Is the petroleum activity subsidized?

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Abstract: Global Subsidies Initiative criticizes subsidies of fossil fuels in many countries. In the report on Norway, the conclusion is that production of petroleum is subsidized. For 2009 the amount is 25.5 billion NOK. But the report has many weaknesses. It is necessary to see the petroleum tax system as a whole. With the discount rates used in the report, the system gives a negative investment incentive, compared with ordinary company taxation. Exploration activity has a certain positive incentive, but much weaker than calculated in the report. The method used in the article does not require choice of discount rate for the operating income of the companies, only for the tax deductions. Thus a controversial topic in earlier discussions on petroleum taxation is avoided.

1. INTRODUCTION

The consultancy firm Pöyry Management Consulting (Norway), formerly Econ Pöyry, has published a report (Aarsnes and Lindgren, 2012) that concludes that the petroleum activity in Norway is subsidized. The report is part of a project, Global Subsidies Initiative (GSI), that among other things aims at revealing and criticizing subsidies of fossil fuels internationally. The project is started by the International Institute for Sustainable Development. So far reports exist on Canada, Indonesia, and Norway, see www.iisd.org/gsi. The report on Norway was presented in an open seminar in Oslo February 16, 2012, see Wooders (2012) and Aarsnes (2012). Both in the seminar and in several media in the adjacent days there was

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discussion on the conclusions, see, e.g., Ramm (2012) and Lund (2012). The purpose of this article is to go more in depth, especially on a couple of points.

The background of GSI is a justified worry that many countries subsidize fossil energy. This contributes to worsening the emissions of climate gases, see, e.g., OECD (2005). Bruvoll et al. (2012) discuss the topic without considering the possibility that Norwegian petroleum activity is subsidized. Many countries subsidize consumption, e.g., of gasoline, heating oil, or kerosene, and some countries subsidize extraction, e.g., of crude oil or coal. However, it is not always easy to decide what are subsidies, and what are their magnitudes, and it is difficult to compare between countries. Among the reasons for this is that authorities use several tools simultaneously, e.g., taxes, regulations, and direct subsidies, and that there are obviously good reasons to consider the net effects, not each tool in isolation. GSI (2010) is aware of some of the problems, and write, e.g., that "The concept of subsidy can be rather murky and the reform process can easily become bogged down in the attempt to find a suitable definition" (p. 1). But their own attempt at a definition has weaknesses, and this is part of the basis for weaknesses in the Norwegian report.

Sections 2 – 5 discuss the most important conclusions in Aarsnes and Lindgren (2012) on subsidies. A new method to compare effects of different tax rates and deductions is presented in section 4. Section 6 discusses the relation between marginal and average considerations. Section 7 discusses whether focus should be on emissions from production or consumption. Section 8 looks at the concept of neutrality. Section 9 concludes. Some details on the calculations are in an appendix.

2. MAIN CLAIMS IN THE REPORT

Aarsnes and Lindgren (2012) is written on commission from GSI and follows their guidelines (GSI, 2010). The point of departure is a definition of subsidies from the World Trade Organization (WTO). The definition is a classification of different types of direct subsidies and other arrangements that WTO regards as possible subisidies. It does not give a method for calculating the total net effect of a system of taxes and subsidies to decide to which extent such a system actually entails subsidization.

Based on this point of departure the report finds a number of arrangements that may represent possible subsidies in Norwegian petroleum extraction. Next each of these is discussed to find whether it actually is a subsidy, and monetary amounts are calculated for the most important ones in 2009. The two decidedly largest ones are the value of accelerated tax depreciation, 20.8 billion NOK, and the value of tax refund of exploration costs, 4 billion NOK. The remaining arrangements are valued at less than a quarter billion each, and the sum is 25.5 billion NOK. This exceeds comparable numbers for Canada and Indonesia, see Wooders (2012).

Among the lesser arrangements are the subsidy of LNG plants in Northern Troms and Finnmark counties, in practice the Melkøya plant for gas from the Snøhvit field, and subsidies for research and development. There is hardly any disagreement that these are subsidies, but they are calculated to be less than two percent of the total. Besides, the subsidies for R&D can be regarded as a correction of positive external effects, and it is difficult to check the claim in the report that R&D in the petroleum activity are subsidized too much compared with other industries. Anyhow, there are good reasons to concentrate on the two large elements, both due to their magnitude and due to the attention they have received. Ramm (2012) goes

through both the larger and smaller elements, with arguments that supplement the arguments here. The arguments in section 3 and 4 below are different from Ramm's.

