducted against positive cash flows in others.

The commissions proposed unlimited loss carry-forward with interest accumulation. They went further and attempted to make deductions close to risk free. The Norwegian commission proposed that companies leaving the sector with an accumulated negative balance should be allowed to sell its activities with this balance to other companies. The Danish commission went even further and proposed payouts from the tax system in these cases (only). But in both cases the perceived risk of the deductions will depend on the companies' trust in the politicians. The perception will vary between companies. But even if the tax system is taken as given and trusted, the circumstances which may make the deductions risky, will also vary between companies and projects. Thus a correct risk adjustment in the discount rate will be impossible to find. It may not be an inferior solution for tax authorities to choose a lower bound for the risk adjustment, that is, no risk adjustment at all. This relies, of course, on the assumption that the correct risk adjustment is small.

In Garnaut and Clunies Ross (1975) there is no specific model to explain what interest rate should be used in the accumulation. They suggest to try to approximate the “supply price of investment,” which they define as the required expected rate of return for investments. This is clearly at odds with value additivity, since they give no justification why the deductions would be as risky as the pre-tax cash flows of a project.

There is little doubt that the idea of only taxing a supranormal rate of return has caused some confusion over the neutrality of the suggested system. As a simple example, consider a situation with \( r_s = 5 \) percent, and an investment cash flow of \( X_0 = -100 \) (non-stochastic) in year zero which yields revenues in year one and two with expected values \( E(\tilde{X}_1) = E(\tilde{X}_2) = 56 \). This expected cash flow stream, \((-100, 56, 56)\), has an
internal rate of return of approximately 8 percent. Suppose that \( \tilde{X}_1 \) and \( \tilde{X}_2 \) are risky, and that the company ex ante considers the cash flow stream \((X_0, \tilde{X}_1, \tilde{X}_2)\) as exactly marginal. For this example there is no need to specify exactly why the required expected rate of return exceeds \( r_x \) and is 8 percent. Supposedly this has to do with \( \tilde{X}_1 \) and \( \tilde{X}_2 \) being risky.

Suppose a rent tax of the type outlined above is introduced. Table 1 shows the expected cash flows when the tax rate is 50 percent.\(^{13}\) Deductions for the investment outlay is given in the form of a linear two-year depreciation schedule combined with a deduction for a 5 percent return on the remaining tax value of invested capital. The deductions are 55 in year 1 and 52.5 in year 2. These are effective in each year because the company with certainty has other income against which to take the deductions in case the realized project cash flows are too low.\(^{14}\) The tax rate is the same in all three years. The example is so constructed that the company is indifferent between a deduction of 100 in year 0 and this pair of deductions in the two subsequent years, since they have a net present value of 100 at the 5 percent discount rate. From the company's point of view, the tax is thus equivalent in present value terms to a true cash flow tax.

Table 1: Expected effects of a cash flow tax and of an income tax.

<table>
<thead>
<tr>
<th>Year</th>
<th>Before tax</th>
<th>Cash flow tax</th>
<th>Income tax with linear depreciation schedule and capital return allowance</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cash flows</td>
<td>Expected cash flows</td>
<td>Expected c. fl. after tax</td>
</tr>
<tr>
<td>0</td>
<td>( X_0 )</td>
<td>-100</td>
<td>-50</td>
</tr>
<tr>
<td>1</td>
<td>( \tilde{X}_1 )</td>
<td>56</td>
<td>23</td>
</tr>
<tr>
<td>2</td>
<td>( \tilde{X}_2 )</td>
<td>56</td>
<td>23</td>
</tr>
</tbody>
</table>

\(^{13}\) The principle to be illustrated has nothing to do with the tax rate. For comparison, a cash flow tax with the same rate is illustrated in the fourth column.

\(^{14}\) One could imagine that the project's risky cash flows had outcomes which, although risky, would exceed 55 and 52.5, respectively, with full certainty. This would contradict the assumptions. In that case the project would stochastically dominate a risk free cash flow stream which is exactly marginal, so the project could not be exactly marginal. The example relies instead on positive cash flows from other projects.
Suppose now that the realized cash flows are exactly equal to the expected ones. The rent tax has a revenue equal to the tax rate multiplied by 56-55=1 in year 1 and by 56-52.5=3.5 in year 2. Even though the realized cash flows are the expected ones, and the project is ex ante exactly marginal before the rent tax, it has to pay a rent tax under this system. Specifically, the tax payments are never negative, and they are strictly positive in two years. Nevertheless the theory shows that such a tax system is neutral, and that the company regards the cash flows after the tax as exactly marginal.

