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The Norwegian Petroleum Tax Act

Is the Norwegian Petroleum Tax Act neutral to investment decisions and treatment of companies with respect to tax position?

Master thesis

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Abstract

This thesis evaluates the neutrality of the Norwegian Petroleum Tax Act (PTA) in light of theories on neutral taxation by Boadway & Bruce (1984), Fane (1987) and Sandmo (1989). More specific, we investigate if there is neutral fiscal treatment of equity based capital investments in the onshore and offshore tax regimes and furthermore if decisions offshore are affected by tax position. Relevant research is presented and applied in a descriptive analysis of the current fiscal system offshore to reveal systemic distortive properties. Our analysis show that companies in theory should be indifferent to the distribution of tax allowances. Furthermore, we find that the petroleum tax act is not in accordance with theory regarding how normal returns are shielded from special tax. Our analysis will illustrate if the favourable tax allowances offshore are proportional with the high marginal tax rate, thus making it neutral to onshore investments.

According to theory and systemic features in the PTA and the regulatory system, companies should value tax allowances as risk free cash flows. Company behaviour tells us otherwise, which may imply that the authorities make wrong assumptions about company behaviour under uncertainty. It could also imply that companies are not differentiating between risky and risk free cash flow due to valuation methods applied offshore. This is also supported by theory. To analyse both perspectives in regards to neutral taxation, a deterministic discounted cash flow model is applied and compared to a study by Lund (2012). According to theory and the authorities' perspective, our findings suggest neutral treatment with respect to tax position and investment incentives offshore due to favourable tax allowances. From the industry's perspective, where risky and risk free cash flows are not differentiated, the industry is likely to perceive a favouring of companies in tax position. Investment incentives between offshore or onshore are dependent on the discount rate employed, and our findings are inconclusive.

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1. Introduction

A tax system is defined as neutral when it does not affect decisions - the relative profitability estimate is the same before and after tax (Sandmo, 1989). The desired property of a neutral tax system is based on the assumption that decisions in the absence of taxes would be optimal from a socio-economic point of view. This thesis will describe and evaluate the neutrality properties of the Norwegian Petroleum Tax Act (PTA). Since total neutrality in its most comprehensive form is merely a *theoretical* concept, the *degree* of neutrality will be central.

An Official Norwegian Report released in 2000, concluded that the PTA distorted investment decisions[1]. Tax allowances offshore were demonstrated to be too beneficial. As a consequence, effective tax rates on marginal investments offshore were below the marginal tax rate for capital investments onshore. By applying prominent theories of neutral taxation, companies in tax position were found to be treated favourable. Hence, the PTA also caused fiscal barriers to entry. In the aftermath of the release, the PTA has been subject to revisions aimed at reducing investment incentives offshore and ensuring neutral resource rent taxation regardless of tax position. In light of recent changes, the objective of this thesis is to analyze if *the current* offshore fiscal system has become more neutral. A capital investment will be analysed and compared in both the offshore- and onshore tax regime. Furthermore, we investigate if decisions offshore still are affected by tax position. This thesis can thus be interpreted as an evaluation of the changes. Central to the analysis will be to study the systemic properties of the current fiscal regime in light of literature on neutral resource rent taxation. A discounted cash flow (DCF) – model is developed and applied to determine if the internal rate of return (IRR) for offshore investments is affected by the tax system and dependent on tax position. Tax allowances will be considered both certain and uncertain to illustrate the difference between theoretical and perceived neutrality and the importance of correct valuation of tax allowances. The thesis will answer the following question:

"Is the Norwegian Petroleum Tax Act neutral to investment decisions and treatment of companies with respect to tax position?"

Both these dimensions of neutrality have a significant impact on state revenue and the Norwegian economy. *Neutrality in investment decisions* will have implications for the

[1] (NOU 2000:18, chapter 6)

allocation of resources between offshore and onshore investments. *Neutral treatment of companies* implies that decisions are the same irrespective of tax position and is vital to ensure the diversity on the Norwegian Continental Shelf (NCS).

Brown (1948) showed how a tax system could be designed neutral by taxing the net cash flows and immediately reimbursing the tax value of any negative tax. Boadway & Bruce (1984) later demonstrated how accruals/scheduling of tax allowances could have the same neutral properties in a profit based tax system under full certainty. Fane (1987) later showed the same when assuming uncertainty of future cash flows. These theories were central in the official report, and the suggestions made on how the system could be improved (Lund 2002)[2]. However, despite recommendations to align the offshore tax system on principles derived from theory[3], the PTA still has a different approach to ensure that only the *resource rent* is subject to higher marginal tax. It is then of interest to evaluate the degree of neutrality in the system, as it is only partly based on what theory suggests.

The above mentioned theories are based on two fundamental assumptions. The first is that companies maximize profits and the principle of *value additivity.* The latter implies that the sum of an investment's individual cash flows is equal to the investment's value. These are common assumptions in much of the financial literature and value additivity allows for separate cash flow valuation. However, no single objective function describes investment decisions for companies under uncertainty, and actual company behaviour may contradict the assumptions (Lund, 2009). It follows that a theoretical neutral system based on the wrong assumptions likely would be distortive.

The second assumption for neutral taxation is that tax allowances must be perceived as certain and valued as such, something that is shown by Ruback (1986) and Fane (1987). Neutrality is then dependent on a legal framework for which the value of tax allowances are maintained and guaranteed to eventually be redeemed. The intention is to make companies indifferent as to receive tax allowances today or in the future. Given full certainty of future tax allowances, discounting rates employed to value investments must be adjusted accordingly. This implies separate valuation of tax allowances based on the risk free rate of return. However, what theory assumes (and is reflected in the PTA) may not be applicable to actual conditions. Summers (1987) find that most companies do not differentiate cash flows

[2] Diderik Lund is a Professor in Economics at the University of Oslo and he played a central role in the tax committee behind the Official Norwegian Report (NOU 2000:18).
[3] See NOU (2000:18, pp. 219-220)

when making investments decisions, as theory suggests. Instead they employ one single discount rate on the net cash flow, which may underestimate the value of the tax allowances. Other academics claim that companies base investment decisions on other criteria than what theory assumes[4].

Due to both the nature of the industry and the vast impact on the Norwegian economy, the PTA is often debated in the public sphere. On one side, the industry is calling for eased fiscal burden due to falling profitability[5], while environmentalists claim that the industry is subsidized[6]. In the middle, academics point to the tax system's sensitivity to the assumptions made and discount rates applied[7]. This thesis will contribute to the debate by an attempt to illustrate how neutrality is perceived by different stakeholders. However, with different perceptions of the neutral properties in the PTA, we expect our findings to be somewhat ambiguous.

Why neutral taxation is desirable will first be motivated with references to the welfare theory. How it can be achieved is illustrated by presenting relevant literature, including theory on net profit- and resource rent taxation. Findings will then be compared to the current fiscal regime on the NCS in a descriptive analysis where key aspects in the PTA will be addressed. The descriptive part of our analysis will discuss if the systemic properties in the PTA are in accordance with theory regarding neutral taxation.

To consider if the tax allowances are proportional to the special tax rate, a developed discounted cash flow model will be employed. The aim is to analyse and compare how tax regime and tax position affect the internal rate of return and net present value to an equity based investment project. Cash flows derived from tax allowances are separated and regarded both as risky and certain. This is what allows us to highlight different points of view. We define *the state point of view* to be consistent with the described literature, thus discounting tax allowances at the risk free rate. When considering *the industry point of view*, we employ one single discount rate on the net cash flows, consistent with Summers (1987). This will illustrate the perceived difference and thus contribute to the debate by *objectively* illustrating both points of view.

[4] See Osmundsen, Emhjellen, & Halleraker (2000)
[5] See Kon-Kraft (2003)
[6] See Aarsnes & Lindgren (2012)
[7] See Lund (2001, 2012), Osmundsen (2000).

Furthermore, this will able us to determine *the conditions* for which the PTA is theoretical neutral and perceived neutral. This will be discussed in light of the development on the NCS to reveal possible implications and the relevance of our findings. A recent cash flow model by Lund (2012) will also be presented and serve as a reference point in our analysis of neutrality between offshore and onshore investments.

Our findings when employing the state's point of view suggest an investment incentive offshore for marginal projects, consistent with the official report in 2000. The reason is found to be too favourable tax allowances – reducing the ordinary tax base on marginal projects. The consequence is that normal returns on marginal investments are taxed at a lower rate than the alternative onshore. This will cause unprofitable projects onshore to become profitable when subject to the offshore tax regime and give incentives for too high capital intensity on all projects. More investments will evidently be marginal when the NCS matures, as this development lies in the nature of exploiting a non-renewable resource. It is then unfortunate for the resource allocation that the PTA reduces the tax base compared to alternative investments onshore.

When the analysis is done from the industry's point of view, we find that neutrality is dependent on the employed discount rate. For rates below 11.7 percent, the PTA provides investment incentives offshore and for rates above, the onshore tax system is favourable. Plotting the internal rate of return (IRR) for different levels of profitability, they intersect at 11.7 percent, indicating neutrality at this rate. This is not consistent with our reference point, Lund (2012), who uses other assumptions and finds the intersection to be at 7 percent. The implications of our findings are dependent on what discount rates investment decisions on the NCS are based on.

We also demonstrate how the treatment of companies with respect to tax position is neutral from the State's point of view, while the industry is likely to perceive the system as distortive, favouring companies in tax position. Fiscal treatment of exploration investments is found to be neutral irrespective of tax position from both points of view. The reason is that the tax value of exploration investments are immediately reimbursed after 2005, thus resembling a *Brown tax* element in the PTA. Descriptive statistics suggests that the diversity

has increased after this policy change in 2005, but the relation to lower fiscal barrier to entry is not empirically tested[8].

The conclusion is that problems described in the official report in 2000 still prevails with respect to the investment incentive offshore from a theoretical point of view. The reasons are too favourable tax allowances. However, this can be *perceived* different by the industry, depending on the discount rate employed. If it is above 11.7%, the two points of view will have opposite conclusions.

The authorities have succeeded in increasing the certainty of future tax allowances. From a theoretical point of view, the system is neutral, irrespective of tax position. The industry is on the other hand likely to perceive a benefit for companies in tax position.

The rest of the thesis is structured as follows: *chapter two* will present relevant research and literature on neutral taxation to motivate the choices and assumptions made in our analysis. Some basic valuation principles will also be presented, as this is central in our analysis and discussion. *Chapter three* will discuss the PTA with emphasis on neutral properties relevant for our thesis. In *chapter four*, our model will be described and the assumptions motivated. *Chapter five* analyses the neutrality in investment decisions onshore and offshore while *chapter six* assesses the treatment of companies with respect to their tax position. In *Chapter seven*, our results are presented and discussed in light of implications and relevance. We also discuss limitations to our assumptions and discuss other views on company behaviour. Limitations to our model are also addressed. *Chapter eight* concludes our thesis, followed by the appendix and bibliography. The appendix will give a mathematical presentation of the DCF-model we have applied.

2. Theoretical Framework

This chapter will present relevant theory, which will give the reader both general understanding of prominent tax theories, but also understanding of the assumptions we make. Welfare theory will be presented and applied to explain the desired property of neutral taxation that ensures efficiency in production. Since neutral taxation is dependent on what assumptions we make about company behaviour under uncertainty, this will briefly be discussed. Tax theory applicable to the PTA will be presented, which includes corrective

[8] Due to the short time period and the subsequent lack of data, significant results are unlikely to be found.

taxes, net profit taxation and resource rent taxation. Finally, basic valuation theory will be presented, as valuation of tax allowances is central to our analysis.

2.1. From Welfare Theory to Neutral Taxation of Production

Taxation of the petroleum industry is based on principles to ensure economic efficiency. The aim of having a neutral tax system is based on the assumption that decision making in the absence of tax would be optimal from a socio-economic point of view. To understand the connection, Sandmo's (1989) analysis of neutral taxation in light of general welfare theory can be applied.

Welfare theory tries to answer what the optimal allocation of resources is. This question cannot be answered unless one makes a stand concerning the value of welfare for the individuals that constitute the economy. Thus, *the optimal allocation* must reflect both effective utilization of resources as well as the prevailing view of social justice/equality. These two conditions are often in conflict and the trade-off and valuation of the two, is more a question of political preferences than pure economic efficiency. However, the two criteria's for effective resource allocation can in principle be analyzed independently of subjective opinions of social justice and the value of equality. This is known as Pareto optimality, which is defined as a resource allocation where *"…no one can be made better off without making someone else worse off"* (Pindyck & Rubinfeld, 2005, p. 584).

The reason is that the welfare theory states that free market equilibrium in absence of any distortions or externalities provides a Pareto optimal allocation (Pindyck & Rubinfeld, 2005, pp. 584-593). Thus, a marked equilibrium can exist with an unequal distribution of input factors, which contribute to unequal consumption among individuals. Sandmo (1989, p.311), however, argues that the concept of Pareto-optimality is so abstract and disconnected from reality that it can hardly serve as a guide for efficient allocation. The free enterprise model also suffers from this, but in his opinion, it refers to a framework that is closer to observations of how a market economy actually works. As an ideal state or benchmark, the free enterprise model is therefore better than the concept of Pareto optimality. In this way, Sandmo creates a framework for which economic efficiency can be analyzed with the use of neoclassic economic theory, which will also serve as the basis in this thesis[9].

[9] By assuming a small and open economy, interest rates, demand and price for petroleum products can be treated as exogenous given factors. This will limit the discussion regarding efficient resource allocation in the welfare theory to efficiency in production, thus disregarding efficiency in consumption and how production affect consume.

Sandmo (1989, pp.312-313) also recognize the fact that some or more of the requirements for a free enterprise model may not apply, and only an approximation of neutrality is realistic. Sandmo refers to this as second best alternatives. The theoretical foundation must therefore be checked and balanced with actual market conditions, not only to achieve a neutral taxation, but also to indentify the potential distortions. These distortions must further be analyzed in the context of optimal resource allocation, cost of necessary changes and the political will to actually changing it.

In this context, Sandmo (1989, p.312) argues that one of the main purposes with economic policies is to optimize the organization of the economy and secure efficient allocation of resources. Allocation policies are meant to minimize barriers to entry, secure a judicial framework for contracts and intervene to correct market failure. According to this model the state should distribute income, provide infrastructure and intervene when markets fail to correct imperfections. The state is thus dependent on taxes to distribute income and finance its own expenditures. The central question is then how to do this in the most efficient way.

Neutral taxation is in this context central, and the concept has long traditions in scientific tax literature (Sandmo 1989, p.310). The basis for neutrality is that taxes distort decision makers in the economy and can lead them to make decisions motivated by tax adoptions rather than real economic conditions (Sandmo, 1989, p. 310). A neutral design of the tax system aims at not distorting the decision-making of companies' and consumers', hence the relative profitability estimations of different investments should be the same before and after taxes. It is however questionable whether this is possible and even desirable taking into account the purpose of taxation (Sandmo, 1989, p.310). As mentioned, this could be distribution of wealth, financing public expenditure and to stimulate desired activities. A more realistic benchmark would then be to analyze neutrality in terms of capital allocation between sectors of the economy, and even neutral taxation of companies with regards to their tax position.

Having set a relevant benchmark and scope of which to analyze neutral taxation, it is further of importance to describe theory regarding company behaviour under uncertainty.

2.2. Company Behaviour under Uncertainty

In economic theory, two different traditions may apply to describe investment decision under uncertainty (Lund, 2009, p. 289). The first is that companies are assumed to maximize their

market value on the behalf of its shareholders in efficient financial markets. This requires that value additivity applies, which can be understood as a net present value (NPV) of a portfolio have to be equal to the sum of the net present values of each asset in the portfolio. The implication of this is that companies are assumed to realize all projects that generate a positive NPV when valued according to the after tax cost of capital. By disregarding uncertainty, as done by Boadway & Bruce (1984), this can mathematically be expressed by a value function (*V*) that has the following properties (Lund, 2002, p.39):

(2.1) $$V\ (X_t + \ Y_t) = V(X_t) + \ V(Y_t)$$

(2.2) $$V(Z_t) = \frac{Z_t}{(1+r_{at})^t}$$

X, *Y* and *Z* express investments that yield a future net cash flow. (2.1) express value additivty, which states that the value of a portfolio that consist of two projects that yield a certain future cash flow, is the same as the value of the two projects when valued separately. (2.2) express the NPV of a certain future cash flow when discounted by the risk free rate after tax[10]. These two properties allows us to define projects that are marginal, and thus, expected to be materialized. This can be expressed as:

(2.3) $$\sum_{t=0}^{t} V(Z_t) = 0$$

The alternative to value additivity is to assume that companies are risk averse and maximize expected utility. Studies of neutral taxation based on this tradition are not considering the ability of a company or its shareholder to diversify. This implies that companies under-exploit investment opportunities and take on too little unsystematic risk when compared to value additivity (Lund, 2009, p.303). This tradition receive support due to apparent financial market failures, which may be due to information asymmetry, self interest and incentive schemes, transaction cost, capital immobility to mention some. Sandmo (1989, p.317) on the other hand, argues that even if it is difficult to measure, the assumption of companies maximizing profits has received overwhelming support in various studies on company behaviour. It is therefore widely accepted in the scientific literature.

A third theory that is not well documented, but has received much attention in the petroleum industry in Norway, is that companies in the petroleum sector requires a minimum or lower limit of financial volume for a project to be of any interest. This is referred to as the term

[10] Under uncertainty, the appropriate discount rate would be the alternative cost of capital after tax.

materiality, and is discussed in Osmundsen et.al (2000). *Materiality* implies that positive NPV is not enough for a project to be realized. If true, and assuming that companies are subject to neutral taxation, marginal profitable projects after tax could be rejected, in contrast to the above cited theories. If this theory or line of argumentation has any hold to it, it could have grave consequences for the NCS, since the financial volume decrease as the NCS matures. The theory will be discussed in section 7.3.1 under *Alternative Assumptions.* This thesis will assume that companies are expected to maximize their market value.

2.3. Optimal Taxation to Capture the Resource Rent

We recognize that the main purpose of taxation is to secure income to cover the state's expenditure as well as dividing income in accordance with the prevailing opinion of social justice and equality. A central part of this is to maximize the government take of the resource rent. A general advice for any tax system is to first apply efficiency promoting or corrective taxes[11]. The petroleum industry for instance is subject to taxes on emission from *Green House Gases (GHG).* This is meant to bring forth the *true social cost* of GHG emission, thus correcting for negative externalities that are detrimental to social economic efficiency.