3. DEDUCTIONS FOR DEPRECIATION AND UPLIFT

Since the tax reform in 1992 Norwegian tax on corporate and capital income has aimed at achieving a kind of neutrality. If uncertainty and inflation are disregarded, this may be explained as follows: With 28 percent tax the required rate of return after tax should be 72 percent (= 100 percent minus 28 percent) of the required rate of return before tax, both for financial capital income and for income from fixed capital, independently of the type of fixed capital. (This concerns neutrality between different types of investment, but in an open economy this is not the same as neutrality compared with a situation without taxes.) The neutrality is achieved by (as closely as possible) true economic depreciation. The connection is discussed, e.g., in Appendix 3.1 in Ot.prp. nr. 35 (1990–91). The difference between required rates of return before and after tax is referred to as the tax wedge. The extra tax on the hands of shareholders that was introduced in 2006 is only effective if the return exceeds the requirement, and will thus not increase the requirement.

In order to channel as much as possible of the net resource value (also known as rent, or resource rent) to the state, oil companies have been subject to special petroleum tax since 1975. If only the tax rate had been increased, while the tax based had been maintained as in ordinary company tax, this would have increased the tax wedge accordingly. Today's special tax rate is 50 percent in addition to ordinary company tax at 28 percent, combined at 78 percent. If, e.g., other industries had required rates of return of 10 percent before tax and 7.2 percent after tax, a project in the petroleum sector would have required 32.7 percent rate of return in order to give the same return after tax, 7.2 percent (= 22 percent of 32.7 percent).

Such an increased tax wedge would imply that many projects that would have been profitable under ordinary company tax, would be unprofitable in the petroleum activity. This concerns not only whole field developments, but also many decisions within each development, e.g., more wells, assisted extraction, and other means of extending the life of a field. To avoid this the petroleum tax system allows extra deductions proportional to investments. In practice this concerns two types, uplift in the special tax and accelerated depreciation in both company and special tax. The uplift is a kind of extra depreciation deduction which, since a tax law amendment in 2005, has amounted to 7.5 percent of investments per year for four years. Accelerated depreciation means linear depreciation over six years, 16.7 percent per year, instead of the declining balance method being used in ordinary company tax.

Aarsnes and Lindgren discuss uplift and accelerated depreciation separately. They conclude that accelerated depreciation is a subsidy. They claim (sections 4.3.5 and 5.7) that true economic depreciation would imply a rate of 10 percent in the declining balance method. This is also the main alternative in the calculations of the Petroleum tax commission (NOU 2000:18, p. 89). The difference in present value of the tax value of depreciation deductions, both in company and special tax, are considered by Aarsnes and Lindgren as subsidies. This is calculated as 20.8 billion NOK based on investments made in the sector in 2009, forward looking, i.e., present values of deductions following in the subsequent years. The uplift is kept out of this calculation and is assessed separately (section 4.3.7). It is not regarded as a subsidy, because it is only deductible in the special tax and explicitly aimed at shielding a normal rate of return from such taxation.

A serious weakness of the calculations is that the two types of deductions are not seen together, and not together with the high tax rate. The effects on the incentives of companies are obviously dependent of the sum of both types of deductions, not only one. It is true that the uplift is explicitly justified by shielding the normal rate of return, and that one sometimes can get the impression that the uplift is the sole means for this purpose. But in the preparatory work leading to the system (NOU 2000:18, esp. pp. 90–95) it is clear that the two types of deductions are seen together, and that one is fully aware that the depreciation rules are lenient.

* * * TABLE 1 HERE * * *

An example may show how a move to true economic declining-balance depreciation may imply that a project which is profitable before tax, and under today's tax system, will no longer be profitable after tax. In Table 1, columns A–F, the cash flows are shown for an investment of 100 in year zero, followed by exponentially decreasing net operating income, $Y_t = Y_1(1-\delta)^{t-1}$, indefinitely. With $\delta = 0.1$ this is consistent with declining balance depreciation at a 10 percent rate. In the example, $Y_1 = 40$ is chosen arbitrarily, but sufficiently large to ensure a positive tax base every year. With a 9 percent discount rate (the main alternative in Aarsnes and Lindgren (2012)) the net present value is 110.5.