The intuition behind this has to do with the different risk characteristics of the elements of the cash flow. As presented above, the example highlights the expected values, but the correct point of view is the ex ante, risky flows. Lund (2002b) shows how to find the effect of taxes on the cost-of-equity element in the weighted average cost of capital (WACC). The tax reduces the risk of the net cash flow, and thus reduces the WACC.

Obviously, a company which has a capital budgeting procedure which violates the two assumptions made about the $V$ function will tend to disagree with the neutrality result. Using the same discount rate for expected cash flows irrespective of the risk characteristics will necessarily have such consequences. This explains the controversies over the lack of risk adjustment in the discount rate which arose both in Norway and Denmark.

### 2.4. Tax adjustment in the discount rate?

Even if one agrees that a cash flow (such as the value of a tax deduction) is risk free, it is not obvious what discount rate to use. For this discussion it may be important to observe that both commissions were concerned about foreign companies. In particular, many companies are based in the U.S., and the commissions assumed that their countries had effective treaties with the U.S. against international double taxation. Thus the discussion assumes that the after-tax cash flow accrues to a wholly-owned subsidiary of a foreign company, and is immediately transferred into (out of, if negative) the after-tax cash flow.

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15 The translation into effects on the risk of the net cash flow will be specific to each situation, and is mainly of interest here in order to show the magnitude of mistakes which have been made.
of the parent company. Only host country (Norway, Denmark) taxes apply, since the rates (in their petroleum sectors) are substantially higher than home country (for example, U.S.) taxes.

The Norwegian commission assumed that the company has an after-tax cost of capital for risk free cash flows equal to the market interest rate multiplied by a factor “one minus the corporate tax rate.” The result is called the “after-tax” interest rate. This is implemented by using the Norwegian corporate tax rate. The justification for the tax factor is that the investors’ return on alternative investments is taxed, so that they do not require more than this “after-tax interest rate” as long as the cash flow is risk free. Since investors face different tax rates on these alternatives, the justification for using the Norwegian rate of 28 percent could be that it is fairly low by international standards. One may prefer to be in the lower end (that is, a discount rate in the higher end) in order to attract investors.

The Danish commission assumed instead that the after-tax cost of capital may be as high as the market interest rate itself, with no tax adjustment. This is based on the view that the marginal investor is tax free. It is justified in part by consistency with a previous Danish governmental proposal using the same assumption. The marginal investor is supposed to be, for example, a tax exempt pension fund.

While it is certainly true that pension funds are important investors in most OECD countries, and increasingly so, it is not obvious what assumption to base the tax system on. I shall review some arguments, but offer no definite conclusion.

In order to keep different arguments apart, I stick with the assumption of full equity financing in this section, turning to debt financing next. It should be noted, however, that a standard argument in corporate finance text books is that risk free future cash flows can always be financed one hundred percent by debt, see section 19.5 of Brealey and Myers (2000). This seems to underlie their recommendation of the after-tax interest rate as the after-tax cost of capital for risk free cash flows.

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The question is now, to the extent that an investment is financed by equity and yields a risk free return, what is the required rate of return after tax? A standard reference on the topic is Sinn (1991), who shows that this may depend upon the particular situation in which a company finds itself. This means the parent company, given the discussion above. If the company is mature, its marginal source of equity finance is retained earnings, and its marginal use of profits is distribution to shareholders. The distribution could be some fraction in the form of dividends, the remainder as repurchase of shares. The fraction does not matter as long as the same fraction applies in the retention period, that is, the retention replaces dividends and repurchases in the same ratio.

There are reasons to believe that a company considering investment in Norwegian or Danish petroleum projects is mature in this sense. The alternative would be that it needs to issue shares to raise new equity, which implies a higher cost of capital under, for example, the U.S. tax system.