The second advice, as discussed by Sandmo (1989, p.315), is to implement neutral taxes in order to prevent sub optimal resource allocation, and thus socio economic inefficiency. This is of special importance with high marginal because the distortive properties will be amplified with higher tax rates. This is further described and illustrated in the appendix, section 8.3. Since companies operating on the NCS are subject to both ordinary income tax and special tax, the following will first describe theory regarding neutral taxation of net profit. This is a benchmark for the Norwegian Tax Act. The Norwegian Tax Act will be referred to as the General Tax Act (GTA) or just the onshore tax system in this thesis. The second part will describe neutral taxation of the resource rent, which is the benchmark for the PTA (offshore tax system).

2.3.1. Neutral Taxation of net profit

A tax on net profits can under certain assumptions be neutral when it comes to decision making. Assuming profit maximizing behaviour, a company will try to maximize revenue after production costs. According to micro economic theory this is done by adapting production so that the price (or marginal income) is equal to the marginal production cost

[11] In general this is taxes or fees correcting for market failure, see (Pindyck & Rubinfeld, 2005, pp. 647-649). A tax would have the same effect of what here is referred to as a *fee*. Most commonly used to correct for negative externalities.

(Pindyck & Rubinfeld, 2005, p. 267). If companies face a tax of e.g. 30 percent on profits this could be interpreted as a cost. It would now maximize profits after tax. However, maximizing the remaining 70 percent evidently implies maximizing the initial 100 percent of profits *before* taxes. The tax would therefore not interfere with the company's decision making. The optimal strategy is to adapt where marginal income equals marginal cost after tax. This is the classical argument for taxes on profits being neutral (Sandmo, 1989, p. 317).

This conclusion is crucially dependent on two assumptions; (1) companies' maximize profits and (2) authorities and the companies have the same definition of profit. The first assumptions has been discussed previously, where we described that other assumptions may apply. In regards to the second assumption, one could imagine that a cost element is not recognized by the authorities and therefore not deductible. This activity would then become relatively more expensive and the tax on profits would act as surtax on that specific activity, thus cause distortions. To ensure neutrality, a crucial factor will be that the definition of taxable profit equals the companies' definition of profits.

Profits can be defined as sales revenues after operating and capital costs. Capital cost equals depreciation plus interest costs on the tied up capital and any potential capital gains/losses. While operating costs and revenues are in theory easy observable, the depreciation rate on different investments is estimated costs which only partly reflect actual transactions. The ideal is that depreciation allowances equal the annual physical wear of the real capital. However, this is impossible in practice and only approximations of actual depreciation and unrealized capital gains are realistic in a fiscal system (Boadway & Bruce, 1984, p. 232). The tax authorities in Norway has therefore divided real capital into relatively broad categories with different standardized rates of depreciation (cf. the Norwegian Tax Act §6-10 and §§14-40 to 14-43).When the tax system is based on such an approach, the best case scenario will be an approximation of theoretical neutrality.

A more likely outcome is that the system will lead to distortions. Consider a piece of real capital which is allowed to be written off and deducted with 20 percent linearly over five years, but has a real lifetime of less than five years. This means that the company is not allowed to deduct the actual depreciation and therefore is subject to surtax on this asset. If the actual economic lifetime exceeds five years, the depreciation schedule could be interpreted as a subsidy, and this is often referred to as a *tax credit*. There are also other factors that may lead to distortions. This could be adjustment of taxable wealth due to change in the market price (amortization and capital gains) and adaption of capital structure

as only financial costs on debt are deductable, not the alternative cost of equity. Mathematical evidence for neutral taxation of net profit is further described in the appendix, section 8.2.

2.3.2. Cash Flow Taxation of the Resource Rent – Absolute Neutrality

In 1948, E.C. Brown proposed a tax on the net cash flow in every period. This system was based on the assumption that companies seek to maximize its present value which is consist with the sum of the company's future discounted cash flow. Such a system was intended to make project that was profitable before tax, profitable after tax and vice versa[12]. Assuming that a tax is levied on the net cash flow in each period with a constant rate of (τ^{CF}), this can be expressed as the following (Lund, 2002a):

$$\sum_{t=0}^{t} V(Z_t) \geq 0 \rightarrow \sum_{t=0}^{t} V(Z_t(1-\tau^{CF})) \equiv (1-\tau^{CF}) \sum_{t=0}^{t} V(Z_t) \geq 0 \tag{2.4}$$

The variables are the same as before, but we have now introduced tax. The left side of the arrow is the value before tax, while the right side is after tax. If the state disburses any negative cash flows with the same rate as a positive net cash flow would be taxed with, this tax system is neutral. The reason is value additivity, where the value function is not affected by the tax. This assumes that there are no externalities, because this would affect the value function. In the expression above, a project with a positive NPV before tax is also positive after tax.

Under this regime, the state could be seen as a passive partner who takes a share in the investment equal to the tax rate. The state will cover a certain percent (the tax rate) of the investment, and claim the same share of the investment's future profits (Brown, 1948). The *internal rate of return* (IRR) is the same before and after tax, and hence neutral when it comes to the company's investment decision. With neutral taxation, companies could in theory be taxed close to 100 percent, under the assumption that all investments yielding positive NPV will be realized. However, some profit must be left to companies if they are not to be indifferent.

To incorporate that companies operating on the NCS are subject to special tax in addition to ordinary corporate tax, the cash flow above (X_t) must be considered as the net cash flow after ordinary tax. Thus, the model is only neutral when compared to a situation with only

[12] A disadvantage of the original proposal to Brown is the exclusion of financial transactions, which gave companies incentives to hide operating income and to allocate costs as financial. The system was therefore further developed by a UK tax committee lead by Professor James Meade (Meade et.al, 1978, pp.230-233).

corporate tax. Discussion of neutral taxation and efficiency in production is thereby only relevant when comparing the petroleum sector to other sectors in the Norwegian economy. This is on the other hand a realistic assumption since most sectors in the Norwegian economy are subject to ordinary corporate tax, which will be used as a benchmark when discussing the neutral properties of the PTA.

In the current fiscal system in Norway, only exploration activity in the PTA can be said to contain a cash flow tax element as described by Brown (1948). However, a pure cash flow tax is not widely used and there are several reasons why authorities do not want to apply such a system. As described by Lund (2002a), the liquidity factor and the reluctance to take on risk, are prominent arguments against such a system[13]. Another reason is that tax treaties to prevent international double taxation are not designed for true cash flow taxation.

2.3.3. Alternative Cash Flow Tax Systems to Capture Resource Rent

Garnaut & Clunies Ross (1975, p. 286) illustrated a general but different approach compared to a pure *Brown*-tax. This is known as the *Resource Rent Tax* (RRT), and the general idea is that investments are to be expensed so that the yearly tax base is the actual net cash flow. This means no depreciation of capitalized assets. Upon negative tax base, the State is not to disburse any negative cash flows, but the company should balance the net losses and carry it forward with interests. In the following period, losses carried forward with interests should be subtracted from the tax base[14]. If still a negative tax base, the losses should be carried forward in the same manner. In this way, deductions are used as soon as the positive cash flow allows it. This system ensures that only internal rate of return from the accumulated net cash that exceeds the rate at which losses are carried forward with are subject to tax. If this rate of return is not realized, no taxes will be paid (Lund, 2009, p. 291). Due to high front end investments, tax payable would then typically be minimal or none in the beginning, but with an increased fiscal burden later on. If net cash flows are on an after ordinary tax basis, normal return would be shielded from special tax.

According to Lund (2002a), a RRT-system as described by Garnaut & Clunies Ross (1975) also suffers from the fact that companies may be subject to double taxation due to the design of tax treaties. However, this problem can be circumvented by letting capitalized investment be written off over a specific number of years, instead of being immediately expensed. As long as the NPV of the tax allowances, when discounted by the companies' cost of capital

[13] E.g. the state may not be liquid and/or it may be a substantial burden in periods of economic stagnation.
[14] This will also be referred to as provision for loss in the thesis.

after tax, is equal to 100 percent of the actual investment costs, there is no difference compared to a RRT (Lund, 2002a). This was shown by Boadway & Bruce (1984, p. 235), under the assumptions of full certainty of future cash flows. They showed that any scheduling/accruals of depreciation over time is equal to RRT given that; (1) depreciation equals 100 percent of the investment cost and (2) deduction of the capital costs (rate of return) for the remaining tax value of the capitalized asset is allowed. These two assumptions are of interests. First of all, the fiscal depreciation rate (δ) can be arbitrarily chosen, since (1-δ) will be the basis for the deductions of the capital costs. Regardless of scheduling and depreciation rate, they will always sum up to the same, given that the rate of return remains the same. In this way, the company will be compensated for the opportunity cost of committing capital, and thus indifferent between immediate refund and scheduling of tax allowances (Boadway & Bruce, 1984, p. 237). Fane (1987) illustrated that the same apply when assuming future cash flows as uncertain. More precisely, Fane showed that if a company was to be indifferent between receiving the tax allowances today or in the future, the company must be certain that deductions will be redeemed eventually (Fane, 1987, p. 101).

As the above theory suggests, neutral net profit taxation and resource rent taxation is possible. These systems will give different distribution of the tax burden over time, which may be unfortunate from an economic stabilizing point of view. From a resource allocation point of view, this will have no importance (Sandmo, 1989 p.320). Sandmo (1979) also points to the fact that neutral taxation reduces the ability to use the tax rates to influence demand, since tax levels in theory are disconnected with the investment decision. It could therefore be of interest to have non-neutral features to empower the tax system as a tool for economic stabilization (Sandmo, 1979, p. 176). However, neutral taxation requires that any deviation from an indisputably neutral cash flow tax system must be compensated. If not, companies would not be indifferent whether to receive the tax allowances today, or in the future. The question then is what interest rate applies to compensation for loss offset/valuation of tax allowances.

2.3.4. Certainty and Valuation of Future Tax Allowances

If fiscal allowances are regulated in the Tax Act and guaranteed by the state, they can be considered to be *certain,* or *riskless*, future cash flows. The tax allowances are then more valuable than other cash flows that contain different degree of uncertainty and risk, since in NPV terms tax allowances should be discounted with the lower risk free rate.

This conclusion can be reached by using an arbitrage argument as suggested by Ruback (1986). A set of future tax deductions that a company is entitled to, can be compared to a portfolio of riskless bonds paying coupons which corresponds to the allowed deductions. Both are claims on the state. The two assets represent equal value to the company. It then follows that the appropriate discount rate for valuing the deductions should be the same as a portfolio of riskless bonds (Ruback, 1986, pp. 323-326). Fane (1987, p. 98) also argued that neutrality in a cash flow based system can be maintained when provision for loss offset are certain and the deviation from a constant rate cash flow tax has present value of zero at a risk free interest rate. Given value additivity, such risk free cash flows should then be valued separately from other riskier cash flows or the single employed discount rate must be appropriately adjusted.

However, Lund (2009, p.300) argues that this theoretic uncontroversial result from Fane (1987) is disconnected with much of the following literature on resource rent taxation and on company practice. Graham and Harvey (2001), Siew (2001) and Summers (1987) finds that a common practice is to apply one discount rate to all net cash flows, regardless of the inherent risk. This is only correct as long as the discount rate is risk adjusted. Garnaut & Clunies Ross (1979, p 196), however, argues that companies will suffer from information asymmetry and the correct discount rate is the companies' required rate of return which will depend on the risk characteristic of the project. A recent contribution is Emhjellen & Osmundsen (2011) that point to the fact that the current parliament cannot guarantee for future fiscal policies. This implies that political risk induce a risk premium when tax allowances are valued. As described, the view varies and this issue is central in much of the literature that is written on neutral taxation.

Other studies have also shown that resource rent tax systems that fails to disburse allowances when the future income stream is too small, will lead to distortions. This is formally illustrated by Mayo (1979). However, this can be solved by taxation of an entity and not a ring fenced project. Negative tax could be used to reduce the tax base of related activity within a company. So-called *cross-field* allowances have been adapted by many countries, Norway included. Another way, as pointed out by Boadway & Bruce (1984, p 234) is to let companies sell unused tax credits to firms in tax position, also allowed in the PTA (see section 3.1.3).

An extension of the appropriate discount rate discourse, is whether the rates should be on a before or after tax basis. The key question here is whether the marginal company that a

country want to attract, have a opportunity cost subject to tax or not. As illustrated by Lund (2002a) with reference to Sinn (1991), this is not a straightforward question to answer. It both depends on the capital structure which changes over time, different tax rates that apply to an international company and if the legal framework actually prevent double taxation. Thus, it may be difficult for a tax system to be absolutely neutral, given that the alternative cost of capital after tax may vary between companies. One way of solving this, is to assume that the marginal investor is tax free something that e.g. Denmark assumes in their tax system (Lund, 2002a). This implies and pre-tax rate when valuing deductions.

2.4. Basic Valuation-Theory

In both investment theory, and in practice, firms and investors decide whether or not to invest in a given project by computing the present value of the net cash flows it generates. They use a discount rate corresponding to their cost of capital (Koller, et al., 2010, p. 103). In a world without risk and perfect information symmetry, this is a straight forward process. There will be only one rate of return, and companies should invest just enough to where the marginal project earns this rate of return. Formally, the NPV of the marginal project evaluated at the required rate of return is zero (Summers, 1987, p. 297).

However, when we introduce risk to the project, and recognize that future profits are uncertain, the problem of investment decision becomes more difficult. The theoretical correct procedure is to find the certainty equivalent of each period's cash flow and then to discount the certainty equivalents at the risk free rate of return (Summers, 1987, p. 297). Summers points to the problem that the certainty equivalent of the cash flow in one period normally depends on the distribution of the cash flow in preceding and subsequent periods. A normal and practical solution suggested by Summers (1987 p.297) and in the valuation literature is to add a risk premium to the weighted cost of capital. This will give the *risk adjusted discount rate* appropriate to the project under consideration (Koller, et al., 2010, pp. 235-273).

Assuming that a company seeks to maximize its value, capital are allocated to projects that when discounted with the risk adjusted rate of return from the best alternative capital allocation, have a positive net present value. This implies that for an investment to be profitable, the return must at least be higher than the alternative capital allocation. If the alternative capital allocation is subject to tax, the discounting factor must also be on an after tax basis. To express the best opportunity cost a *weighted average cost of capital* (WACC) is often applied.

The same methodology as described above can be applied to analyzing how tax may distort investment decisions. Deterministic models are used by Boadway et al. (1987) when calculating the effective tax rates for various projects in Canada, or Kemp (1992) used such models to compare different tax system in Northern Europe. The problem with this kind of approach is that it often treats risk as both constant over time and equal for a wide range of different cash flows. Additionally, it presumes that all decisions are made at the time of the analysis. Neither can be said to be true. A *discounted cash flow* (DCF) - model can differentiate between cash flows according to their inherent risk, but to consider uncertainty, option theory must be applied. This is shown by Ball & Browers (1983) who illustrate how a RRT-system with imperfect loss offset and tax claims are similar to European call options. Such models are often referred to as *modern asset pricing* (MAP). Studies show that project selection and prioritizing often differs when MAP-models are applied compared to DCF-models (Emhjellen & Alaouze, 2002, p. 13). However, models that take into consideration uncertainty are often sensitive to the parameters used to model the stochastic process for oil price movement.

2.5. Chapter summary

This chapter have illustrated the desired effects of neutral taxation, given that companies are maximizing their net present value and value additivity applies. Assuming a small and open economy, we can reduce our analysis to efficiency in production. However, by applying welfare theory and neo-classic economic theory, a weakness is that we indirectly assume a free enterprise model, which likely not applies to the NCS. However, this seems to be the prevailing framework for which resource rent taxation is analysed. By assuming value additivity, we are able to differentiate between risky and riskless cash flows. This is necessary because tax allowances under certain assumptions are assumed to be risk free, thus required to be valued differently from other cash flows. Whether this is done in practice and even correct from a company point of view is debateable. Literature is not coherent on the subject, and we must therefore account for different opinions in regards to how tax allowances are valued and what is the appropriate compensation for loss offset.

3. The Norwegian System to Capture the Resource Rent

In 1999, the Ministry of Finance ordered a revision of the PTA by appointing a tax commission to analyze its neutrality features. The revision was initiated due to concerns of too generous investment based deductions and inherent fiscal barriers to entry for companies

outside tax position. The Tax Commission's mandate was to reveal potential distortions and propose reforms towards a neutral tax system, justified by objective economic efficiency (NOU, 2000, ss. 4-6).

In June 2000, the tax commission published their conclusions in an *Official Norwegian Report* (NOU 2000:18 – *Petroleumsskatteutvalget*), where they illustrated that the Ministry's concerns was not uncalled for. The PTA had too favourable deductions which reduced the ordinary tax base and made investments considered unprofitable onshore, profitable offshore (NOU, 2000, ss. 131-132). This was also claimed to increase the capital intensity offshore to sub optimal levels. In other words, cost of the marginal investment was higher than the marginal income from the same investment. Furthermore, the *Tax Commission* supported the findings by Wood Mackinzey (1999) that the PTA favoured companies in tax position and subsequently caused fiscal barriers to entry. Major revisions were suggested, many of which are aligned with the theory regarding neutral taxation presented in the previous chapter. In the aftermath of the commission's proposal, several changes have been done to the PTA and the regulatory system. However, not all of the tax commissions' proposals have been taken into account. Furthermore, the authorities have had a gradual approach when changing the system.

This section will describe and discuss the current tax system for extractive activity on the NCS. Only relevant parts for our analysis will be included. Secondly, both the state's equity participation on the NCS and the concession system will be presented. This is necessary because distortive taxation cannot be discussed without taking into consideration other elements that may prevent sub-optimal resource allocation. Findings are summarized in the chapter summary.

3.1. The Norwegian Petroleum Taxation Act (PTA)

Companies operating on the NCS are subject to resource rent taxation, hereafter referred to as special tax (50 percent), which comes in addition to ordinary corporate taxation (28 percent). The special tax is accompanied with additional investment deductions, know as uplift, which purpose is to shield normal rate of return from special tax. With a discretionary licensing system with no up-front payments for licenses on the NCS, the state's strategy is to capture a substantial share of the resource rent through high marginal tax rates. From the state's point of view, a marginal tax rate of 78 percent is justified to ensure that the state/Norwegian people capture the resource rent (Jansen & Bjerke, 2010, p. 10)

The PTA is based on the taxation of the offshore entity. This means that *cross-field* allowances apply, as opposed to a *ring fenced* taxation system (cf. PTA section 3d). This reduces the perceived risk of not being able to use tax allowances in certain projects as they can be utilized against other taxable income. In principle, income from offshore activities cannot be offset against losses incurred from onshore activity and vice versa. This prevents costs from being allocated offshore and income to be allocated onshore due to different tax rates. To further prevent potential offset between internal transfer pricing and transactions based on fair market values, administratively determined prices decide the value of transactions. This is referred to as *norm prices*.