Today's depreciation for six years is shown in column C and the uplift in column D. The cash flow after tax is column E, with a net present value of 16.8. If declining balance depreciation, column B, replaces linear depreciation, the cash flow after tax will be column F, with a net present value equal to minus 0.49. The change leads to the project being unprofitable. The uplift alone is too small to shield the normal rate of return from special tax.

However, this is not sufficient to conclude that today's depreciation rules are necessary and that Aarsnes and Lindgren (2012) are wrong. It can be shown that with a lower discount rate, 4 percent, today's depreciation rules imply subsidization at the margin. From column A to G the project has been enlarged: Investments are increased by 10 percent, and the operating income is increased by 3.5 percent. This change is realistic in the sense that it is reasonable to think that there are decreasing returns to scale, i.e., the relative increase in income is less than the increase in investments.

The change from A to G is chosen so that it is exactly at the profitability margin before tax at a 4 percent discount rate, $\Delta Y_1 = \Delta I(r+\delta)$. Net present values are 185.7 both for the original and the enlarged project. But the table shows that the present value after tax is increased from 44.6 to 45.0. This means that the change in the present value of taxes is negative, a subsidy at the margin. If income had increased somewhat less, e.g., 3.4 percent instead of 3.5, the project change would have been unprofitable before tax, but profitable after tax. With a discount rate of 4 percent the conclusion is that the tax system is a subsidy, not an obstacle, to investments.

4. A METHOD TO COMPARE DEDUCTIONS AND TAX RATES

To shed more light on the problem, the effects will be shown for an interval of discount rates. There have previously been disputes at this point between the oil companies and the Ministry of Finance, both over method and level of discount rates, mentioned by Aarsnes and Lindgren (2012, p. 40). The Ministry of Finance relies on the theory from financial economics which implies that cash flows with different risk should have different discount rates (Myers 1974; Lund 2001, 2002a; see also Osmundsen 2002). St.meld nr. 2 (2003–2004), p. 97, first argues for this method, but then uses the same discount rate for all types of cash flows. So do

Aarsnes and Lindgren (2012, section 2.6). Their 9 percent is higher than any alternative of the Ministry of Finance.

In the example in Table 1 petroleum tax was implicitly compared with a situation without tax. Another possible point of departure is to compare with ordinary company tax. Aarsnes and Lindgren (2012) seem to consider the petroleum tax system as subsidization if it gives better conditions for investment than ordinary company tax. The comparison with company tax is also used by St.meld nr. 2 (2003–2004), p. 97–98. Since both the Ministry and Pöyry compare with company tax, this will also be done below.

In the following a method is used in which it is unnecessary to choose a discount rate for the income stream, and thus also to decide whether this is the same as the discount rate for the tax value of deductions. This should be a useful improvement when those who discuss taxes and profitability cannot agree on method. Which discount rate to be used for the deductions will still be disputed. To cover different views, results are presented for nominal after-tax discount rates between 1 and 20 percent. Low risk pulls in the direction of lower discount rate. The risk of the deductions is probably still low, even if the political risk may have increased somewhat after the publication of Aarsnes and Lindgren (2012).

They only consider the difference under 78 percent tax between today's linear depreciation and the declining balance method. It is desirable to consider also the uplift (which makes today's petroleum tax appear even more lenient), but at the same time consider the effect on profitability of the payment of special tax. Figure 1 shows the present value of cash flow after tax as a function of the discount rate of a project that would be exactly at the margin of profitability under ordinary 28 percent company tax with 10 percent declining-balance

depreciation. The method is chosen to coincide with the point of departure of Aarsnes and Lindgren.

The investment cost is set to 1. Figure 1 shows the present value of subsequent cash flows, without subtracting the investment cost itself. The three assumptions underlying the calculations are also meant to coincide with the assumptions of Aarsnes and Lindgren:

(a) Deductions for depreciation and uplift (if any) start in the year after investment.