The expression in Sinn (1991) for the before-tax nominal cost of capital is

\[ r = \frac{1 - \tau_i}{(1 - \tau_c)(1 - \tau_r)}, \]  

where \( r \) is the market interest rate, \( \tau_i \) is the shareholder’s tax rate for interest income (the alternative investment), \( \tau_c \) is the shareholder’s effective tax rate for capital gains, and \( \tau_r \) is the company’s tax rate for retained earnings. This corresponds to an after-tax nominal cost of capital of

\[ r \frac{1 - \tau_i}{1 - \tau_c}. \]

In most countries capital gains are taxed only at realization, which lowers the effective tax rate in present value terms compared with the statutory tax rate on capital gains. That
rate is often lower than the rate for interest income. Thus the fraction is below unity. But Sinn (1991) points out that in the U.S. the capital gains rate is not zero, so it would be wrong to ignore it. This means that the “after-tax” interest rate, \( r(1 - \tau) \), may be underestimating the true after-tax cost of capital.

If the profits repatriated from Norway or Denmark are subject to additional tax in the company's home country, this will of course increase the cost of capital, see Jun (1995). Both commissions assumed that treaties against international double taxation would prevent this.

In a closed economy it would be relevant to consider the taxation applied to companies in other sectors, as well as to the personal taxpayers in the economy. This is hardly relevant in a partial equilibrium model of a small open economy, since the investment is done by foreigners, at least to some extent. The fact that the commissions in both countries proposed to maintain the corporate income tax, and intended to make the petroleum tax neutral compared with a situation with only a corporate income tax, has no particular implication for what the after-tax cost of capital is for a foreign company.\(^{17}\)

The main policy question addressed by Sinn (1991) and the papers he refers to, is the impact on investment of double taxation of dividends and a possible relief in the dividend tax rate. It turns out that the discussion is equally crucial for the application of the results by Boadway and Bruce (1984), Fane (1987), and any similar recommendation which needs to write some interest compensation into the tax system.

To obtain neutrality it seems crucial to identify the relevant investor. This is bad news, since it complicates tax policy. Different investors will have different tax rates if they are based in different countries. Within one country there are also differences due to progressivity and due to different legal status (and, over time, tax position) of investors. Some are companies, some are individuals, while some may be tax exempt pension

\(^{17}\) In a general equilibrium model, or some Nash equilibrium between nations, the two issues could of course be related.
funds. The Miller (1977) equilibrium is the most famous attempt at presenting an equilibrium model consistent with these differences. In that model the investors specialize in bonds or equity, depending on the ratio of their tax rates for income from these. A marginal investor is indifferent between the two and “determines” the required rates of return to both. But a tax exempt investor would specialize in holding debt. It is hard to reconcile a Miller equilibrium with a situation in which a tax exempt investor holds equity.\footnote{18}

Alternative models to describe an equilibrium where companies use both debt and equity, despite favorization of debt in company taxes, usually add some costs to high debt levels or some benefit to equity. An extensive review is found in Harris and Raviv (1991). Typically, such costs or benefits are supposed to be decreasing at the margin, and at the margin the cost of equity financing is not as if the equity investor had been tax exempt.

Although theories point in different directions, there are certainly tax researchers who assume that the marginal investor is tax exempt. In a study of tax effects on foreign direct investment, Devereux and Freeman (1996) assume “that personal tax rates of shareholders are zero” (p. 94). Others maintain expressions like (4) above, where $\tau_i$ appears, without mentioning that it might be zero.\footnote{19} With conflicting theories, there is definitely a need for empirical studies. Graham (1999) considers personal tax effects on corporate financing decisions in the U.S. He finds that differential personal taxation contributes significantly to explaining corporate financing diversity. This raises doubt over the view that the marginal equity investor is tax free.

Two further questions which should be raised are whether we know anything about rates of return actually required after tax by oil companies (whether we can reconcile these with theory or not), and whether we can say anything about what kinds of investors the two Scandinavian countries want to attract. The answer to the first is somewhat problematic, because the companies have an interest in overstating their requirements.

\footnote{18} But see section 11.3 in Scholes and Wolfson (1992).
\footnote{19} In addition to Sinn (1991), this is found in, for example, Jun (1995), footnote 11.
One could assume that they followed the corporate finance text books, which use the “after-tax” interest rate, as mentioned above.