To capture the resource rent, the PTA differentiates between the tax base subject to ordinary corporate tax and the tax base that is subject to special tax. This is shown in the diagram below. If this had not been done, e.g. by having a higher corporate tax rate in one sector relative to other sectors, projects which are seen as profitable under the low tax sector would not be realized in the high tax rate sector (see mathematical example in section 5.1). Such a system also gives incentives to allocate costs to the high tax regime, while income to the low tax regime. It is therefore necessary to adjust the tax base (Lund, 2009, p. 291).

To ensure optimal capital intensity on the NCS relative to other sectors that are only subject to ordinary tax, two criteria's must be fulfilled. The first is that only the resource rent must be subject to higher marginal taxation. If not, too little capital will be channelled to the NCS. Secondly, deductions given in the PTA must not reduce the ordinary tax base. Otherwise, investments on the NCS will be to capital intensive. However, identifying the resource rent is not straight forward, and requires that all relevant costs and income items are deducted to indentify the actual net profit. In practice, this is done by the tax allowances as shown below.

	Schematic presentation of the PTA
	Operating income (norm price based)
-	Operating expenses
-	Linear depreciation for investments (over 6 years from year of investment)
-	Exploration costs
-	Environmental taxes (NOx & CO2)
-	Area fees
-	Net financial costs
-	Loss carry forward (with interests - risk free rate after tax)
=	**Ordinary tax base (tax rate 28%)**
-	Uplift (7,5% of historical investment cost for 4 years - in total 30%)
-	Excess uplift from previous years (with interests - risk free rate after tax)
=	**Special tax base (tax rate 50%)**

Table 3-1. Identification of the ordinary and special tax base in the PTA.

The diagram above illustrates the tax allowances in the PTA. As shown, companies on the NCS are subject to corrective taxes on GHG-emissions. In addition, companies are subject to area fees that are meant to stimulate for efficient exploration of awarded licenses. Environmental taxes and areas fees constituted only 2.2 percent of total direct petroleum taxes to the State in 2011 (Minestry of Petroleum and Energy, 2012, p. 22), and with the marginal importance for investment decisions, these taxes and fees will not be included in our analysis.

Only when the ordinary tax base is positive does a company pay corporate tax. The special tax base is the ordinary tax base after deductions of uplift, and only when the special tax base is positive will the special tax come in effect. This means that all taxable income, less the uplift, is subject to a marginal tax rate of 78 percent.

3.1.1. Tax Allowances

It is important to note that all relevant costs and income must be included in the tax base in order for the taxable net income to be the same as actual real net profit, as Sandmo (1989 pp.317-319) describes as a crucial element for neutral taxation. In the PTA, all relevant operating expenses (opex) are deductible, in the year costs incurred. This is for instance exploration costs, R&D costs, operational costs and plugging and abandonment costs.

3.1.1.1. Depreciation

Investments in permanent production facilities, pipelines and other installations (tangible assets in accordance with PTA section 3b) used for extraction are considered a capital expenditure (capex). These investments are expensed in the fiscal system over a six year

period, from the year the costs incurred[15]. In contrast, onshore capital expenditure is expensed over its economic lifetime, applying a declining-balance method, from when the capitalized investment is delivered or ready for use (cf. GTA § 14-30). In the preparatory work of the PTA, the short period over which capitalized cost is written down is due to risk, special financing and the large investments required when operating on the NCS (NOU, 2000, p. 107). For investments with an expected lifetime less than three years, costs can be deducted immediately.

According to the tax commission's report, they considered that the fast depreciation made the system distortive. Theory suggests that the discount rate can be arbitrarily chosen[16], something also the commission points out. The reason is that depreciation and the allowance for normal return will always be the same, since provision for normal return is based on the fiscal value. However, the tax commission point out that six years linear depreciation in combination with the uplift fails to isolate the resource rent and consequently reduces the ordinary tax base. Furthermore, the system fails to give the correct picture of the actual resource rent due to depreciation allowances not reflecting the actual physical wear of the capitalized asset (NOU, pp. 225-26). Despite their objection to the system, no changes have been made since 2000.

Different depreciation allowances between fiscal systems, e.g. faster depreciation offshore than onshore in Norway, is often referred to as a tax credit. This implies that the State gives cost free credits to one sector of the economy and this fact has received much attention in Norway recently. This is partly due to a report issued by Pöyry Management Consulting (2012), where they argued that the Norwegian petroleum sector in 2009 alone was subsidized with approximately NOK 19bn through the favourable depreciation deductions (Aarsnes & Lindgren, 2012, p. 41). The later analysis will reveal whether there is some truth to this argument.

3.1.1.2. Uplift

To shield normal returns from special tax, additional allowances are deductable against special tax. This means that the company is compensated for the alternative cost of capital related to investments in extractive activity in order to shield normal returns from special taxation. This is often referred to as uplift, which is set to 30 percent of the capital

[15] Depreciation over 3 years apply for gas projects that use onshore processing units (for cooling and liquefying) located in Finnmark and part of North Troms - see section 3b. in the PTA for further description.
[16] Boadway & Bruce (1984) - described in the previous chapter.

investments over a four year period - 7.5 percent each year (cf. PTA section 3c). Uplift also applies from the year of the investment transaction.

It is somewhat difficult to understand why 30 percent of the investment applied linearly over four years is assumed to isolate the resource rent from special tax or be a correct measure for the alternative cost of capital on the NCS. First of all it is not given what is considered normal return, and secondly, normal return will change over time.

Boadway & Bruce (1984), illustrated that in order to compensate for the alternative cost of capital, deductions of normal returns from the remaining fiscal value must be allowed. Fane (1987) later illustrated that when tax allowances was certain, the correct alternative cost would be the risk free rate. The proposal to the tax commission's report also suggested the latter, in combination with other changes that would reduce uncertainty and ensure symmetrical treatment of cost and income (NOU, p. 220). However, this is not really a relevant discussion since the current system does not give provision for normal return based on fiscal written down values. Instead, the PTA assumes that 30 percent of the investment cost is representative, disbursed over four years. This is not in line with theory suggested by Boadway & Bruce (1984) and Fane (1987).

In the Revised National Budget of 2004, accruals of the uplift were formally changed from six to four years (The Minestry of Finance, 2004, p. 112). This is interesting, since this change was in contrast to the suggestions and findings in the tax commission's report, who argued that the investment based allowances was too generous. The only reason given in the revised national budget was that the change meant to give incentives for increased production from existing field. The authorities did not argue the changes were based on increasing the neutrality properties. Previous to the change, it was however a plea from the industry to ease the fiscal burden due to low oil price and increasing cost level on the NCS (Kon-Kraft, 2003, pp. 71-80). As to whether the change came about to adjust what was considered to be normal return (thus improving the neutrality features), or if it was based on political wheel dealing and safeguarding of investor relations is therefore unclear. In present value terms, the change had marginal positive effect for a company's decision.

3.1.1.3. Deduction of net financial costs

Before 2007 net financial costs deductable in the PTA was limited by the so called *thin capitalization rule*. This meant that companies with a debt ratio (the ratio between interest bearing debt and total capital) above 80 percent, the exceeding debt over this limit was only

partially deductable. The idea was to give incentives for a reduced debt ratio. However, the thin capitalization rule was not robust enough to prevent financial window dressing, meaning capital structure adjustments to maximize net financial cost deductions offshore (Jansen & Bjerke, 2010, p. 52).

As of 2007, only a proportion of the net financial costs on interest bearing debt and loss/profit from currency investments, are deductable against income subject to surtax. The proportion is set to:

$$\text{(3.1)} \qquad \text{Deductable financial costs} = \frac{\text{Net financial costs} * 50\% * \text{tax value of offshore related assets at year end}}{\text{Average interest bearing debt}}$$

The remaining costs are deductable against onshore revenue, but only if the company have onshore income. If not, financial costs may be allocated back to the offshore activity, and deducted against the income subject to ordinary income tax (28 percent), including losses carried forward with interests (cf. PTA section 3d). Compared to onshore taxation, there are still beneficial deductions of net financial costs, but compared to the *thin capitalization*-rule, this is significantly reduced[17].

Assuming only interest costs we can find an expression of the maximum deductable financial costs for a given time. The net financing cost is the lending rate (r_L) multiplied by the average interest bearing debt over the year ($\widehat{\text{Debt}}_t$). Equation (3.1) can then be reduced to:

$$\text{(3.2)} \qquad \text{Deductable financial costs}_t = \frac{r_L * \widehat{\text{Debt}}_t * 50\% * \text{Tax value}_t}{\widehat{\text{Debt}}_t} = r_L * 50\% * (I - \frac{t}{6} * I)$$

Where the latter part in equation (3.2) is the investment cost (I) less the accumulated depreciation at time (t), thus the remaining fiscal value in equation (3.1).

3.1.1.4. Value of the Tax Allowances

As the value of the tax allowances is central to neutral taxation, a simple example will show the totality of the tax allowances. Assume that an investment (I) is carried out at the beginning of year one and financial costs deductable against the special tax base are maximized, as described in (3.2). We first assume that the debt issuer (creditor) is subject to ordinary income tax and additional financial costs are deducted against onshore activity (and

[17] In tax literature, the difference between financial cost deductions offshore and onshore is often referred to as *financial value added.*

not taken into account). The present value of tax allowances in the PTA as seen from the state's perspective, can then be expressed in the following way:

$$(3.3) \quad \left[78\,\% * \sum_{t=1}^{6} \frac{\frac{1}{6} * I}{(1+\delta)^t}\right] + \left[(78\% - 28\%) * \sum_{t=1}^{6} \frac{r_L * 0{,}5 * (I - \frac{t}{6} * I)}{(1+\delta)^t}\right] + \left[50\% * \sum_{t=1}^{4} \frac{\frac{0{,}3}{4} * I}{(1+\delta)^t}\right]$$

The expression assumes that companies are in tax position, therefore neglecting any compensation for loss offset. The first part of equation (3.3) is the present value of depreciation, which is deductable against income subject to a marginal tax rate of 78 percent. The second part is the present value of deductable financial costs. Since income in the hands of the creditor is subject to ordinary tax, the tax value of the deductions is the marginal tax rate minus ordinary tax. The last part is the accumulated tax value of the uplift, which is only deductable against the special tax base.

Given a debt financed investment of 100, a risk free rate before tax of 2.5 percent and a risk premium to creditors of 1.5 percent, the nominal accumulated value of the allowances are 135 percent of the investment – 130 percent when deductions of financial costs are excluded. This means that 135 percent of the investment is deductable against the offshore tax base. This is illustrated below, where both the accruals of tax allowances and the accumulated tax allowances are shown.

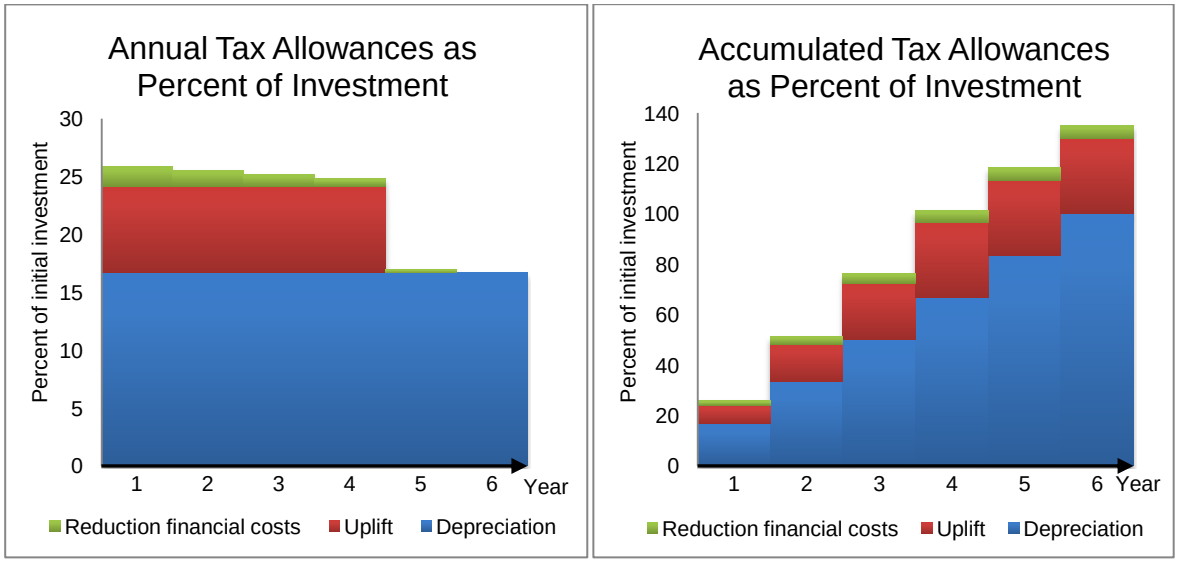
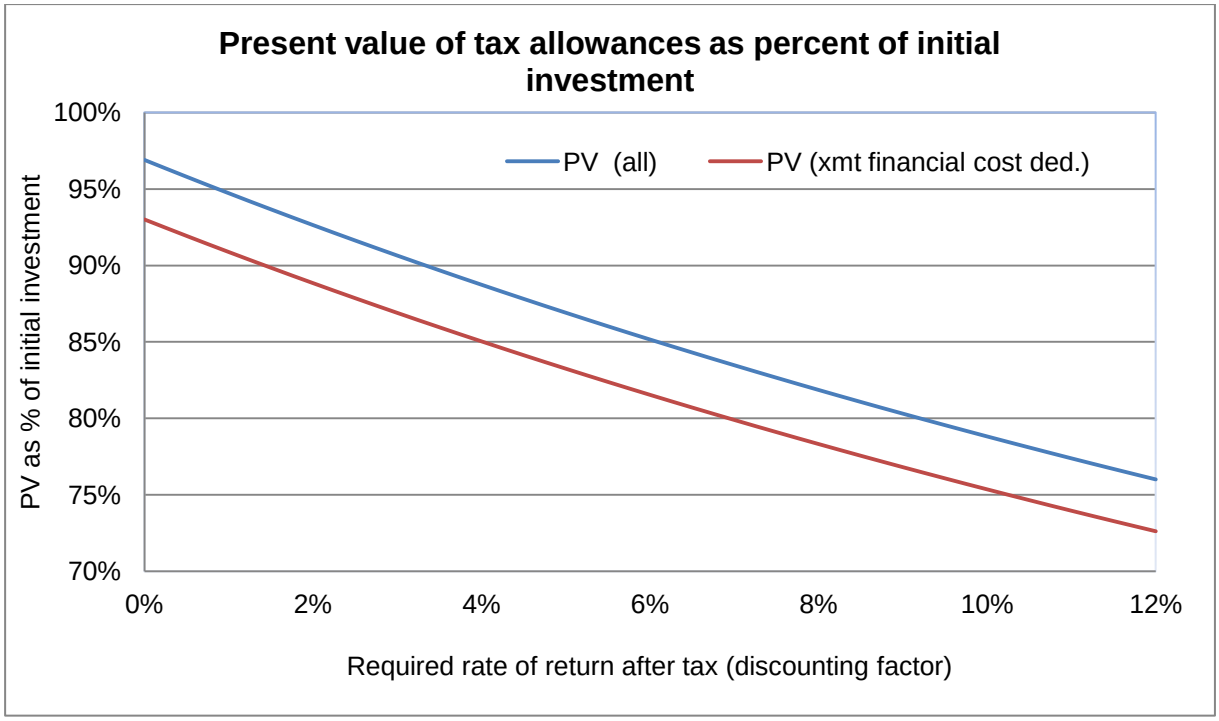


Figure 3-1. Accruals of tax allowances – annual and accumulated

Considering tax value in present value terms, the value is of course depending on the discounting factor, which is shown in the graph below. The graph also shows the value when excluding the financial cost deductions. Assuming a discount factor equal to risk free rate

after ordinary tax (in this example 1.8 percent), the PV is 91.7 percent of the initial investment (89.3 percent when excluding the financial cost deductions). Seen from a company's perspective, where the tax value of deductable financial costs are 78 percent - not 50 percent as used above - the PV of allowances are 93 percent of the initial investment. This implies that if a capitalized investment yields no return, everything else being equal, the state would refund 93 percent of the investment through tax allowances. As shown, the PV of tax allowances as percent of the investment costs exceeds the marginal tax rate of which income is taxed. For a company, fiscal symmetry between cost and income would imply a discount rate equal to 9.72 percent (8.2 percent when excluding the financial cost deductions). Income would then be taxed 78 percent while tax allowances would have a value of 78 percent of the initial investment, thus leaving the company in a 22/22 regime. This means that the company gets 22 percent of the upside and 22 percent of the downside.



Graph 3-1. Present value of tax allowances and sensitivity to discount rate

3.1.2. The Refund-Scheme for Exploration Costs

Exploration costs are not considered a capital expenditure, but the fiscal treatment of such costs is the only element in the PTA that resembles a pure *Brown*-tax. This implies that companies are guaranteed an immediate refund of the tax value (78 percent) of any losses incurred in relation to exploration activity on the NCS, irrespective of tax position. This includes both direct and indirect costs, but not financing cost. The claim on the state can be

pledged, and this collateral has opened up for easier and cheaper funding of exploration activity on the NCS, and thereby lowered the barriers to entry for newcomers.

With immediate reimbursement, the value of the tax allowance is not distorted by any difference in opinion regarding the correct discount rate to employ. Tax position is neither of importance because provisions for loss offset is not necessary. This change came as result of low exploration activity in the late 90s and beginning of the last decade (Norwegian Petroleum Directorate, 2011, p. 28), and came in effect in 2005. The chart below, illustrates the effects of the changes described above. We see that the interest for the concession rounds has significantly increased since 2005, mainly because of the emergence of small exploration companies. Categorized by their market capitalization, these companies are represented by the grey part in the histogram (small and micro cap). From the diagram, we also note a slow increase of companies already from 2002 and onwards, and a probable reason for this will be described next.