(b) The company is always in tax position, so that deductions are effective as soon as they are allowed.

(c) The variable on the horizontal axis, the nominal discount rate after tax, *r*, is constant over time and is used to find the present value of deductions for depreciation and uplift.

The details of the calculations are given in the Appendix.

* * * FIGURE 1 HERE * * *

In order to compare three other sets of tax rates and deductions with ordinary company tax, a method is used which may appear as confusing: For each level of *r* (the discount rate mentioned under (c)) the incomes of the project are adjusted so that the project is exactly at the profitability margin under ordinary company tax. It is thus not the same project which is the basis for comparison at different levels of *r*. But for each level of *r* the same project is compared, and it is shown how three other sets of tax parameters affect the profitability of a project which is marginal under ordinary company tax. The horizontal curve with a constant value of 1 in Figure 1 shows the present value of cash flows after (but not including) investment for the projects under ordinary company tax. Usually a present value curve will

be a decreasing function of *r*, but due to the adjustment of the income stream, this curve is constant.

If the tax is increased from 28 to 78 percent in this sector, the present value will be reduced (bottom curve). At a 9 percent discount rate, the present value is 0.67, so that the net present value of the project is -1+0.67 = -0.33. If the depreciation deductions are replaced with six years' linear depreciation, the present value is increased (second lowest curve). At a 9 percent discount rate, it is increased from 0.67 to 0.84. It is this difference, 0.17 NOK per invested NOK, which constitutes a subsidy according to Aarsnes and Lindgren (2012). If multiplied with the total amount of capitalizable investments in the sector in 2009, the amount is approximately 20 billion NOK.

If, in addition, deduction for uplift is allowed in the special tax, the present value is again increased (highest non-constant curve). This is today's Norwegian petroleum tax. At a 9 percent discount rate the present value is 0.97. Under these assumptions the system gives a weak disincentive for investment, since the net present value is about minus 0.03. But if the discount rate is 7 percent or below, the net present value is positive, so that the system gives a weak, positive incentive compared with 28 percent company tax.

It makes little sense to regard the increase due to accelerated depreciation, 0.17 NOK, in isolation, as a subsidy and disregard the other elements of the calculation. The Ministry of Finance has previously used a lower discount rate than 7 percent, and has concluded that the system gave some incentive for overinvestment, i.e., some projects which would not have been profitable under ordinary company tax, would be profitable under petroleum tax. But this is a significantly lower amount than the 0.17 NOK which Aarsnes and Lindgren apply,

per NOK invested. If it is meaningful at all to calculate total subsidies, one will at a discount rate of 6 percent (the lowest alternative in Aarsnes and Lindgren) find about 0.02 NOK subsidy per invested NOK. This is the difference between the highest non-constant curve in the diagram and the constant curve at level 1.

Besides, this subsidy from the total system, relative to 28 percent company tax, is decreasing in the discount rate, while the subsidy calculated by Aarsnes and Lindgren is increasing in the discount rate. Since Aarsnes and Lindgren tend to use higher discount rates than the Ministry of Finance, more in line with the oil companies, the total effect of the petroleum tax system using their discount rates will not be subsidies, but the opposite.

There are several formulations in Aarsnes and Lindgren (2012) which suggest that one should see accelerated depreciation in light of, or in connection with, the high tax level in the sector. In page 42 it says that "It is important to note that the favourable investment deduction rules are made in relation to the high tax on profits." In footnote 1, page 14, it says about accelerated depreciation that "It is, however, not obvious that this is a subsidy, since these deductions are part of the rationale for higher tax rates on the petroleum industry than on other industries." In spite of these reservations, it is exactly the "subsidy" of 0.17 NOK per invested NOK which constitutes more than 80 percent of the total amount which is claimed in the report to be subsidies, 25.5 billion NOK. Not least, this amount has contributed to give the report much publicity in Norwegian newspapers. The reservations in the report do not receive the same publicity.