The interesting question does not concern the marginal investor in the OECD area as a whole, or in the U.S. as a whole. The two countries want to attract oil companies. If most oil companies require an after-tax return in the limiting case of risk free equity investment equal to the “after-tax” interest rate, the tax system should reflect that, and there is no reason to grant a higher interest accumulation.

3. Debt financing

A wholly-owned subsidiary of a multinational oil company is not limited by usual considerations of bankruptcy risk and agency problems in its financing decisions. It can borrow from its own sister companies, or with guarantees from the parent company. If debt finance is favored by the tax system, it is likely to be chosen to the extent allowed by tax authorities. Both countries have thin capitalization rules preventing one hundred percent debt finance, allowing interest deductions for a maximum of 80 percent. The companies have been known to approach these limits. The deductible interest rate is limited by transfer pricing regulations, and this is one of the easier prices to regulate. It is the quantity of debt which causes more problems.

The Norwegian commission had been given a specific mandate to look into interest deductibility. There was an additional problem in the Norwegian system before 2001, regarding the division of a company’s net financial expenses between the petroleum sector and other activities. Interest expenses were deductible against a 78 percent tax rate in the petroleum sector, but against 28 percent tax on other activities in Norway and abroad. The division was made in proportion to non-financial income in the two sectors. Since the justification for the petroleum tax is exactly that in the sector income is high compared with investment, the division rule clearly implied that a disproportionately high share of interest expenses could be deducted against the high tax rate.
This has even lead to financing of investments in other countries by borrowing in the Norwegian subsidiary. A solution to this problem was given high priority by Norwegian authorities. The commission proposed that reported interest expenses should only be deductible in the standard corporate income tax, not in the special petroleum tax. Instead the Capital Return Allowance would represent a normalized deduction in that tax, as mentioned above.

The Danish commission proposed instead that reported interest expenses should be deductible in both taxes. The deduction for the rate of return on the remaining tax value of assets, the ACE, should be limited, however, to the equity financed part of assets. This is supposed to have the advantage that it is more easily accepted by foreign tax authorities in their evaluation of whether the Danish petroleum tax qualifies as an income tax in relation to double taxation treaties.

The Danish proposal allows for the possibility that equity, not debt, is favored by the tax system. This is the topic of the next subsection. The standard corporate income tax allows deductions for interest expenses, but not for the rate of return on equity. The corporate income tax, at rate \( \tau^s \), is supposed to be deductible in the petroleum tax, at rate \( \tau^k \). Thus the marginal tax rate on petroleum income is \( \tau^s + \tau^k (1 - \tau^s) \).

### 3.1. Is equity or debt favored by the proposed tax systems?

Formal models of debt financing often assume, for the sake of tractability, that the debt either lasts for one period or eternally. A somewhat more realistic, yet tractable, assumption is exponentially declining debt. I shall assume the same exponential decline for the tax value of assets. In this section I neglect carry-forward of losses. The discussion which follows also appears in Skatteministeriet (2001), pp. 214–217. The assumptions are:

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20 At this point the Norwegian proposal is seemingly different, since the corporate income tax is not deductible in the base for the special rent tax (nor vice versa). But other deductions are arranged in order to achieve the same tax payments year by year as if it had been, see NOU (2000), p. 201f.
• The company invests in year 0 only. The tax base is positive in all later years.
• The project lasts indefinitely. Tax depreciation is exponentially declining, with a yearly rate \( \delta \) of the remaining tax value of assets.
• The petroleum tax gives a deduction for the rate of return on equity at a rate \( r_e \).

This opens up the possibility of the allowed rate to differ from the company’s actual after-tax cost of capital, \( r_s \).

• The subsidiary in the host country pays the market interest rate, \( r \), on its debt. These interest expenses are deductible both in ordinary corporate income taxation and in petroleum taxation.
• The company borrows a fraction \( 1 - w \) of the investment cost, while a fraction \( w \) is financed with equity.
• Remaining debt is repaid at the yearly rate \( \delta \), equal to the depreciation rate. There is no uncertainty with respect to debt payments.

There is a substantial theoretical literature on risky debt, but in this case it is possible that the parent company effectively guarantees the debt.