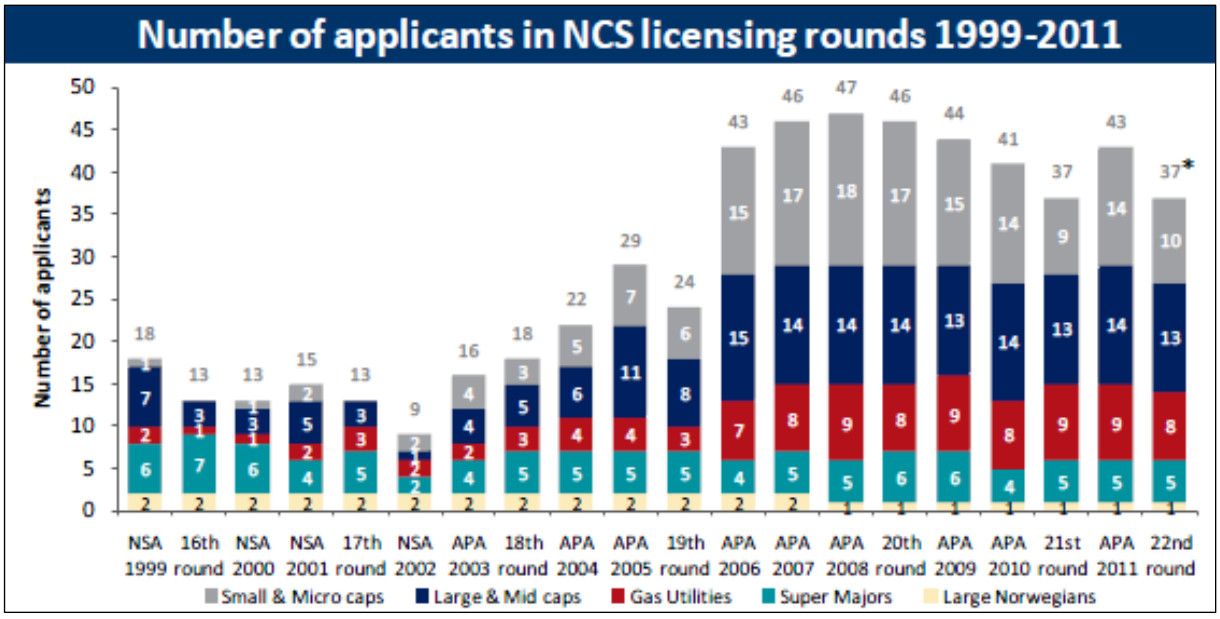


Figure 3-2. Number of applicants in NCS licensing rounds (RS Platou Markets, 2012)

3.1.3. Loss Carry Forward and Unconditional Refund of Tax Allowances

Before 2002, companies not in a tax position had a disadvantage compared to companies in tax position. This was due to the fact that companies trying to enter the NCS were not compensated for loss offset, and utilization of future tax allowances was not certain, thus increasing the cost of capital. This constituted a significant fiscal barrier to entry and had a disinvesting effect on the NCS, as described in the tax commission's report.

This was a major problem for the NCS since the oil province was maturing and new discoveries and the subsequent investments became more marginal. The large oil companies were not interested to pursue these projects and this required presence of companies with lower required rates of return than the major oil companies. This was also necessary to realize time critical resources[18] and increase production from existing fields in production with utilization of specialized knowhow in various phases of the production process. Consequently, the state made several changes in the PTA from 2002 and onwards to promote smaller companies to operate on the NCS (Minestry of Finance, 2001). The steady increase of the interest in the concession rounds since 2002 is a noticeable effect of the changes. It should be noted that both increased oil price and changes in the concession system[19] that lowered barrier to entry can explain the increase.

Today, companies not in tax position (net loss), may carry forward losses from offshore activity subject to special tax indefinitely, with interests if the losses occurred in 2002 or later. Interest rates are decided annually by the Ministry of Finance, and reflect companies' opportunity cost for risk free investments (Ministry of Finance, 2000, p. 3). According the instructions to the PTA (chapter 5, § 16) this is based on the average yield of twelve months Treasury Bills plus half a percent adjusted down with the ordinary tax rate. Thus, the PTA applies risk free rate after ordinary tax, based on the assumptions that companies operating on the NCS have an alternative cost of capital that are subject to corporate tax. This is in line with the prevailing theories described in the previous chapter. As Lund (2002a) point out, after ordinary tax may be justified, because relative to other countries, ordinary corporate tax of 28 percent is considered to be in the lower range. For the tax assessment in 2010 the rate after tax was 2 percent p.a.

To ensure that companies subject to the special tax are guaranteed the full tax value of all costs incurred, losses can be transferred in connection to sales of activities and M&A with other upstream companies, or be refunded upon cessation. If a company does not have taxable income to shelter costs of plugging and abandonment, the tax value of the losses incurred can be immediately refunded from the state upon cessation. This will increase the

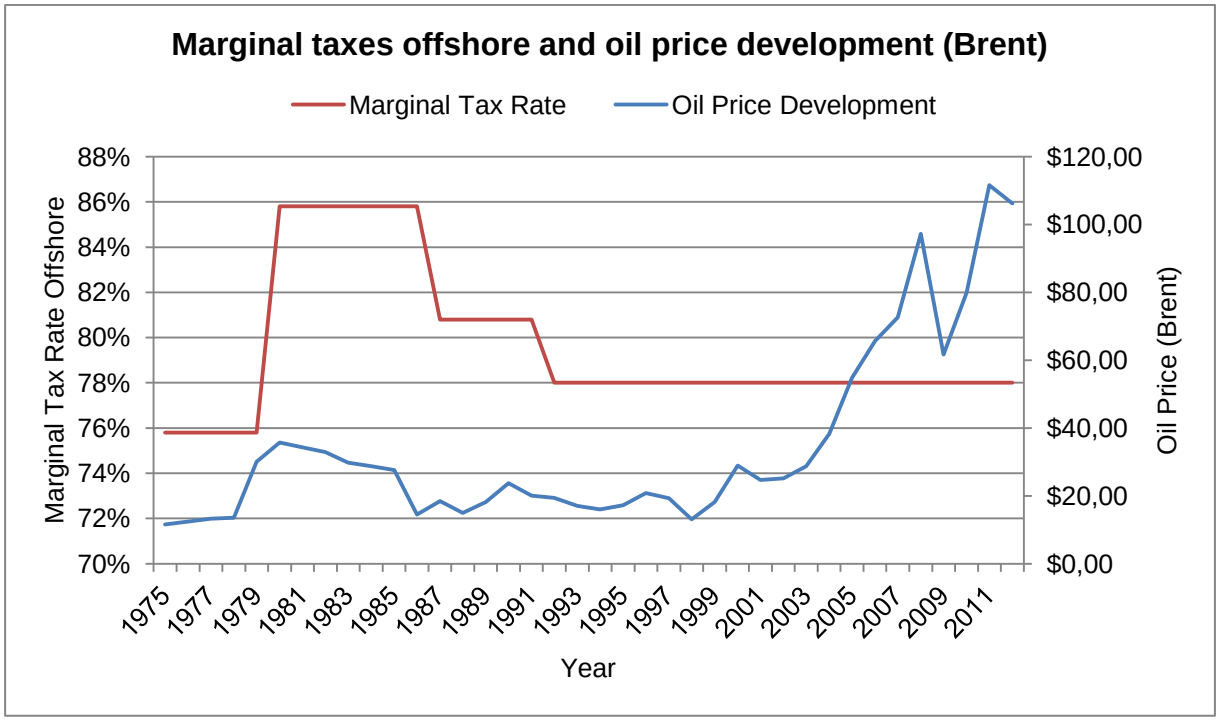
[18] This means that in order for investments to be commercially viable, the use of existing infrastructure must be utilized, together with standardized production solutions.

[19] Introduction of pre-qualification of companies before applying for licenses reduced companies' risk of not being qualified and thus wasting resources on comprehensive applications for licenses.

certainty of eventual redemption of the tax value as Fane (1987) sets as a condition for tax allowances being valued at the risk free rate (cf. chapter 2).

All these changes implies that if companies value the tax allowances with the same discount rate as losses are carried forward with, the tax system is in theory a linear function of costs and income. This requires that all relevant costs and income are identified and included in the tax base. Emhjellen & Osmundsen (2011), however, question if this is possible, considering that a ruling Parliament cannot convincingly commit to tax policies of future Parliaments. The basis of their argument is that the PTA has been used as a policy instrument over the business cycle (Emhjellen & Osmundsen, 2011, p. 49).

As illustrated in the graph below, the marginal tax rate has historically been increased in periods of prevailing high oil price and been reduced when the oil price has remained low. This can reduce the risk perceived by the companies, as it reduces the variance in income after tax caused by oil price volatility while maintaining the cash flow's expected value. However, as Emhjellen & Osmundsen (2011, p.50) point out, the increased tax rate has often been imposed on all projects, while the reductions only on new projects, thus implying an asymmetric treatment over the business cycle. The state then limits the upside and not the downside of expected cash flows. This is on the other hand based on historic events, and does not reflect the current fiscal regime, which Osmundsen (2008) argues reflect absolute commitment from the state. This is also seen in the diagram with a stable marginal tax rate since 1992, which was the year the corporate tax reform came in effect.



Graph 3-2. Oil price and historic change in marginal tax rate offshore (Source: Wood MacKenzie - data used on the Ekofisk area).

3.2. Licensing and concession system

To ensure an optimal depletion strategy for areas open for exploration and extractive activities on the NCS, companies must apply for licences. Licences are normally distributed through concession rounds, and different rounds ensure satisfactory exploration of areas close to existing and planned infrastructure and frontier areas with little or no infrastructure in place (Olje- og Energidepartementet, 2011, p. 16).

Licences are awarded free of charge, giving low barriers to entry. Companies can either apply as a group or individually, and the licensing process is based on known and objective criteria in order to ensure a non-discriminatory process. Production licences for specific fields are often awarded to sets of companies, and an operator who responsible for the operations is appointed. Giving licences to joint ventures is thought to be an insurance against sub-optimal depletion/resource allocation, since licence-holders act as a control mechanism of the operator. This is believed to ensure that company interests are aligned with the state's ambition of optimal depletion. How control mechanisms work in practice is however a complex field and beyond the scope of this thesis to evaluate. Exercised control by the Petroleum Directorate is also limited to what they in fact can observe, which is probably not sufficient enough to ensure that companies exert the optimal level of unobservable efforts (Osmundsen, 1999).

3.3. State Direct Financial Investment (SDFI)

The Norwegian State also participates as a producer, on the same terms as other companies operating on the NCS. This is done through the so-called *state direct financial investment* (SDFI), which is managed by the state-owned company Petoro. Equities on the NCS capture additional resource rent, and the state's strategy is to focus on licenses with high expected profitability, the infrastructure and on high value assets on the NCS (Ministry of Petroleum and Energy, 2011). By adjusting the state's share according to the assumed profitability of the fields and assets[20], companies' financial burden and income is normalized. It is also Petoro's task to control that the state's interests are attended to on the basis of sound economic decisions (Petoro, 2012).

Direct involvement of the state is in many ways similar to cash flow taxation. If one assumes a ring-fenced project, with one owner that is subject to a neutral tax on cash flows at rate (*t).* All costs are reimbursed by the state at the rate (*t),* and all income is taxed by the rate (*t).* This is equal to a situation where the state owns a share (*t*) in the field, cover a share (t) of all costs and claim (*t)* percent of the income. If the tax on the cash flow is deductible in the ordinary corporate tax base, it would equal the system with SDFI. The system would then be neutral in investment decisions since it would not affect a company's internal rate of return.

The required rate of return could however be affected if involvement by the state influence/reduces a company's executive power to make independent decisions. This would be perceived as a political risk and a risk premium would be added to the required rate of return. This is only valid of one assumes that what is best for the license may not be the best for the state, which is not unlikely. This can be solved by self-imposed requirements from the state to be a *silent partner*. A reputation for this would reduce political risk, but likely not remove it completely (Osmundsen, 2001, p. 4). The ability to affect activity through an active participation could on the other hand be valuable to ensure socio-economic efficiency, which is the current strategy. With only 70 employees, and the fact that Petoro control over one third of all gas and oil reserves on the NCS (Petoro, 2012), it is natural to assume that they do not have the resources for in-depth control of all licenses they take part in.

3.4. Chapter Summery

The PTA has been subject to major changes in recent years to improve the neutrality features. This is done by ensuring that tax allowances are perceived as certain and with

[20] Petoro's share in a license is determined before any resources are proven. The SDFI can buy into/sell out shares at fair market price, thus no perceived risk of nationalization of resources.

allowing losses to be carried forward with interests. As the presented theory in chapter 2 states; neutral taxation is achievable as long as the tax system has loss offset provisions, cross fields deductions, sale of negative tax position or refund of tax values of unused deductions. These factors are now present in the PTA, thus ensuring that the systemic features are in place to ensure neutral treatment of companies. The fiscal barriers to entry have been significantly reduced and the state has not given any signal of future changes. Since provision for loss offset and certainty regarding the tax value of investments, the appropriate discounting factor for tax allowances should be the risk free rate after tax. This should also apply to shield normal return from special tax (uplift). However, the systemic features regarding uplift are not in line with prevailing theory on neutral taxation. This means that the PTA may imply sub optimal capital allocation.

From the graph showing net present value of tax allowances, we see that the tax value of allowances exceeds the marginal tax rate when discounted by the risk free rate after tax. From a theoretical point of view, costs are therefore treated beneficial compared to income. Compared to a situation without tax, this would then imply incentives for too high capital intensity on the NCS, but this is irrelevant in our context, since we compare to a situation with ordinary tax. However, a potential pitfall with asymmetric treatment of costs and income is that that it may give incentives for wasteful expenditure that would be partly subsidized by the state (Lund, 2002a). The regulatory system that is meant to prevent this is however beyond the scope of this paper, and we do not consider how the PTA effect companies willingness to take on risk. It is also important to point out that changes described here (in additions to others) have made the system more transparent and simple, thus preventing subjective interpretation and limiting administrative resources necessary to collect the resource rent.

The Norwegian system to capture the resource rent and to optimize the depletion of resources on the NCS consists of three policy instruments; the PTA, equity participation by the state and the concession system. The latter two will be referred to as the regulatory system in the following. This chapter has mainly focused on the PTA, but it is important to know the totality of the system, as this will be the relevant risk for the companies operating on the NCS, not only the fiscal risk. To what degree the regulatory system is perceived as a risk factor is unknown, but it is believed to be low due to both the transparency and predictability of the system. To system is intended to prevent suboptimal capital allocation on the NCS. However, this will be limited to what can be observed.

4. Model

This chapter will explain the main model applied in the analysis. Other analytical approaches will be explained, and assumptions made in the model are based on previous discussion, but repeated here. The model is further explained in the appendix, and summery of the basic assumptions is presented at the end of this chapter.

4.1. Choice of Model

The purpose of this thesis is to assess whether the PTA distort investment decisions compared to a situation with only corporate tax. In addition we want to analyze whether the PTA allows for equal treatment of companies with regards to their tax position. Our intention is not to give exact quantitative measures of the distortive properties of the PTA, but rather illustrate under which assumptions the PTA can be considered neutral with regards to our chosen dimensions. This kind of analysis of the PTA has been done before and was a central element in the tax commission's report in 2000. They applied both stochastic and deterministic models to determine whether marginal investments offshore left companies better or worse off when compared to investments onshore. However, since the current system guarantees the tax value of transactions, and provision for loss offset is given, a model that treats tax allowances as uncertain will not be necessary.

Central to the tax commission's report was a deterministic model to calculate the marginal real rate of return where tax allowances was assumed to be risk free[21]. In this model the marginal real rate of return showed how profitable a project must be before tax, if the project is marginally profitable after tax. The basis for choice of model was that investment decisions on the margin determine the distortive properties of a tax system. Their conclusion, as previously stated, was that the PTA implied great differences between marginal real rate of return for investments onshore and offshore, and between companies inside and outside tax position (NOU, p. 403-414).

Other models can also be applied when analysing how tax systems affect investment decision, both applying real and nominal values. A common approach is to consider an investment that yields a constant but diminishing rate of return[22]. By applying a discounted cash flow model (DCF), the net present value (NPV) after tax and/or the internal rate of return (IRR) after tax can be used to assess neutrality between different tax regimes and tax position. This kind of model will be used in the following analysis. By analysing

[21] This method is based on studies by Hall and Jorgensen (1967) and Fullerten and King (1984).
[22] See e.g. Kemp (1992)

investments on the margin, our conclusion will not differ from models that calculate the marginal rate of return, given that the same assumptions apply. The only difference between the two models is that calculation of NPV or IRR requires assumptions regarding the income cash flow, while the marginal rate of return does not. The choice of model is based on the assumption that a DCF model is more intuitive and will allow us to be more dynamic when analysing sensitivity to assumptions made.

4.2. Differentiated DCF-model

Loss offset provision in the PTA is based on risk free rates after tax. Applying risk free rate is based on the fact that the state guarantees continuity and unreserved refund of tax allowances. After tax provisions, is based on the assumption that alternative risk free investments are subject to ordinary tax. Thus, neutrality in the PTA is based on the assumption that companies on the NCS differentiate between riskless and risky cash flows. This view is consistent with previously described literature regarding requirements for neutral taxation given[23]. The discussion of the current fiscal regime also indicated that there is no apparent reason why companies should value tax allowances differently e.g. adding a risk premium due to SDFI or due to fiscal instability.

However, tax literature indicates that companies use one single discount rate for the entire project's cash flow, irrespective of difference in risk. See for example Siew (2001), Summers (1987) and Graham and Harvey (2001). This fact is also confirmed by the industry in the tax commissions report. Companies typically discounted cash flows using a risk adjusted WACC that is common to a wide class, if not all of the cash flows to be considered (Macmillan, 2000, p. 26). This is probably because it is convenient and applicable on local levels (Osmundsen, 2001, p. 11). Other reason may also explain why companies do not differentiate between risky and risk free cash flows. This can be hurdle rates - minimum required rates of return set by a company to express goals or motivate for efficiency - that are above the correct WACC (Investopedia, 2012). It can also be to get large margins/buffers in order for a project to be robust enough against a significant price drop of energy carriers, or even just to mitigate for too optimistic estimations (underestimate costs and overestimate revenue). Lund (2002b), however, argues that companies apply one discount factor because companies operate in a multinational environment with a wide diversity of tax systems, and do not correct the discount rate to be aligned with the fiscal system of a given country.

[23] See e.g. Fane (1987) and Ruback (1986)

Regardless of seemingly irrational behaviour from companies, this perspective will be incorporated in our analysis, because assumptions of valuation method have significant implication for neutrality properties in the PTA. Differentiating between riskless and risky cash flows will be referred to as the state's perspective in the following analysis, and reflect the theoretical correct method. When applying one single discount factor to all cash flows, irrespective of their inherent risk, this will be referred to as the *industry's perspective*, and this will represent the *perceived* neutrality of the PTA.

4.3. Model assumptions

Two investment cases will be subject to analysis, and both the state and the industry's perspective with regards to valuation of tax allowances will be incorporated. The first investment case is a company in tax position that can choose between investing onshore or offshore. The only difference between the investments is the tax regime, and this will allow us to see if marginal investments offshore are distortive compared to onshore investments. The second investment case is two companies, one in tax position and the other initially outside tax position, that invest in the same project offshore. This allows us to assess whether the PTA treats companies with regards to tax position differently. The investment is the same for both cases.