Besides, Aarsnes and Lindgren (2012, p. 44) conclude that the uplift is not a subsidy: "We conclude that the uplift is not a subsidy to the oil and gas industry as long as its value is

directly connected to the special tax rate and thus provides a tax shield against special taxation of 'normal' profits." Figure 1 shows that the uplift is not sufficient to shield against the special tax rate if the discount rate is 9 percent. The present value of the uplift is 0.12 NOK, but if it were combined with declining-balance depreciation, the total present value would only be 0.80, which is 0.17 NOK lower than the present value of 0.97 mentioned above. Only if the discount rate is as low as 2.5 percent, the uplift would be sufficient, without accelerated depreciation.

The method used here also has the advantage that it is unnecessary to specify the shape of the income stream. The calculations in public documents and other reports on these questions are almost always based on examples, see, e.g., St.meld nr. 2 (2003–2004), figures 5.6, 5.7, and 5.10. Typical project examples may well be necessary to illustrate some questions, but where possible, it will be an advantage to use more general methods, like here.

5. DIRECT REFUND OF EXPLORATION COSTS

Exploration costs in the petroleum activity may be expensed in the year they accrue, against 78 percent tax. But many companies have no taxable profit while they explore. The rules in effect before 2002 implied that they could then only get deductions by carrying forward losses until they, if at all, got positive taxable income in which to deduct them. Since 2005 the companies have received refund of the tax value of these deductions directly. This is regarded as a subsidy by Aarnes and Lindgren (2012, section 4.3.4), and the value is calculated as 4.0 billion NOK in 2009.

The background for the arrangement is obviously the combination of a high tax rate, large uncertainty about outcomes of exploration, and long time from exploration until taxable profit

appears, in case anything is found. Moreover, the arrangement gives equal incentives for new companies as for those that already have taxable profit from other petroleum activity. It is well known that a tax which takes parts of profits, but gives poor possibilities for deductions of losses, have negative incentive effects (see Lund (2009, 2011) and references there). The authorities have thus chosen to introduce an element of cash flow tax, as proposed by Brown (1948) and in Norway by Christiansen and Sandmo (1983). All other tax forms, in which deductions are not effective in the same year as the exploration costs accrue, will have problems giving deductions that have neutral effects. In the years 2002–2004 the principle was that the companies were allowed to carry forward with interest, and that they could sell deduction positions to others if they gave up the activity in the sector without having been able to deduct everything. The authorities regarded this as equally valuable as a refund or same-year deduction, but the companies claimed it was insufficient. This could be due to political risk, of the arrangement being changed in a direction unfavorable to the companies. The interest rate was thus, or for other reasons, regarded by the companies as being too low.

A cash flow tax is neutral if the valuation function of the companies give value additivity, cf., e.g., Lund (2002b). When the intention is neutrality in relation to a company tax, one could have introduced a cash flow tax on the cash flow after company tax. It had been possible to refund the tax value of exploration costs only in the special tax, while the companies would have to carry losses forward for calculation of company tax. Exploration which would have been profitable under ordinary company tax, would have been profitable also under such an arrangement, and vice versa. This raises the question whether today's arrangement with refund of exploration costs is too lenient, and gives incentives for increased exploration, as compared with a situation in which the sector had been subject to ordinary company tax only. If so, Aarsnes and Lindgren calculate a too high value of the subsidy, since they apply a tax

rate of 78 percent, while the correct would have been 28 percent (mentioned by Ramm (2012)). That is, it may be claimed that the system subsidizes since it gives a refund in ordinary company tax which is not being given to companies with negative tax base in other sectors. This view suggests that the subsidy is 28/78 of the amount found by Aarnes and Lindgren, that is, somewhat above 1.4 billion NOK instead of 4.0 billion NOK in 2009.

It may nevertheless be argued that the subsidy from today's refund arrangement is less than 1.4 billion. If the sector had been subject to ordinary company tax, companies with taxable income in other Norwegian sectors would have the possibility to deduct exploration costs in this profit in the same year. It is difficult to predict how companies would have organized this, but there is s clear tax incentive to gather activities with positive and negative taxable income in the same company. Some of the exploration that today results in refund, would have been organized in companies with taxable income, and would thus obtain deductions in the same year against this income. The conclusion is that this subsidy, based on the other assumptions of Aarsnes and Lindgren, can be estimated at an amount between zero and 1.4 billion NOK.