In order to investigate whether the company wishes to reduce \( w \) from \( w = 1 \), a flow-to-equity approach is chosen. The question is whether a lower equity fraction increases the net value to equity. \( \tilde{X}_r \) is now the cash flow from the project after corporate income tax, given full equity financing. The details of the corporate income tax are not important, except that interest expenses are deductible, and that the company is assumed to be paying the tax in every year. The cash flow after both taxes in year zero will be

\[
X_0 (1 - \tau^k) - \tau^k J, \quad (5)
\]
when the petroleum tax does not give immediate deduction for the investment \( I \) \( (I > 0) \), the negative of which is an element in \( X_0 \), without necessarily comprising the whole of \( X_0 \). In a later year, \( t \), the cash flow with full equity financing will be

\[
\tilde{X}_t(1 - \tau^k) + \tau^k I (1 - \delta)^{-1} (\delta + r_e),
\]

when deduction for the rate of return to equity is given at a rate \( r_e \). If \( r_e \) is equal to the actual \( r_s \), it is easy to show that the present value of the deductions is equal to \( I \).

Assume now that the company borrows \( (1 - w)I \) in year 0. The cash flow to equity in year 0 after both taxes is then

\[
X_0(I - \tau^k) - \tau^k I + (1 - w)I = X_0(I - \tau^k) - \tau^k wI + (1 - \tau^k)(1 - w)I.
\]

In a later year \( t \) the cash flow will be

\[
\tilde{X}_t(1 - \tau^k) + \tau^k I (1 - \delta)^{-1} (\delta + r_e w) - I(1 - w)(1 - \delta)^{-1} \left\{ \delta + [(1 - \tau^k - \tau^k (1 - \tau^t))^r] \right\},
\]

which can be rewritten as

\[
\tilde{X}_t(1 - \tau^k) + I(1 - \delta)^{-1} \left\{ \tau^k w(\delta + r_e) - (1 - w)(1 - \tau^k)^{\tau^k} \right\}.
\]

One can now calculate the present discounted value, using the discount rate \( r_s \) for risk free elements of the cash flows. Assume that the project is marginal before the petroleum tax, given equity financing,

\[
X_0 + \sum_{t=1}^{\infty} V(\tilde{X}_t) = 0,
\]
and find the present discounted value, $\Pi$, as

\[
\Pi = I \left[ -\tau^k w \left( 1 - \frac{\delta + r_e}{\delta + r_s} \right) + (1 - w) (1 - \tau^k) \left( 1 - \frac{\delta + r(1 - \tau^e)}{\delta + r_s} \right) \right].
\]  

(11)

Its dependence of $w$ is given by

\[
\frac{\partial \Pi}{\partial w} = \frac{I}{\delta + r_s} \left\{ \tau^k [r_e - r(1 - \tau^e)] - [r_s - r(1 - \tau^e)] \right\}. 
\]

(12)

Whether this is positive, zero, or negative, depends on the interest rates. The sign depends on the expression in curly brackets. The results are summarized in table 2.

Table 2: Preferred financing as a function of the after-tax discount rate, $r_s$, and the rate of the allowance for corporate equity, $r_e$.

<table>
<thead>
<tr>
<th>$r_e$</th>
<th>$r$</th>
<th>$r(1 - \tau^e)$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>debt</td>
<td>debt</td>
</tr>
<tr>
<td>$r(1 - \tau^e)(1 - \tau^e)$</td>
<td>indifferent</td>
<td>debt</td>
</tr>
<tr>
<td>$r(1 - \tau^e)$</td>
<td>equity</td>
<td>indifferent</td>
</tr>
</tbody>
</table>

The Danish proposal is $r_e = r$, based on the view that $r_s = r$. Because of the interest deductibility in the corporate income tax, this makes debt the preferred instrument. If the true after-tax discount rate is lower, the company may be indifferent, or it may even prefer equity. The Norwegian proposal is $r_e = r(1 - \tau^e)$, based on the view that $r_s = r(1 - \tau^e)$. This makes the company indifferent. But if the true after-tax discount rate is higher, the company will prefer debt.
The conclusion is that a good idea of the after-tax cost of capital is crucial, not only for giving the right investment incentives, but also because it affects the financing incentives.

4. The subsequent events
The proposal in Norway in June 2000 was not well received by the oil companies. Using the same WACC for all elements of their (expected) cash flows, they found that the proposed tax system gave too low investment-related deductions. They claimed that the system would be distortionary.