4.3.1. Investment assumptions

Investments are assumed to be equity financed, thus overlooking the inherent financial value added in the PTA. Capital structure is therefore not considered in the analysis. Discount rates and risk free rate rates are assumed to be constant throughout the investment horizon. Transactions are free of costs and made in the beginning of the year, indirectly assuming annual fiscal payments. Cash flows are in nominal values. The investment is assumed to be one single capital cost, referred to as *the investment (I).* The investment cost is set to 100, making it convenient to analyze differences in terms of percent of the initial investment.

Income from the investment will follow a profile as described in graph (4.1) below. *Peak production level (Ω)* will be the first year of production, and a geometric and constant declining output rate (*depletion ratio* (γ)). The time from the investment transaction to production starts is referred to as the *lead time*. Production will continue indefinitely, and we assume no abandonment/closing costs. *Peak production* level is synonymous with the investment's profitability. Since all transactions and recordings are done at the beginning of the year, production will represent previous year's production/net operating income. We do not consider uncertainty to future income streams (e.g. oil price fluctuations). However,

sensitivity analysis to required rate of return will indirectly express the projects total risk or uncertainty to future flow of income.

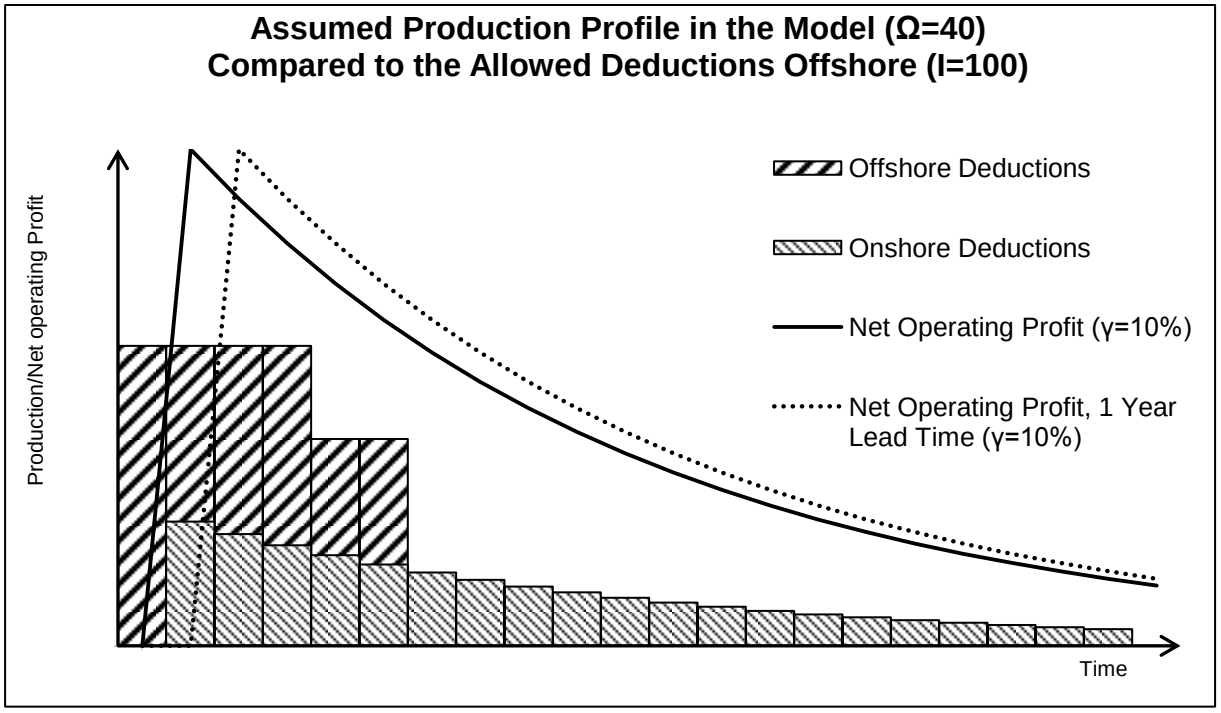


Figure 4-1. Production profile, lead time and accruals of tax allowances offshore and onshore.

The above figure is an illustration, not derived from the model. It shows the assumed production profile from the considered projects with different lead time. As we keep the *depletion ratio (γ)* constant at 10% in all analyses, the *peak production level (Ω)* will represent the projects profitability alone. The allowed depreciations onshore and offshore are also included for comparison. Note that with one year lead time (dashed curve) the deductions onshore would have been moved one period ahead in time as well, since these are only allowed deducted from when the production starts. This is not the case offshore. The values are nominal.

4.3.2. Assumptions Regarding Fiscal Regimes

Tax allowances are used as previously described, and to the full extent possible. Marginal corporate tax rate onshore is (τ_o) 28 percent. The fiscal depreciation rate onshore (δ) is set to 10 percent p.a. Depreciation allowances onshore are only allowed when the production facility is on stream, and not from when the investment transaction is carried out.

The depreciation deductions offshore (d_t^{off}) are allowed at the time the investment is carried out (linear over six years). The same applies for the uplift deductions (u_t) - 30% linear over four years. The special tax rate (τ_s) is 50 percent. Environmental taxes are not considered.

4.3.3. Assumptions Regarding Tax Position

A company outside tax position can be considered as a ring fenced-project, thus limiting the ability of any transfer of losses and unused uplift to associated activity offshore. Upon losses carried forward in the ordinary tax base, this will be compensated with risk free rate after tax, and the same with deferral of unused uplift. The risk free rate adjusted for ordinary tax will serve as proxy for the loss offset provision, and we disregard the half percent point described in previous chapter. When the project generates enough total income for the accumulated losses/tax allowances to be deductable, the ring-fenced project will be in tax position. This will depend of the profitability, expressed by the peak production level.

A company in tax position can be considered as a consolidated company. Any tax allowance not deductable against income a given year, will be transferred to subsidiaries cost free. The net cash flow effect will then be the tax value of the transfer which equals the reduced tax payable to the subsidiary. Losses transferred in the ordinary tax base will then have a net cash flow effect equal to the transfer multiplied by the marginal tax (28 percent onshore and 78 percent offshore). Transfer of unused uplift offshore will have a tax value of 50 percent. It is assumed that the consolidated company will be in tax position throughout the project.

4.4. Risk free rate and WACC

Long term Treasury Bills serve as good proxy for the long term risk free rate. The Norwegian 10-year bill is currently 2.03 percent. This is, however, not representative over the business cycle. Calculating the average yield of Norwegian 10-year Treasury Bills from 1987-2011[24], we find 6.74 percent, which seems more reasonable. Emhjellen & Osmundsen (2011, p.52) use a risk free rate of 6.5 percent in their studies of the PTA. Calculations used in the tax commission's report (NOU 2000 pp.419-422) is based on studied by Børhen & Gjærum (1999) and Johnsen & Frøystein (1999), who use a nominal tax rate before tax of 5.6 percent and 7.6 percent respectively. In our analysis a nominal risk free rate before tax of 6.5 percent will be used.

Finding the accurate discount rate (alternative cost of capital) employed by companies on the NCS is beyond the scope of this thesis. It is neither vital to identify the exact discount rate used, but we need a proxy for which our findings can be compared with. The tax commission based their analysis on a nominal discount rate after tax of 7.2 percent (NOU 2000, p. 129). Wood Mackenzie, a leading analytical company for upstream activity on the NCS, applies a

[24] Based on the annual average return on the 10-year Treasury Bills reported from the Norwegian Central Bank.

real discounting rate after tax of 8 percent in their base case analysis of current projects on the NCS. Aswath Damodaran (2012) finds an industry average WACC after tax for integrated and producing oil companies of 9 percent after tax. This will serve as a reference when we conclude our findings.

4.5. Chapter Summary – Assumptions in the Model

Summary of variables and parameters (assumptions)	
Risk free rate before tax	6,5 %
Risk free rate after tax	4,7 %
Required rate of return after tax (r_c)	Variable
Ordinary income tax (τ_o)	28 %
Special tax in PTA (τ_s)	50 %
Marginal tax rate in PTA $(\tau_o+\tau_s)$	78 %
Linear depreciation allowances over years in PTA	6
Annual fiscal depletion as percent of investment in PTA	16,67 %
Linear uplift allowances over years in PTA	4
Total uplift allowance in PTA	30 %
Geometric fiscal depreciation rate (μ)	10 %
Investment cost (I)	-100
Investment year (beginning of year)	0
Annual depletion rate (γ)	10 %
Peak production year (beginning of year)	Variable
Peak production level (gross income) (Ω)	Variable

Table 4-1. Summary of assumptions made in the Model

5. Neutrality between Offshore and Onshore Investments

This part will analyze whether the PTA distorts the allocation of capital between onshore and offshore activity. To start of the discussion, a model by Lund (2012) will be presented and applied. This will serve as a reference when our model is applied. However, we argue that assumptions applied in our model are a better approximation of the distortive properties in the PTA, something that will give different results compared to Lund (2012).

The analysis will show that neutrality of the PTA in investment decisions onshore and offshore is found to be sensitive to the profitability of the investment, the chosen discount rate and if tax allowances are valued according to theory. We find that from the state's point of view, where allowances are discounted at the risk free rate after tax, the PTA favours offshore investments, while the industry, employing a single discount rate for all cash flows, could perceive the PTA as distortive towards onshore investments.

5.1. Analytical Approach

Analyzing and comparing tax systems, all relevant aspects should be included in order to draw the right conclusions. A recent study by Pöyry Management Consulting (2012) [25] includes an analysis of the benefit from the favourable depreciation in the PTA compared to onshore deductions. This study fails to analyze the tax credits in light of the higher marginal tax rate offshore and concludes that in 2009, the Norwegian petroleum industry was subsidized with approximately NOK 19bn through the favourable deductions alone (Aarsnes & Lindgren, 2012, p. 41). The conclusion was reached by summing up all investments subject to depreciation and comparing the discounted future tax benefit of six years linear depreciation to a 10 percent annual deduction rate used in the GTA. Tax allowances were discounted at 9 percent. The study recognizes that the allowed depreciation deductions have to be seen in context with the higher marginal tax rate, but choose to ignore it in the analysis and concludes: *"…investment deduction rules are a subsidy, since they may skew investment decisions and channel resources toward the petroleum industry at the expense of other investment opportunities onshore"* (Aarsnes & Lindgren, 2012, p. 42).

If the tax benefits in the PTA are to be considered as subsidies, the special tax must be considered a penalty. What is of interest to analyze is the *sum* of these two effects and see if they neutralize each other and subsequently cause neutrality compared to onshore taxation. This is done in an analysis by Lund (2012 pp.25-27), where he also includes the tax benefits from the uplift.

Six years linear depreciation and 30 percent uplift over four years for production facilities often lasting over twenty years, will at first glance seem like a violation to Sandmo's (1989) requirements for neutrality in a profit based tax system. However, the negative effect a higher marginal tax rate has for investment incentives must be counteracted by incentives to invest in order to secure neutrality between capital allocation onshore and offshore. This can be shown by looking at how tax rates affect the required rate of return.

If an onshore project has a required rate of return of 10 percent before tax, the after tax rate of return is: $10\% * (1 - \tau_o) = 7.2\%$, where τ_o is the onshore marginal tax rate (28 percent). The required rate of return before tax for an offshore project, if we set the after tax requirement to the same as onshore, is found by:

[25] The study *"Fossil Fuels – At What Cost? – Government Support for Upstream Oil and Gas Activities in Norway"* was done on the behalf of the Global Subsidies Initiative (GSI) of the International Institute for Sustainable Development (IISD).

(5.1) $$x * [1 - (\tau_s + \tau_o)] = 0.072,$$

where (τ_s) is the special tax rate offshore (50 percent). Solving for (x), we find the required rate of return before tax to be 32.72 percent. Without any measures counteracting this tax wedge, many projects that would have been profitable under the onshore tax regime would be unprofitable in the offshore regime. Offshore tax allowances are such measures. In the following sections we analyze to what degree and under what assumption these measures ensure neutrality.

5.2. Model for Comparing Tax Allowances and Tax Rates

In response to the study by Pöyry Management Consulting, Lund (2012) published an article with an approach for comparison of allowed deductions and tax rates. His model will be explained and applied in this section as it illustrates the necessity of analyzing the relationship between tax allowances and marginal tax rates. It also demonstrates that Pöyry's conclusion and methodology is based on wrong assumptions, thus serving as an example of how the perception of the PTA is often biased.

The model is summarized in graph (5.1) below. The curves represent the present value of the cash flows after tax as a function of the discount rate employed when valuing the tax allowances in the two fiscal regimes. The projects analyzed are profitable on the margin under onshore tax when 10 percent annual fiscal depreciation is deductible against the tax base. This will in the following be referred to as onshore taxation. Further assumptions are (Lund, 2012, p.25):

1) Tax allowances (depreciation and uplift) starts in the year after the investment is carried out.
2) The company is always in tax position, i.e. fiscal deductions will be used entirely as they are allowed.
3) The variable on the x-axis is the nominal discount rate after tax, (r), and is constant through the lifetime of the projects. The nominal discount rate after tax is used to determine the present value of the tax allowances.

The method can however be somewhat confusing. For every value of (r), the project's income is adjusted so that it is profitable on the margin under onshore taxation. It is therefore not the same project under consideration for different values of (r). But for a given value of (r), a project can be compared in the two tax regimes, as it is the same project. The horizontal orange curve in the figure serves as a reference point since it illustrates the present

value of the cash flow after tax for marginal projects under onshore taxation. The investment of 1 is excluded. It is not a declining function of (r) because income is adjusted for every level of (r) in order to provide horizontal reference points.

The present value of the fiscal deductions under onshore taxation is determined using the yearly deductions method:

(5.2) $$A(r) = \frac{\delta}{(r+\delta)}$$

Where $\delta = 0.1$ is the allowed fiscal depreciation rate, (r) is the discount rate after tax and the deductions are assumed to continue indefinitely. The present value of depreciation allowances in the PTA is set to:

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

The present value of the uplift is:

(5.4) $$C(r) = \frac{0.30}{4r}\left[1 - \frac{1}{(1+r)^4}\right]$$

In the below illustration, we have differentiated the present value of the *tax credits*, defined as the excess benefit of the deductions in the PTA (not included in the original model). The relative tax credit is defined as the difference in present value between the allowed depreciations in the two tax regimes multiplied by the marginal tax rate offshore. Benefit of the uplift is the special tax rate multiplied by the present value of the uplift, since it is only deductible against the special tax.

(5.5) $$(\tau_s + \tau_o) * [B(r) - A(r)] + \tau_s * C(r)$$

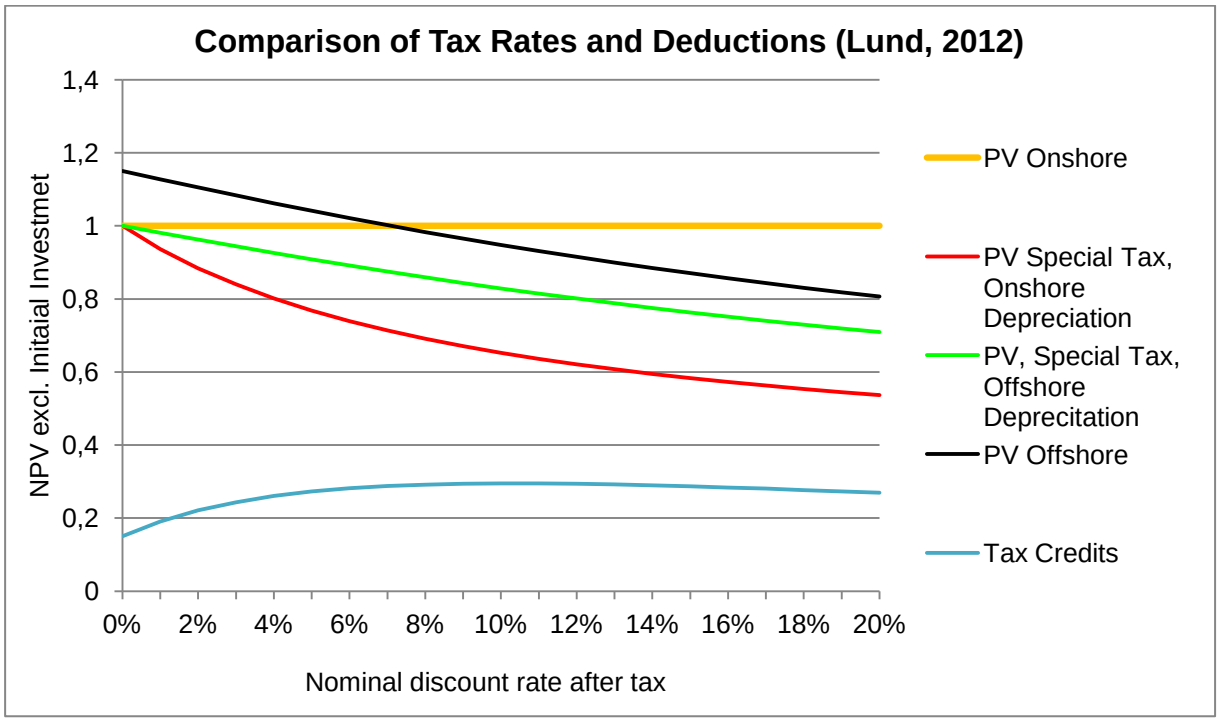
Which is equivalent to:

(5.6) $$(\tau_s + \tau_o) * \left[\frac{1}{6r}\left(1 - \frac{1}{(1+r)^6}\right) - \frac{\delta}{(r+\delta)}\right] + \tau_s * \left[\frac{0.30}{4r}\left(1 - \frac{1}{(1+r)^4}\right)\right]$$

Where (τ_s) and (τ_o) are special- and onshore tax rates. The present value of the revenue before tax, *Y(r)*, is residually decided, since the purpose is to study a project which is profitable on the margin under onshore taxation. The project is considered marginal onshore when: the sum of the present value of the revenues after onshore taxation and the tax value of depreciation allowances, *A(r)*, is equal to the investment cost of 1:

(5.7) $$(1-\tau_o)*Y(r)+\tau_o*A(r)=1$$

This equation defines *Y(r)*. The left side of equation 5.7 is the orange horizontal curve in the graph below. Since (r) is the discount rate used when valuing the tax benefits, *A(r)*, *B(r)* and *C(r)* are all decreasing functions of (r). *Y(r)* is however an increasing function of (r). It is important to stress that (r) is *not* the discount rate for the flow of income, but only used to value the tax benefits. *Y(r)* must therefore increase with respect to (r) since the present value of the revenue is residually decided in order to consider a marginal project and $A(r)$ is declining. Analyzing the slope of the curves is therefore meaningless. The tax systems can only be compared for a given value of (r).