6. SUBSIDIES AT THE MARGIN OR ON AVERAGE?

Ramm (2012) starts with the following statement: "It is quite bold to regard the petroleum activity as subsidized when it is expected to bring the Treasury 352 billion NOK this year. In everyday language one considers subsidies to be governmental support to firms that cannot survive alone, and that are economically unprofitable."[2] It is probably true that the petroleum activity is not subsidized in the sense of the word used in everyday language. But the example in the right-hand half of Table 1 shows that the tax system can give incentives to

[2] This author's translation from Ramm's original: Det er ganske freidig å betrakte petroleumsindustrien som subsidiert når den i år er ventet å skaffe statskassen 352 milliarder kroner. Med subsidier tenker man i dagligtale på statsstøtte som gis til bedrifter som ikke kan klare seg selv, og er samfunnsøkonomisk ulønnsomme.

unprofitable projects even if the average tax rate is high. This happens even if the tax system in the example gave no refund or other payouts from the state. The subsidy came in the form of reduced tax on the original project. Aarsnes and Lindgren are right about the marginal consideration being the correct one.

At the same time this raises doubts about the method by which Aarsnes and Lindgren (2012) calculate total subsidy amounts. If one is interested in effects at the margin, it is strange to emphasize total amounts. The effect of subsidization can often be achieved by giving subsidies that are only calculated in relation to additional activity. An example in Norway are the subsidies of water injection in the Ekofisk area. The effect of the subsidy was achieved without giving general deductions to all activity. Calculations of total amounts in Aarsnes and Lindgren are arbitrary in relation to the effects that they appear to be interested in.

When the marginal perspective is maintained, it is necessary to consider all types of taxes and deductions in connection. At this point the argument fails in Aarsnes and Lindgren (2012, p. 44), for the conclusion that the uplift is no subsidy. The argument given is that it is only deductible in the special tax. When the comparison is profitability under a regime of only 28 percent company tax, this may be a natural misunderstanding. The uplift reduces the special tax, but not below zero. But at the margin, for a company that already expects to pay much special tax, the special tax with the uplift could conceivably contribute to an investment becoming more favorable. An extreme example of such a deduction was a similar deduction in Danish petroleum tax in the period 1982–2003. The present value of the tax value of the deduction was calculated by the Tax Ministry to be 136 percent of the invested amount (Skatteministeriet, 2001, p. 11). There is little doubt that companies that would otherwise have been in position to pay special tax, had strong incentives to increase investments.

7. EMISSIONS ONLY FROM PRODUCTION OR ALSO FROM FINAL CONSUMPTION?

In addition to quantification of subsidy amounts, the report contains calculations of effects both on government revenue, employment, climate gas emissions, et cetera. Attempts are made to take into account changes in the behavior of oil companies if some types of "subsidies" are changed, and effects are also considered via macroeconomic models of Statistics Norway. The latter may be reasonably robust, but the behavioral changes are not modeled. The estimates (low, medium, and high) for changed exploration or investment appear as subjective guesswork. It may well be that the estimates are reasonable, but when the report otherwise gives the impression of a high level of precision, it is unfortunate to mix this with completely subjective numbers.

The effects on emissions of carbon dioxide from the sector are of special interest, since GSI is motivated by subsidies which lead to harmful emissions of climate gases. At this point the calculations in the report can be criticized for relying on a subjective estimate. But a more fundamental criticism will consider the lack of clarity in the perspective of the project. At the outset GSI has initiated international investigations of subsidies both of production and consumption of petroleum and derivative products. For subsidies to production, the question is thus whether to focus on emissions in the production phase or total emissions from production and the subsequent final consumption. Since international climate treaties primarily aim at restrictions where the emissions take place, it may be reasonable, when Norwegian petroleum is analyzed, to concentrate on emissions in the production phase. These are parts of the emissions that Norway is obligated to reduce. But when one reads Wooders (2012), one can get the impression that GSI supports direct restrictions on production also

with the subsequent emissions in mind. In that case one could have expected attempts in the report to calculate total emissions including final consumption, but this is not done.