An additional point of disagreement was the assumption of value additivity. The companies demand “volume” or “materiality” to engage in a project. This means that they require some minimum, strictly positive value from a project in order to undertake it. This is at odds with value additivity, since, for example, fifty percent of an acceptable cash flow stream may be unacceptable according to this view.

Such behavior would imply that the tax systems proposed, as well as a pure cash flow tax, would not be neutral. Any tax rate could make a small project unacceptable, and a high enough tax rate could make any project unacceptable. Whether a neutral tax system exists, given such behavior, is not clear from the literature. But, importantly, the theoretical justification for a neutral tax system breaks down. It is no longer clear why society would be interested in not affecting the companies’ behavior compared with a no-tax (or no-petroleum-tax) situation if the neo-classical theory does not hold.

There may be several reasons why a company behaves in the way suggested, demanding “volume.” It seems crucial to investigate more closely what the particular reason is, and to suggest a tax system based on the answer to this. This is a topic for further research.

Perhaps the most obvious reason would be that the company for each project has to incur some costs which are not deductible in the tax base. These costs could be related to the headquarter’s activities. One answer to such a situation would be to allow some fixed deduction per project, perhaps as a function of observable variables.
The Norwegian commission did not suggest a specific tax rate, since this was not an explicit part of its mandate. The commission did, however, illustrate its proposal by some calculations yielding revenue neutrality compared with the previous Norwegian system.

Surprisingly to some, the existing theory of neutral taxation says very little about what the tax rate should be. Based on theory the rate may be set to 99 percent, allowing the companies just a sufficient share of the profits so that they are not indifferent to the projects.

In Lund (2002a) I suggest one modification of the theory, which yields a specific solution. This is based on the transfer possibilities which exist, and which may be very attractive to the companies if marginal tax rates in one sector are much higher than in other sectors or countries. The result may be transfer pricing and/or real transfers, such as testing of new equipment. I show what combination of net and gross tax rates should be used for a given specification of the transfer “technology.”

The commissions in both countries were aware of these problems, but did not explicitly use the parameters of the tax system to mitigate them. Of course any possible strengthening of traditional transfer pricing mitigation, based on the legal system, is supported by the commissions. Apart from that, the approach taken by the commissions can be described as follows: Given that the petroleum tax system should have the economic effect of a cash flow tax, and thus be neutral in the standard sense, how high can the marginal tax rate be without causing a too serious transfer problem? This follows the given mandates literally, but is not the only possible approach.

In the end, because of protests from oil companies supported by the domestic supply industry, the Norwegian government took a very cautious approach to the reform. It proposed only the most urgent reform elements to the Norwegian parliament, the Storting. My own interpretation is that the minority government was uncertain about its
support in the Storting, and was willing to compromise on neutrality in order to achieve some improvement. In June 2001 the Storting adopted the following two elements: (1) The division of a company's net interest expenses between the petroleum sector and its other activities should be made according to its tax values of capital in the two sectors. (2) Loss carry-forward should accumulate interest at a rate $r(1 - \tau^s)$.

The proposed Capital Return Allowance was not adopted. Instead the pre-existing arrangement will continue, with net interest expenses deductible in the special petroleum tax (but with sector division according to the new rule) as well as in the corporate income tax, and with an uplift (proportional to investment) deemed too generous by the commission.

As of today (June 2002) the Danish government has not made any final decision on the destiny of the Danish reform proposals. In part this may be due to a change of government after the elections in September 2001. The minister who received the proposals belongs to a different party from that of the minister who appointed the commission.

5. Conclusion
The practical implementation of the theory of neutral taxation is not straightforward. Among problems which need to be solved are the effects of some legal institutions. Among these are the imperfect transfer pricing regulations and the imperfect treaties to prevent international double taxation.

The extension by Fane (1987) of the theory to situations with uncertainty is theoretically sound, but at odds with practical capital budgeting methods used by many companies.

Many tax proposals during the last 26 years, such as the Resource Rent Tax and the system based on the Allowance for Corporate Equity, rely on identifying the correct

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21 In its final paper to the Storting, the Ministry of Finance (2001) agrees (sect. 4.1) with the commission that the investment based deductions are too high.
after-tax cost of capital. More work is needed to identify what is the right rate in various situations.

References