Graph 5-1. Comparison of Tax Rates and Deductions (Lund, 2012)

The orange curve represents the base case and is an approximation to the onshore tax system. From the bottom, the blue curve represents the tax credits described above. The red curve is the special tax with ordinary onshore depreciation and no uplift, i.e. higher marginal tax with no counteracting measures:

Red curve: $$[1-(\tau_s+\tau_o)]*Y(r)+(\tau_s+\tau_o)*A(r)$$

The red curve is always below the reference curve and declining as discount rate increase, since the tax benefits decreases in present value terms for higher discount rates. The green

curve is the special tax with six years linear depreciation. It is also below the reference curve for all (r).

Green curve: $[1-(\tau_s+\tau_o)]*Y(r)+(\tau_s+\tau_o)*B(r)$

This illustrates that the favourable depreciations in offshore taxation alone are not enough to neutralize the high marginal tax for any discount rate after tax. The black curve is an approximation to the PTA with special tax, six years linear depreciation and uplift.

Black curve: $[1-(\tau_s+\tau_o)]*Y(r)+(\tau_s+\tau_o)*B(r)+\tau_s*C(r)$

The black curve is equal to the sum of the tax credits (blue curve) and the situation with full taxation and no benefits (red curve). The graph shows that it is above the reference curve in the interval [0%, 7%], implying that for discount rates after tax less than 7 percent the PTA provides investment incentives compared to the onshore tax regime (Lund, 2012, p. 26). For all rates above 7 percent the ordinary tax system is favourable.

The analysis shows how neutral treatment between onshore and offshore investments is depending on the chosen discount rate for the tax benefits, and that it is only neutral when the tax benefits are discounted by 7 percent after tax. When the Pöyry study use a discount rate of 9 percent for all cash flows, their conclusion about the petroleum industry being subsidized due to favourable deductions compared to onshore industry is wrong according to Lund (2012 p.26). Many analyses fail to analyze the system as a whole. Investors and companies tend to focus on the high marginal tax rates while environmentalists only focus on the benefits. Lund (2012) illustrates the necessity of considering both negative and positive aspects of the tax regime to get meaningful conclusions.

5.3. The Industry's Point of View

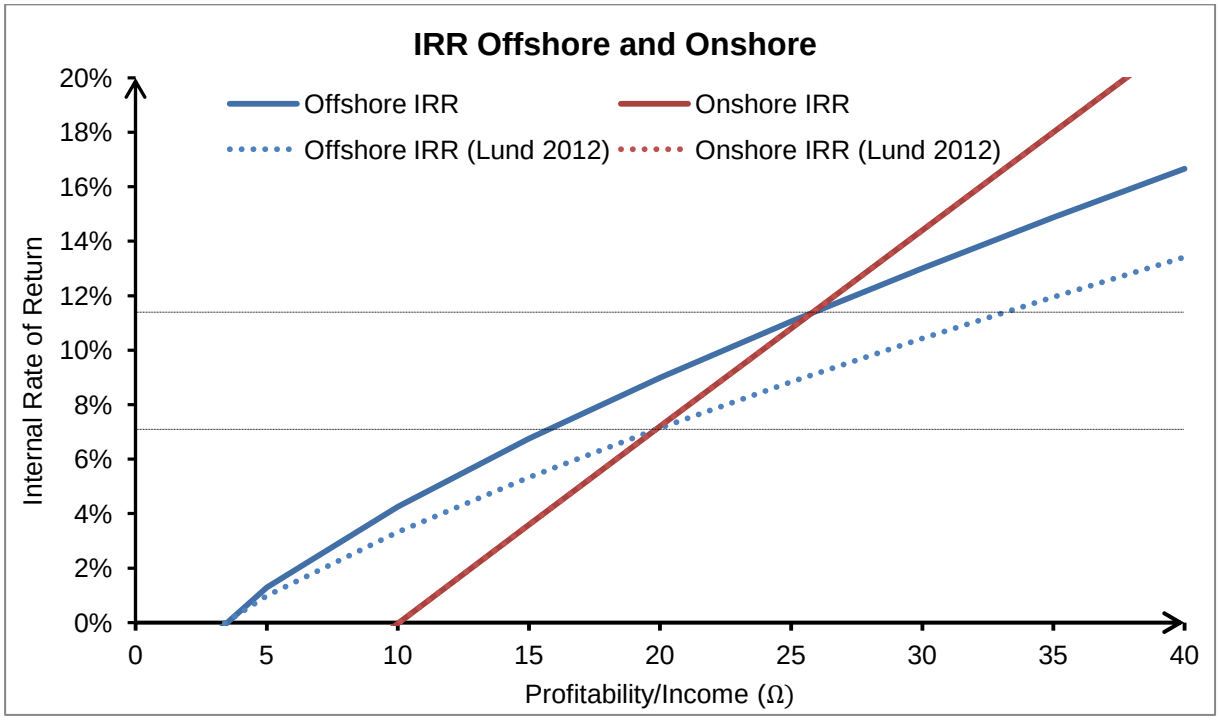
The analysis will in the following be extended by introducing *lead time* and employing other assumptions than Lund (2012) with regards to the accrual of deductions offshore. The model described in chapter 4 will be applied, as it enables analyses of the PTA under various assumptions and conditions. We start with addressing neutrality from the industry's point of view, implying that at all cash flows are discounted by the same rate irrespective of their relevant risk.

5.3.1. Replication of Lund's Approach using a different Model and Assumptions

While Lund (2012) assumes that depreciation starts one year after the investment is made, which is consistent with the tax-regime onshore, we assume that deductions are allowed at

the time of the investment, consistent with the PTA. This applies only for the offshore tax regime and causes a discrepancy between the findings in Lund (2012 p.26) and the analysis presented in this thesis. It is, however, a favourable fiscal treatment in the PTA which should be accounted for when comparing the onshore- and offshore tax system. We therefore assume that the investment payments are carried out before delivery of the capitalized asset, which is not unlikely for projects on the NCS and industry projects onshore.

Graph (5.2) is derived from the cash flow model described in chapter 4. We disregard financial cost deductions, as Lund (2012) and show how the internal rate of return (IRR) for projects under onshore and offshore taxation as a function of different levels of income/profitability.



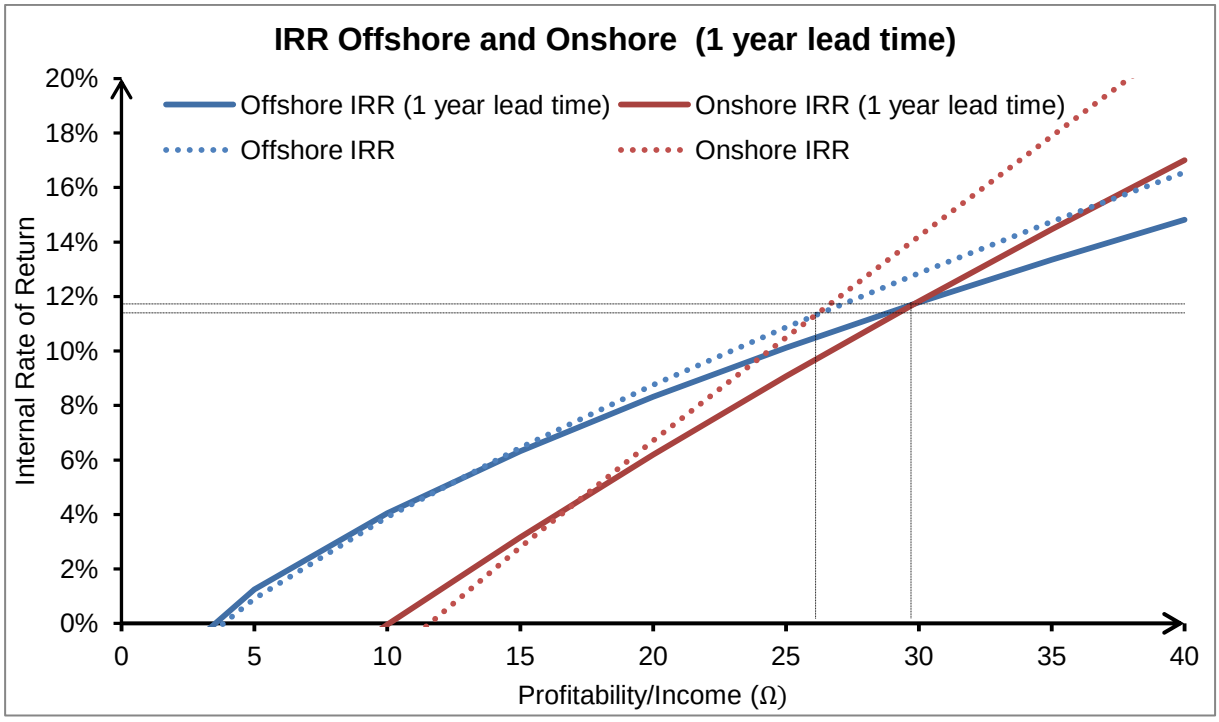
Graph 5-2. Internal rate of return offshore and onshore – different assumptions.

Allowing deductions from the time of the investment offshore increase the internal rate for projects under offshore-taxation, illustrated by the shift in the blue curve. This will in turn change the intersection with the curve representing the IRR under onshore taxation. The intersection between these curves indicates that the IRR is equal in both tax system, and the investment decision is the same. This rate has now increased to 11.4 percent, (intersection

between the solid curves)[26]. For rates below, the offshore tax regime provides an investment incentive since the IRR is higher for the same level of profitability, and the opposite for rates above. Lund's (2012) assumptions are included as the dashed lines. The onshore IRR (red curves) coincide, since they are based on the same assumptions (depreciation deductions start one year after the investment is made). Note that by employing our assumptions, the conclusion found by Aarsnes & Lindgren (2012 p.41) is no longer completely incorrect. Since their analysis is based on a discount rate of 9 percent, the PTA *does* provide an investment incentive which could be interpreted as a subsidy. However, their quantification and analytical approach are still questionable, as they do not conclude based on all favourable and unfavourable items in the PTA.

By including lead time in our model, as shown in the graph below (graph 5.3), this will have a negative effect in both tax regimes. Lead time will postpone the flow of income, which is represented by a shit to the left in both curves. The reduction in IRR is relatively lower offshore. This is because onshore depreciation deductions are only allowed from delivery/when production starts. In the offshore tax regime, deductions are allowed in the lead time period and give the company a benefit. Further analysis will be based on one year lead time, which will marginally increase the above found IRR which neutralize the two tax systems, from 11.4% to 11.7%, illustrated in graph (5.3).

[26] As the tax assessment is conducted two times a year for petroleum tax, it is reasonable to assume that the cash flow effect comes in between our and Lund's (2012) assumptions. In that case, the rate will be somewhere in between 7% and 11.4%. We will however base further analysis on the result using our initial assumptions.



Graph 5-3. Internal rate of return onshore and offshore, 1 year lead time.

Graph (5.3) also illustrates the sensitivity to the assumptions made. The marginal increase in IRR from adding 1 year lead time requires a rise in profitability of approximately 15.7% for the two systems to be neutral. For lower levels of profitability and discount rates than the neutral rate found (11.7%), the offshore tax regime is favourable. Above, the conclusion is reversed. Analysis of the net present values and how these vary to the parameters and variables used will provide useful insight to why.

5.3.2. Analysis of the Net Present Value (NPV)

This section will show and explain which variables and assumptions the NPV under offshore- and onshore taxation is sensitive to. It is essential to our analysis as the NPV is assumed to be the basis for the investment decision. The equations for the cash flows, variables, constants and model assumptions are explained and derived in the appendix.

The after tax cash flow on an onshore project expressed as:

(5.8) $$CF_t^A = CF_t^B - \tau_o(CF_t^B - d_t{}^{on}) \ ,$$

In net present value terms this corresponds to:

(5.9) $$NPV^{On} = -I_0 + \sum_{t=1}^{T}\left\{\frac{CF_t^A}{(1+r_r)^t}\right\} = -I_0 + \sum_{t=1}^{T}\left\{\frac{1}{(1+r_r)^t}[CF_t^B - \tau_o(CF_t^B - d_t{}^{on})]\right\},$$

where (r_r) is the company's required rate of return, and (I) is the investment cost. Equation (5.9) represents the onshore investment decision, given that the company is in tax position. The offshore investment's after tax cash flow for a company is in tax position is set to:

(5.10) $$CF_t^A = CF_t^B - \tau_o\left(CF_t^B - d_t^{off}\right) - \tau_s(CF_t^B - d_t^{off} - u_t)$$

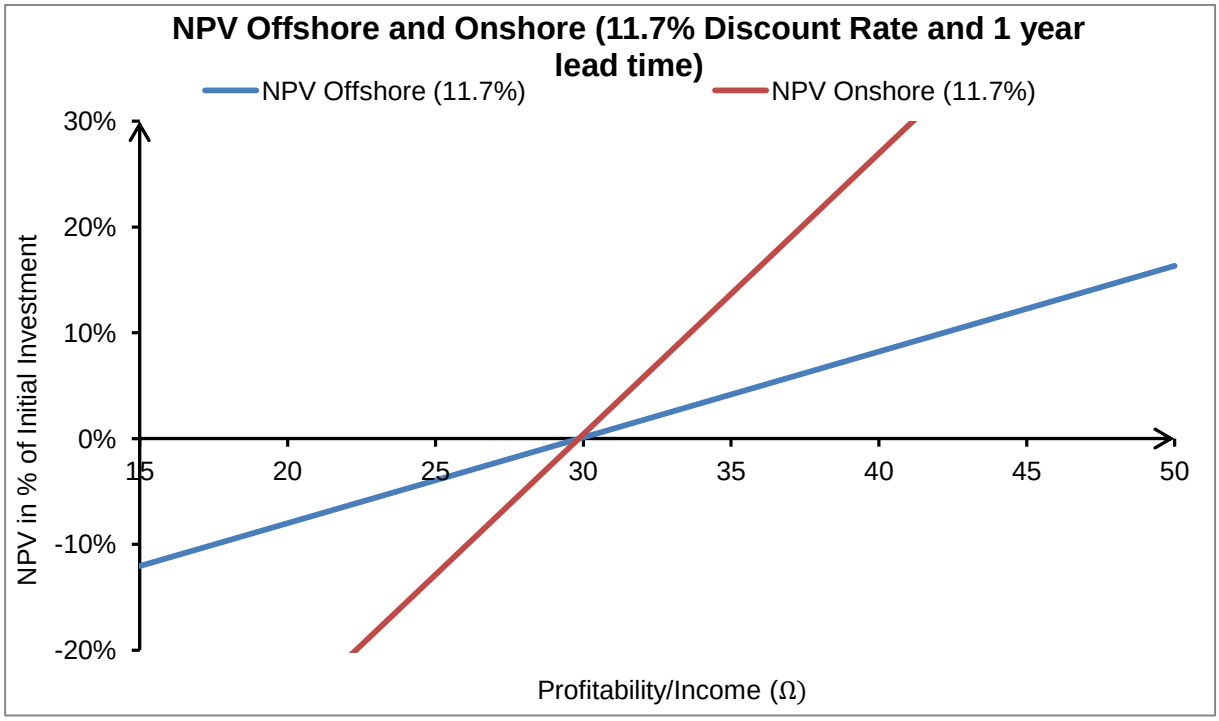
In net present value terms this corresponds to:

(5.11) $$NPV^{Off} = -I_0 + \tau_s\left(d_0^{off} + u_0\right) + \tau_o d_0^{off} \sum_{t=1}^{T} \left\{\frac{1}{(1+r_r)^t}\left[CF_t^B - \right.\right.$$
$$\left.\left.\tau oCFtB - dtoff - \tau s(CFtB - dtoff - ut)\right.\right.$$

Note that the deductions are allowed to start at the time of the investment, and thus not discounted in year 0. The cash flow model allows sensitivity analysis of the NPV with regards to the profitability, or income of different projects. As this is important to the discussion below, we show how profitability is treated in our model. The cash flow before tax, including all relevant costs and revenue at time (t) is set to:

(5.12) $$CF_t^B = \Omega(1-\gamma)^t$$

Where (Ω) is the *peak production level* and (γ) is the *depletion ratio,* i.e. at what rate the production (and implicitly revenue) declines annually. The latter is set constant to 10% in all analyses, and *the peak production level* therefore gives the level of profitability alone. Graph (5.4) shows the NPV in percent of the initial investment onshore and offshore as a function of the *profitability,* which explained is actually is the (Ω)-variable. We assume one year lead time and set the discount rate to the IRR found above, 11.7 percent.



Graph 5-4. Net present value offshore and onshore.

The intersection with the x-axis illustrates a positive NPV at a discount rate of 11.7 percent, and represents the investment decision, consistent with graph (5.3). Both curves cross at the same level of profitability, indicating that the investment decision is the same with and without special tax (in both tax regimes). Formally, this can be shown by setting equation (5.11) equal to equation (5.9). By comparing the same project, assuming that the cash flows before tax are equal, the expression can be reduced to:

(5.13) $$\tau_s\left(d_0^{off} + u_0\right) + \tau_o d_0^{off} + \sum_{t=1}^{T}\left\{\frac{1}{(1+r_r)^t}\left[(\tau_o + \tau_s)d_t^{off} + \tau_s(u_t - CF_t^B)\right]\right\} = \sum_{t=1}^{T}\left\{\frac{1}{(1+r_r)^t}\left[\tau_o d_t{}^{on}\right]\right\}$$

Equation (5.13) implies that in present value terms, the sum of the tax credits and higher marginal tax rate offshore (the left side) is equal to the tax deductions onshore (right side). Hence the investment decision is neutral. Equation (5.13) also provides insight to how distortions between the two tax regimes vary with profitability (cf. figure 5.1 below). Tax allowances are given by the investment alone, independently of the level of income. The increased tax burden is given by the level of income alone and independent of the initial investment. It then follows that for higher levels of income than the equilibrium in equation (5.13), the tax burden will increase while the allowances remains the same, hence the onshore tax regime will be favourable. For lower levels of income, the tax burden is reduced

while the allowances stay the same. The conclusion is then opposite; the offshore tax regime is favourable.