8. THE CONCEPT OF NEUTRALITY

Aarsnes (2012, p. 11) wishes to correct deputy minister Kjetil Lund's (not related to this author) use of the concept of neutrality. The deputy minister is cited on a statement that the petroleum tax system is neutral. Aarsnes answers that, "Well, most of the world would call the Norwegian tax system a 'back-end loaded tax system'". This is illustrated with a diagram that classifies tax systems according to the timing of the bulk of tax payments. It is clearly fully possible to choose to call the middle category of this diagram "neutral," but it should be more interesting for Econ Pöyry to relate to those concepts that tax theorists, authorities, and international organizations have been using for generations. Econ's representative on the Petroleum Tax Commission 1999–2000 (NOU 2000:18) had no problem with this. The World Bank and the IMF are also in line with the Ministry of Finance in this use of the concept, see, e.g., Daniel et al. (2010).

9. CONCLUSION

The report from Pöyry contains considerable weaknesses. It makes little sense to calculate the subsidy effects of particular elements of a tax system. If the whole is considered, most of what the report calls subsidies, disappear. Moreover, the calculations are based on several assumptions that are subjective and at best good guesswork. As a consultancy firm, Pöyry should be aware that the bottom line of the calculations will be quoted. This is common in the press, and particularly relevant when the amount appears to be surprisingly large. The uncertainty about the estimate of 25.5 billion NOK is so large that this alone should have dictated a much more careful presentation.

The method of the present value calculations here gives a comparison of effects of various tax parameters on the profitability of marginal investment projects. The method represents an improvement compared with existing practice, by making it unnecessary to specify a discount rate for the income stream of the project. It is also an advantage to be able to present the effects without having to specify the shape of the income stream.

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APPENDIX

This appendix shows how the present values that are the basis for Figure 1, are calculated.

These calculations do not presume any particular shape of the income stream, and also no choice of a discount rate for this stream, which may be uncertain.

Let the present value, as seen from year zero, of depreciation deductions from the declining balance method be

$$A(r) = \delta / (r + \delta),$$

where it is assumed that deductions continue in infinite time. In the calculations that follow, we have $\delta = 0.1$. Let the present value of depreciation deductions based on six years' linear depreciation be

$$B(r) = \frac{1}{6r}\left[1 - \frac{1}{(1+r)^6}\right].$$

Let the present value of uplift be

$$C(r) = \frac{0.075}{r}\left[1 - \frac{1}{(1+r)^4}\right].$$

Let the present value of operating income before tax be $Y(r)$. This is determined residually, since the intention is to study a project which is exactly at the profitability margin under ordinary company tax.

The project has zero net present value after 28 percent company tax if the present value before deduction of the investment cost is equal to 1:

$$(1 - 0.28)Y(r) + 0.28A(r) = 1.$$

This equation defines $Y(r)$. The left-hand side is shown as the horizontal curve in Figure 1, a constant equal to 1. Notice that $Y(r)$ here becomes en increasing function of *r*, since $A(r)$ is a decreasing function. When $Y(r)$ is a function of *r*, this does not mean that *r* is used as a discount rate for the stream of operating income. One should be careful in interpreting how the curves shown in the diagram, depend on *r*, but for each level of *r* the diagram gives the correct basis for comparing the different tax parameters.

The three other curves are defined as follows, as present values after tax of the project when the investment cost has not been deducted. I all three cases the total tax rate is 78 percent, and depreciation is deductible against this rate. The special tax amounts to 50 percentage points of this, and the uplift is only deductible against this. The present value after 78 percent tax with declining-balance depreciation, solid curve, is

$$(1-0.78)Y(r)+0.78A(r).$$

Present value after 78 percent tax with six years linear depreciation, second curve from bottom, is

$$(1-0.78)Y(r)+0.78B(r).$$

Present value after 78 percent tax with six years linear depreciation and uplift, highest non-constant curve, is

$$(1-0.78)Y(r)+0.78B(r)+0.5C(r).$$

Table 1: Example of change of depreciation for a given project, and of profitability of increasing the size of the project