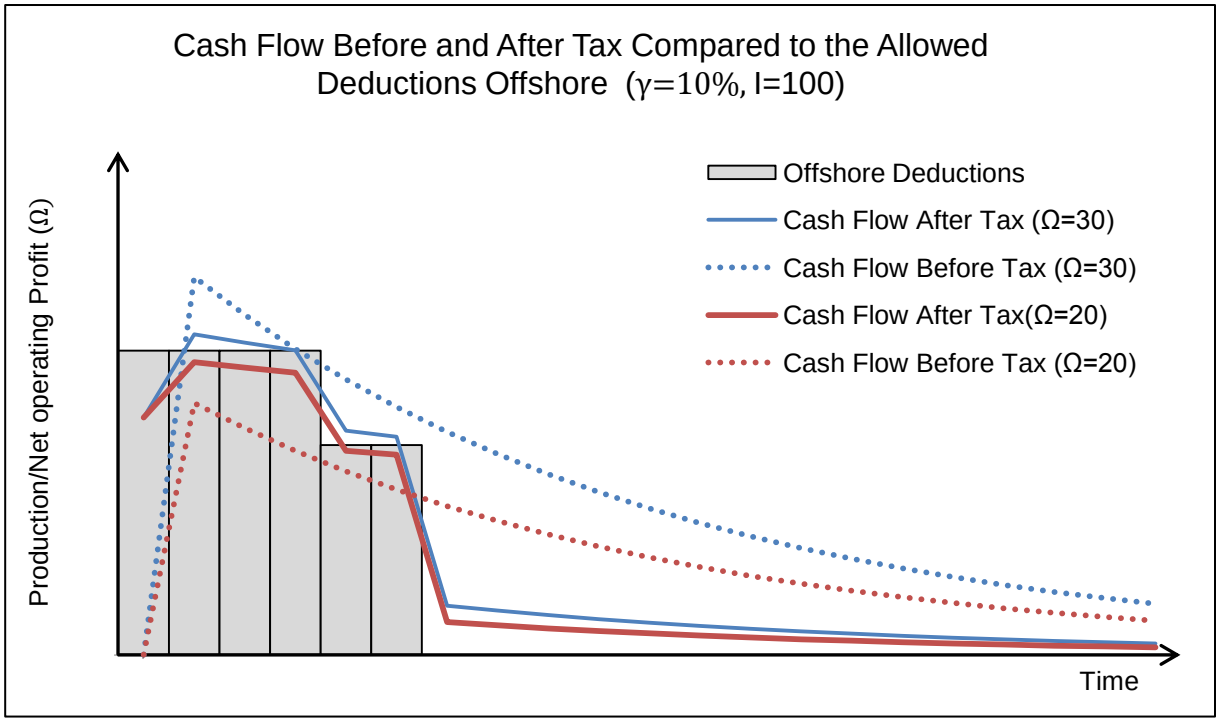


Figure 5-1. Comparison of cash flows offshore, and sensitivity to income.

Figure (5.1) is not derived from the model and is a simplistic illustration. It is included merely to illustrate how the cash flow offshore is less dependent on the derived income from the project through the deductions and high marginal tax rate. By reducing the projects initial income level by over 30% (from the blue to the red dashed curve) the effect on the after tax cash flow is marginal (solid curves). Values are nominal and not discounted.

The slopes of the curves are found by differentiating the NPV with respect to the *profitability*. This is done by substituting equation (5.12) in (5.11) and (5.9) respectively, and computing the partial derivative of the NPV in both tax regimes with respect to (Ω). Offshore this is found to be:

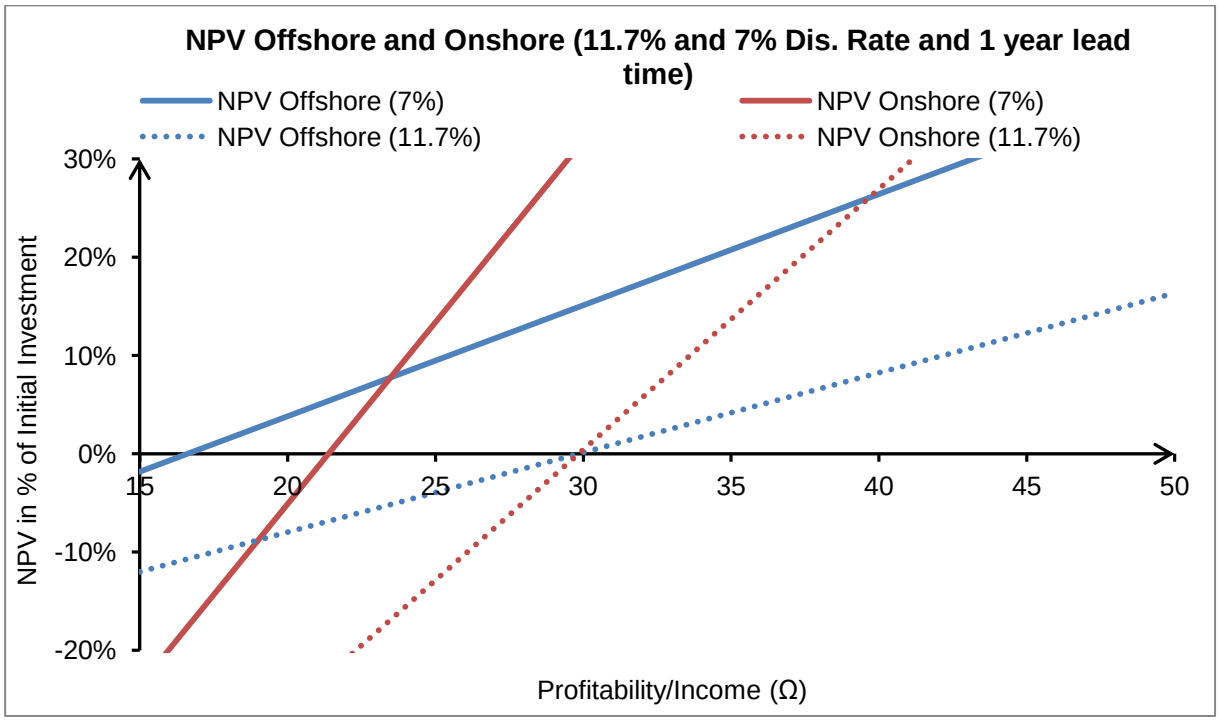
(5.14) $$\frac{\partial NPV^{Off}}{\partial\, \Omega} = (1 - \tau_o - \tau_s) \sum_{t=1}^{T} \left(\frac{1-\gamma}{1+r_r}\right)^t$$

And onshore:

(5.15) $$\frac{\partial NPV^{On}}{\partial\, \Omega} = (1 - \tau_o) \sum_{t=1}^{T} \left(\frac{1-\gamma}{1+r_r}\right)^t$$

Both expressions are dependent on the employed discount rate and the tax rate in the respective tax system. The economic interpretation is that when the stream of revenue change, the effect on the NPV is given by how the profits are discounted, (r_r), and how much the State claim through taxes $(\tau_o)/(\tau_s)$. Given equal required rate of return (r_r) and declining revenue rate (γ) onshore and offshore, it is only the special tax offshore, which makes the offshore NPV-curve in graph (5.4) less steep. This indicates that the State takes on more of the downside risk offshore while limiting the upside equally. The linearity of both curves indicates that companies in both tax regimes can deduct relevant costs at the same rate the profits are taxed and symmetrical treatment of costs and profits.

Graph (5.5) illustrates a situation where the two tax systems are not in equilibrium. The sensitivity analysis on *profitability* is done while employing a discount rate of 7 percent, as Lund (2012) suggests, while keeping our assumptions of offshore deductions and lead time (solid lines). NPVs assuming 11.7 percent discount rate are also included as a reference point (dashed lines).



Graph 5-5. Net present value offshore and onshore at different discount rates.

By assuming a lower discount rate, the investment decision is no longer neutral – the curves cross the x-axis at different levels of profitability. Both curves have shifted to the left as the lower discount rate has increased the NPV for all projects. Also note that the slopes of the

curves are steeper from the lower discount rate as equations (5.14) and (5.15) suggest (the required rate is a denominator in the expression for the slopes).

Consistent with graph (5.2) (illustrating IRR as a function of profitability in both tax systems), the offshore tax regime provides investment incentives for rates below 11.7% under the same assumptions. Projects on the interval [16.6, 21.4][27] will be realized offshore, but not considered profitable under onshore taxation. There are several measures that can achieve neutrality. If we assume the onshore tax-regime and the discount rate as given, thus only the PTA to be changed, we are limited to equations (5.11) and (5.14) as *policy instruments*. Considering (5.11) first; reducing the allowed deductions (d_t^{off}) and/or the uplift (u_t) would cause the blue curve to shift to the right, towards a mutual intersection with the x-axis and a neutral state. Increasing the distribution of the allowances in time would have the same effect of reducing the NPV through the discount rate. From (5.13) we have that increasing the special tax base would reduce the slope of the curve, thus increasing the point of intersection with the x-axis towards the onshore curve's IRR. Adjusting the allowed deductions seems like a more reasonable policy instrument than increasing the marginal tax rate through the special tax.

The same, but opposite reasoning can be applied for rates above 11.7%, which would provide investment incentives under onshore taxation. This is not included here.

5.4. State's Point of View

This section will analyze neutrality between onshore and offshore taxation when applying a theoretical correct valuation technique. This implies separating the cash flows and discounting them according to their inherent risk.

Equations derived in the section 5.3 must therefore be modified. The NPV for an onshore project from the State's point of view is set to:

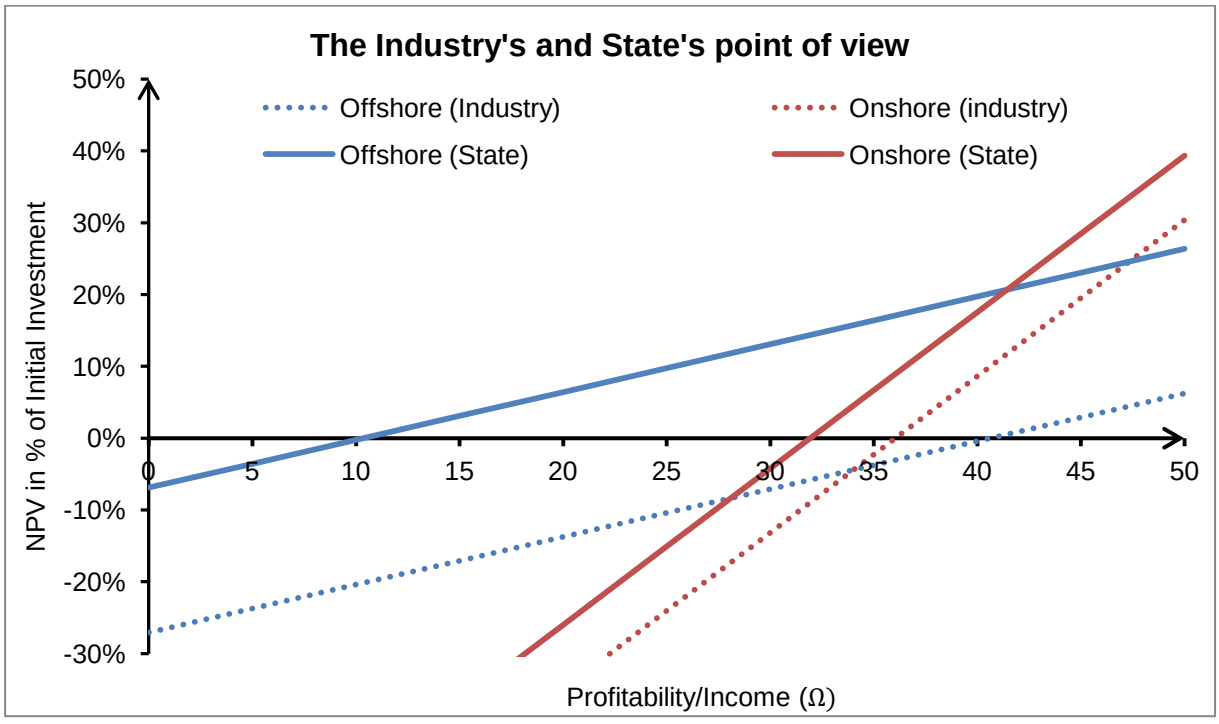
(5.16) $$NPV^{On} = -I_0 + \sum_{t=1}^{T}\left\{(1 - \tau_o)\frac{CF_t^B}{(1+r_r)^t} + \frac{{d_t}^{on}}{(1+r_f)^t}\right\},$$

Where (r_f) is the risk free rate after tax. The only change from equation (5.9) is that the last term is now discounted at the risk free rate since it is a certain cash flow from the stat's point of view. This also applies for the computation of the NPV offshore, which is set to:

[27] The marginal values are found setting the NPV offshore and onshore equal to 0 and solving for (Ω).

(5.17) $$NPV^{Off} = -I_0 + \tau_s\left(d_0^{off} + u_0\right) + \tau_o d_0^{off} + \sum_{t=1}^{T}\left\{(1-\tau_o-\tau_s)\frac{CF_t^B}{(1+r_r)^t} + \tau o + \tau sdtoff1 + rf + \tau sut(1+rf)t\right.$$

The only difference between (5.16) and (5.17) is the special tax and the uplift. Since none of the terms discounted by the risk free rate contain the variable (Ω), the slopes of the curves in graph (5.5) are unaffected by the change in valuation technique. However, given that the risk free rate is below the required rate of return, both curves will shift to the left, as tax allowances increase in value. The NPV offshore will benefit relatively more, since total allowed deductions account for 130 percent of the investment through the uplift, described in chapter 3. Graph (5.6) illustrates this point. To show how the different valuation techniques cause different perception from the two points of view, we have in the below analysis set the discount rate (r_r) to 15 percent. At this rate we know from previous analysis that the onshore tax system is favourable from the industry's point of view. This is merely to illustrate how the system can be perceived to have opposite effects. The risk free rate after tax is set to 6.5%*(1-τ_o)=4,68%, cf. discussion in chapter 4.



Graph 5-6. Industry's and State's point of view – difference of perceived neutrality.

Graph (5.6) illustrates how the industry perceives the tax system distortive (dashed curves), favouring onshore investments, while the State has the opposite view (solid curves). From the industry's point of view, a reduction in the special tax base would make the slope of the

dashed blue line steeper, thus becoming more neutral. Reduced tax to increase profitability and investments is a frequent argument from the industry, and was a main argument in a joint industry report about the PTA in 2003 (Kon-Kraft, 2003, pp.71-80). However, the state's opposite perception could explain why they are reluctant to give into the industry's demand, as this would further increase the investment incentive offshore from their point of view.

It is of interest to determine what discount rate for the risky cash flows which makes the system neutral. This can be done by solving the following optimization problem:

Objective function:	Min $\{(r_r)\}$	#Minimize the discount rate[28]
By changing variable:	$(r_r),\ (\Omega)$	#discount rate and profitability
Subject to:	$NPV^{off} = NPV^{on} = 0$	#NPVs equal zero, marginal investment
	$(r_r) > (r_f)$	#no discount rates below the risk free
	$(\Omega) > 0$	#non-negative profitability

The net present values from the state's point of view are used to solve the problem (5.16 and 5.17). Required rates of return for the risky cash flows below the risk free rate are not allowed, as this makes little economic sense. No solution was found when implementing the problem in the GRG-nonlinear solver function in MS Excel. Different risk free rates of return were also tested with different starting points for the variables (as the problem is non-linear). The interpretation is that there are no discount rates and profitability level in which the present values onshore and offshore are equal when valuing the cash flows as previously shown. This is caused by the benefit of the uplift (which causes the relatively larger shift in the blue curve in graph 5.6).

The conclusion is that under our assumptions and modelling of the PTA, investment decisions are not neutral from the state's point of view under any conditions.

5.5. Chapter Summary

The analysis in this chapter has shown that the problems described in the NOU (2000) may still be an issue on the NCS. By modelling the IRR for an investment offshore, and

[28] The objective function could have been set to maximize or minimize both required rate of return and profitability. The result would have been the equal with the same changing variables and constraints.

compared the result with a situation without special tax, we find that the PTA is neutral under certain assumptions when discounting all cash flows at the same rate. When separating the tax allowances and discounting them with the risk free rate after tax, no solutions are found in our model at which the PTA is said to be neutral. Before we discuss the implications of our findings, we will analyse to see if the PTA is distortive in regards to tax position offshore.

6. Fiscal Treatment Offshore with Regards to Tax Position

This chapter will investigate if the PTA treats companies in tax position different from companies outside tax position and the analysis is thus limited to the offshore tax system only. Since the fiscal treatment differs between exploration and other activity, this chapter is divided in two. First we will analyze if the investment decision is dependent on the tax position in the development and production phase of a project. The developed model will her be used to analyze the effects. No formal distinctions between the development- and production phase will be made. We assume in both cases that the exploration phase is over and regarded a *sunk cost*. The analysis will be divided into the industry- and state's point of view, using the same assumptions regarding the discount rate employed as before. The second part of this section will analyze the fiscal treatment of exploration costs, since this is a unique tax element in the PTA.

Our findings suggest that while the PTA is neutral using the state's assumptions, the industry still perceives the PTA distortive, favouring companies in tax position. For exploration however, this difference of perception is eliminated, since the exploration costs are immediately reimbursed, and not subject to provisions for loss offset.

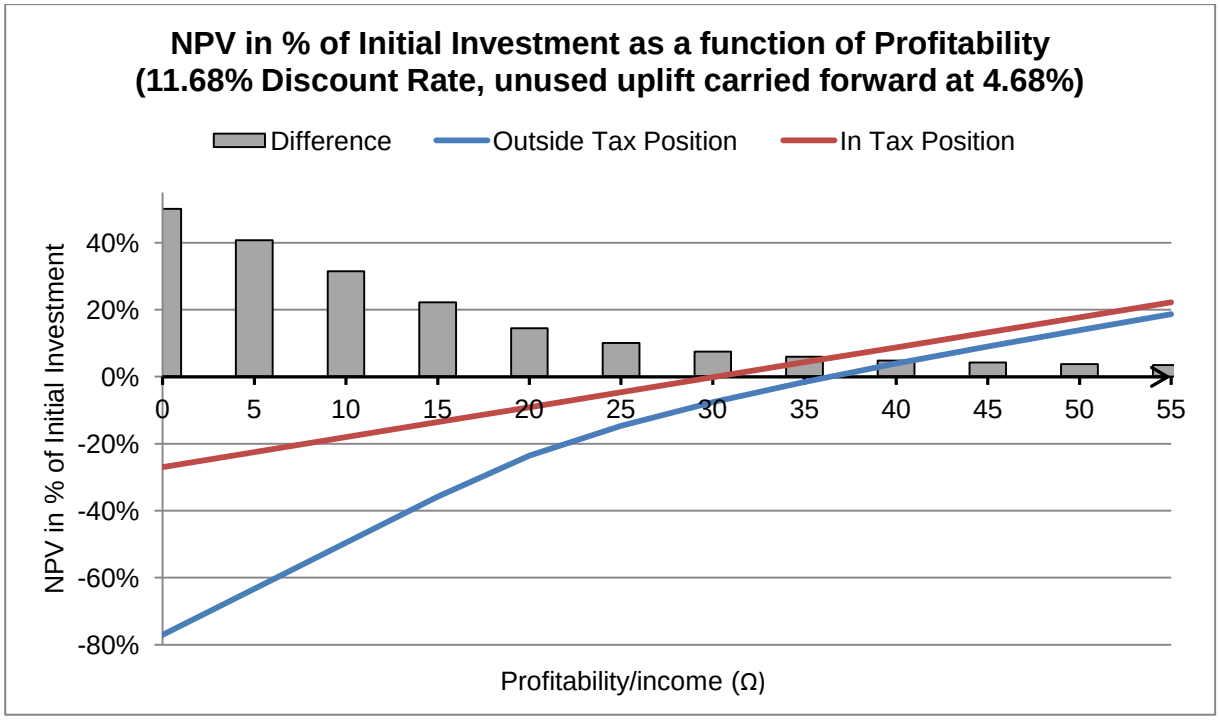
Assumptions regarding tax position are described in chapter 4 and further illustrated in the appendix. In the following, the assumptions of company outside tax position will be referred to as the *outside company* and when assuming that the company is in tax position, this will be referred to as the *inside company*.