	A	B	C	D	E	F	G	H	I	J
	Original project						Enlarged project			
t	Cash flow before tax	Declining balance depreciation	Linear depreci-ation	Uplift	Cash flow after today's tax	Cash flow after adjusted tax	Cash flow before tax	Linear depreci-ation	Uplift	Cash flow after today's tax
					0.22A+0.5D +0.78C *)	0.22A+0.5D +0.78B *)				0.22G+0.5I +0.78H *)
0	-100.0				-100.0	-100.0	-110.0			-110.0
1	40.0	10.0	16.7	7.5	25.6	20.4	41.4	18.3	8.3	27.5
2	36.0	9.0	16.7	7.5	24.7	18.7	37.3	18.3	8.3	26.6
3	32.4	8.1	16.7	7.5	23.9	17.2	33.5	18.3	8.3	25.8
4	29.2	7.3	16.7	7.5	23.2	15.9	30.2	18.3	8.3	25.1
5	26.2	6.6	16.7	0	18.8	10.9	27.2	18.3	0	20.3
6	23.6	5.9	16.7	0	18.2	9.8	24.5	18.3	0	19.7
>6	$40*0.9^{t-1}$	$10*0.9^{t-1}$	0	0	etc.	etc.	$41.4*0.9^{t-1}$	0	0	etc.
PV9%	110.5				16.8	-0.49				
PV4%	185.7				44.6		185.7			45.0

*) Formulae hold for $t > 0$. For $t = 0$ there is no tax, so cash flow after tax equals cash flow before tax.

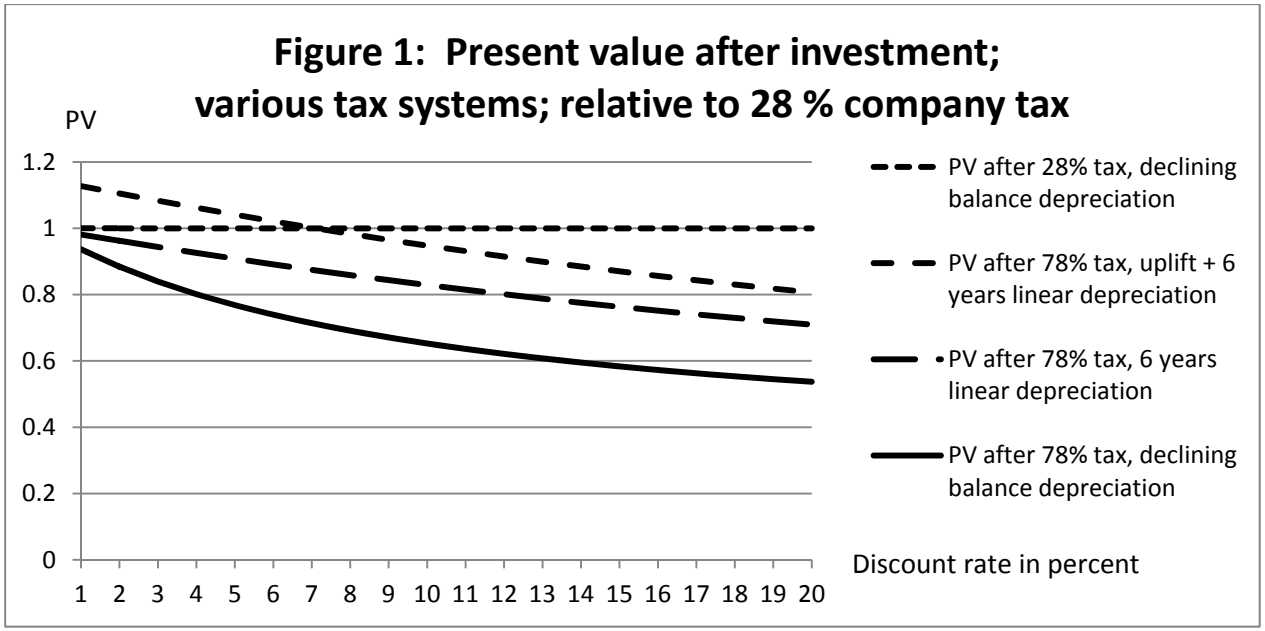
Figure 1: Present value after investment;
various tax systems; relative to 28 % company tax
PV
1.2
1
0.8
0.6
0.4
0.2
0
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
PV after 28% tax, declining balance depreciation
PV after 78% tax, uplift + 6 years linear depreciation
PV after 78% tax, 6 years linear depreciation
PV after 78% tax, declining balance depreciation
Discount rate in percent