6.1. Tax Position and Development/Production Activity

6.1.1. The Industry's Point of View

This analysis is based on the previously found discount rate of 11.7 percent for risky cash flows. One year lead time is applied, and companies outside tax position are compensated with the risk free rate after tax (set to 4.68 percent) when losses are carried forward.

Graph (6.1) is a sensitivity analysis of NPV with regards to the profitability for the *in- and outside companies*. It shows how a company in tax position perceives an investment's NPV to be higher than a company outside tax position. Being in tax position is an advantage for all projects irrespective of their profitability. However, the benefit is reduced as the profitability increase (grey columns). The reason is that more profitable projects will yield higher returns early in the investment's lifetime (cf. the assumption of production profile/income in figure (4.1)). The company initially outside tax position will then have taxable income at an earlier stage, thus be able to use the allowed deductions sooner. Even for highly profitable projects there will be a difference (~3 percentage points) in favour of companies in tax position. The reason is that the *inside company* will immediately utilize the tax allowances even if the production has not commenced. The *outside company*, however, must carry forward the initial tax allowances with interests at a lower rate than their required rate of return. This will make the difference sensitive to the lead time and production delays, as this will increase the period until the *outside company* can utilize the deductions. The difference in perceived NPV will also be sensitive to the discount rate employed, i.e. how much it differs from the risk free rate of return. This gap is the source of the different perception.



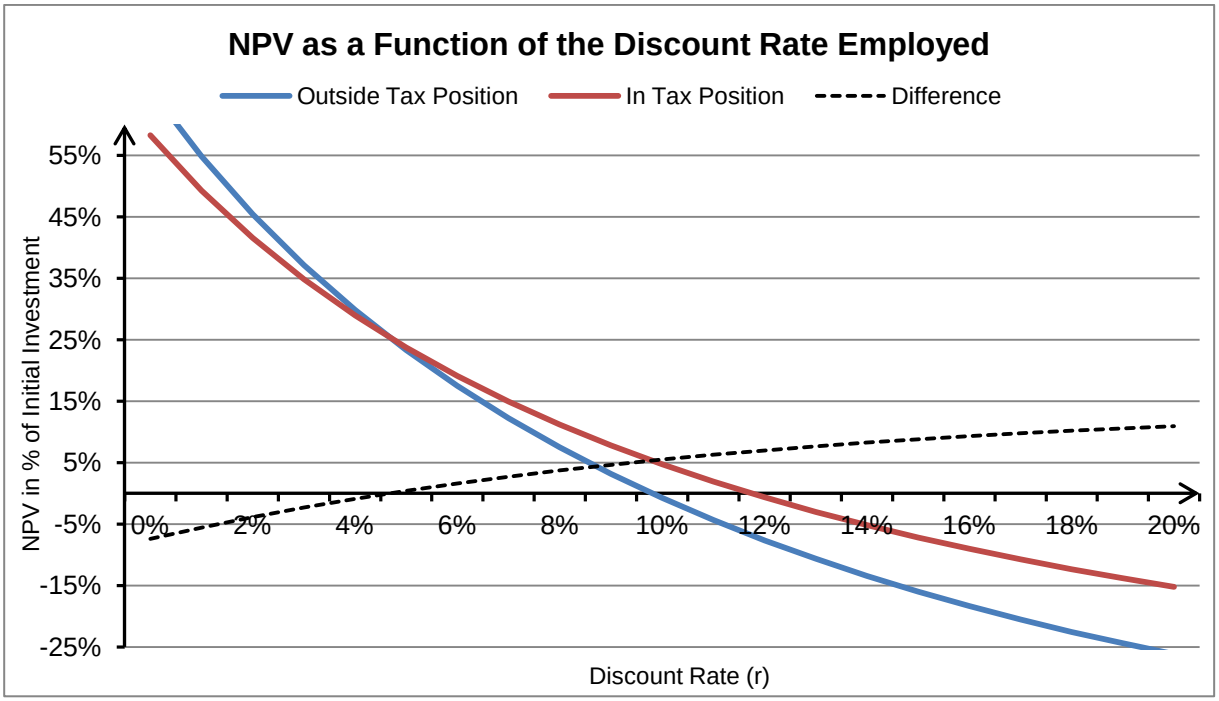
Graph 6-1. Sensitivity analysis of NPV with regards to tax position.

The analysis implies that investment decisions on the NCS are dependent on tax position from the industry's point of view. For projects in the interval [30.2, 36.4][29], the *inside-company* will perceive the investment as profitable, while the *outside-company* will not. Note the non-linear curve describing the development in NPV for the outside company. This is because companies are assumed to employ a higher discount rate than the risk free when computing the NPV. The non-linearity is therefore an expression of the tax deductions being undervalued by the companies. They do not consider the risk free rate as sufficient compensation. Income and costs are therefore not *perceived* to be treated equal, and thus not be a linear function. From the industry's point of view, there is an asymmetrical treatment limiting the upside without sufficient compensation for the downside risk.

The difference is greatest for low profitable projects as the time until the *outside company* can utilize the deductions is shown to be inverse proportional to the profitability. It is, however, not a severe problem as these projects will not be realized by either company, thus the investment decision is the same. Only marginal projects are of interest, since it affects the investment decision.

Considering a marginal project for a company in tax position, we can run a sensitivity analyses with regards to the discount rate employed. This will illustrate how the difference in perceived NPV increases with the discount rate. Graph (6.2) illustrates to what degree tax position distorts investment decisions for different discount rates, while keeping the risk free rate of return fixed. In the special case where the discount rate equals the risk free rate, the investments NPV is equal in both cases (tax position not an issue, as the source of the perceived difference is zero). The reason is that losses are now carried forward at the required rate of return for the *outside company*, hence indifference to when the allowances are utilized. The extreme case where the risk free rate is above the required rate of return makes little economic sense.

[29] Threshold values are found by setting the two net present values equal to zero and solving for Ω.



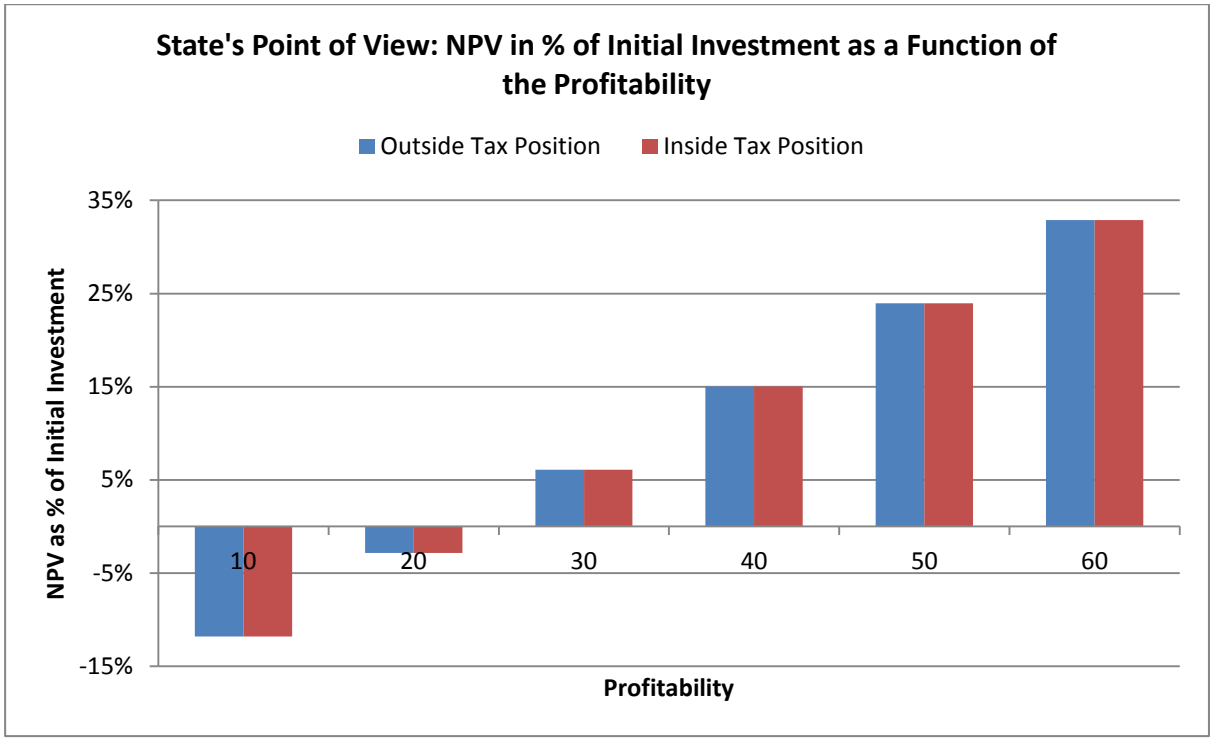
Graph 6-2. Illustration of sensitivity to discount rate for opposite tax position. Risk free rate constant.

The increasing dashed curve illustrates how the perceived difference in NPV for the two companies increase with the discount rate, if the risk free rate of return is held constant. The risk free rate and the required rate of return are to a certain degree correlated, however, the illustration above is merely to illustrate the source of the different perception by the companies.

6.1.2. The State's Point of View

The state base their legislation on economic theory which state that tax allowances should be discounted by the risk free rate after tax and consequently be carried forward by the same rate if a company is not in tax position. From the state's and a theoretical point of view, the system is then neutral. The company outside tax position will receive the same rate of return when deferring the tax benefits into the future as it should discount them back with. It should then be indifferent to when the deductions are utilized. This is illustrated in the graph (6.3) below. When running a sensitivity analysis on profitability as before, now differentiating the valuation of risky and risk free cash flows, the result is that the investment decision becomes independent of tax position. The tax system is as described in the theory neutral. Because theoretical neutrality now equals perceived neutrality, projects are equally valued by both companies and the State. All projects now become more profitable as the value of the tax benefits are correctly discounted by a lower rate than in the analysis using the industry's point of view. The latter also suggest more marginal investments being perceived

commercial viable, thus increased activity. Changing the discount rate for the risky cash flows will not have impact on the neutrality in regards to tax position, but it will change the profitability of the project.



Graph 6-3. Neutral taxation offshore with regards to tax position from the State's point of view.

6.2. Tax Position and Exploration Activity

As presented in the chapter about the PTA, investments related to exploration of petroleum resources are treated differently from other investments in the PTA. Exploration related expenditure - which for the most part are related to the drilling of exploration wells- are expensed as an operational cost. As exploration is considered a necessity for continues operation it is justified as an operational cost, not subject to fiscal depreciation and uplift. Companies in tax position have thus always had the ability of immediate reimbursement as operational costs are deductible in both tax bases. It is still considered an investment, and thus relevant when analyzing how the PTA may distort investment decisions in regards to tax position.

The controversy with different perspectives of valuation of tax allowances is not the case for exploration costs. With immediate reimbursement of the tax value of exploration cost, which

is similar to a *Brown* tax[30] treatment of costs, the problems with inconsistent valuation of tax allowances will lapse and theoretical and perceived neutrality will coincide. The conclusion is then that the refund of exploration costs, irrespective of tax position, makes the PTA neutral in the treatment of companies when it comes to exploration activity.

From the refund scheme we can also get some understanding of whether companies are in fact indifferent between immediate refunds of tax allowances and scheduling of tax allowances. Fane (1987) argues that this should be the case when tax allowances are certain and provisions are given based on risk free rate. A company outside tax position may still choose to carry the deductions (exploration costs) forward, but the Petroleum Tax Office confirms that this is seldom and did not happen once in 2010. This supports our assumption that companies are *not* indifferent between immediate reimbursement and scheduling of tax allowances. To exactly pinpoint the reason is however difficult, but as the exploration costs can be pledged, political risk should not be an issue. Whether alternative risk free investments are not subject to tax can be a factor. The Danish tax system is based on the assumption that the marginal shareholder in an oil company is not subject to tax on the margin, and thus bases the provision on the before tax rate (Lund, 2006, p. 3). A more probable reason could be that the companies require a liquidity premium if they are to be indifferent. Also, the accrual of tax allowances can affect capital structure and return on equity, thus making the companies biased. However, this will not be addressed in this thesis.

7. Implications, Relevance and Alternative Assumptions

This chapter will discuss the main results from our analysis. First, the most important results will be stated and their implications analyzed. Secondly, we will question the relevance of our findings. In the end we discuss alternative assumptions and shortcomings with our analysis.

7.1. Findings and Implications for Capital Allocation

7.1.1. Industry's Point of View

Our analysis shows that the industry is likely to perceive the PTA as distortive towards onshore investments for rates above 11.7 percent and towards offshore for rates below.

[30] Pure cash flow taxation *(Brown tax)* was described in chapter two and will not be repeated here.

Furthermore, the PTA favours companies in tax position. The result is based on the assumption that companies maximize profits. In addition, we assume that companies do not value the tax benefits theoretically correct, and thus acting irrational from the state's point of view. Given value additivity, two reasons may explain why. One is that companies apply inadequate valuation methodology by not risk adjusting the discount factor. Secondly, companies may add a risk premium in accordance with their perceived risk of the Norwegian system.

Analyses of *if* the authorities should adapt the tax system to irrational behaviour are outside the scope of this thesis. The topic is briefly discussed by Lund (2001, pp.9-10) and more thoroughly by Summers (1987). Summer (1987) states that companies not maximizing value will eventually go out of business, thus irrational behaviour should be left to the market. Lund (2001), however, argues that company behaviour varies substantially, and adaptation of the tax system may therefore prove difficult. Furthermore, Lund assumes that companies will adapt to current valuation theory with references to *value additivity* and *real option pricing theory*. He recognizes that there are situations where a tax motivated adaptation could be beneficial for both parts. His conclusion is, however, that it is better with a theoretically neutral tax system that is based on assumptions proven and supported by theory and empirical studies (Lund, 2001, p. 10).

That the PTA is perceived to favour companies in tax position is caused by the difference in the risk free rate and the required rate of return. Since companies are assumed to discount tax benefits at a too high rate, they are not compensated satisfactorily by carrying losses forward at the risk free rate. The risk of falling out of tax position is not analyzed in this thesis as the flow of income is assumed to be certain.

To conclude on whether, to what degree and in which direction the PTA is perceived distortive on investment decision, requires insight in actual employed discount rate on the NCS. This is no straightforward process and varies between companies and projects. Research on the petroleum industry employs various rates, as shown in chapter 4. Osmundsen (2011) points the fact that oil companies recently wished to sell shares in Gassled[31] which yields a close to certain real rate of return above 7 percent. This gives some insight in revealed preferences for companies offshore. This would then indicate that the

[31] Gassled is a joint venture between companies and the authorities, which owns the pipeline grid on the NCS. The price of gas transportation is regulated and set so that the owners yield a rate of return on their invested capital of 7%, see for example (Nilsson, 2007) or (Bjørndalen & Nese, 2003).

PTA gives investments incentives onshore judging by Lund's (2012) model. This is further confirmed with the discount factors expressed in chapter 4, but if the discount factor employed by the tax commission in 2000, the PTA can be said to be neutral according to Lund's model. It should be noted that Lund's model was not meant to give an exact expression of the neutrality properties of the PTA, but rather be a response to the Pöyry study.

Compared to our model, the answer is more ambiguous. 12 percent nominal discount rate after tax is probably representative of actual discount rates employed by some companies. However, taking into account that our model does not consider financial value added, our rate that ensures neutrality is too low. This would then indicate that according to the industry, the PTA favours offshore investments. Again, no single discount rate is representative for investments offshore.

What our analysis has shown is that understanding of how companies make their investment decisions is crucial in order to successfully design a neutral tax system. Our findings underline and show how the neutrality properties of the PTA are crucially dependant on conditions and assumptions made. This is further illustrated when comparing to the state's point of view.

7.1.2. State's Point of View

Based on the changes made in the PTA and numerous official statements and reports from the authorities, we assess that the state have adequately adjusted the offshore tax system to be in line with prevailing theories and research on neutral resource rent taxation. Hence, a correct valuation of tax allowances is assumed to be the same rate as companies are compensated for upon loss offset. Our findings when valuing the tax allowances at the risk free rate after tax suggest that the PTA is distortive and favouring investments offshore.

The PTA aims to shield ordinary profits from the special tax through the uplift, and the choice of depreciation rate can in theory be arbitrarily chosen. However, compared to onshore taxation, the system fails to isolate the resource rent from special tax (cf. section 5.1 and the discussion of equation (5.1)). Our analysis suggests that the fast depreciation and the size of the uplift, shield more than the normal returns, thus reducing the ordinary tax base as well. Unprofitable projects after onshore tax can then be profitable after offshore tax, since the effective tax rate offshore will be lower than onshore for marginal projects.

Offshore projects also become relatively less depended on the investment's return since a higher degree of the investment cost will be redeemed with certainty when compared to onshore investments. This also implies that the state take a substantial share of the downside risk of projects through the PTA. On the other hand, the state already carries the risk of the resources never being exploited.

Section 5.3.2 (cf. figure 5.1) explained how the *tax credits* in the PTA are given by the initial investment, while the increased *tax burden* is given by the level of profitability. It then follows that for low levels of profitability and correspondingly low tax burdens, offshore taxation is favourable compared to onshore. The reason is that deductions are independent of income and stay the same. As the NCS further matures, more projects will evidently become less profitable and more marginal. It is then unfortunate that the PTA fails to tax ordinary profits at the same rate as onshore. An analysis by Mckinsey & Company suggests that even if 44% of the *volume* is extracted, as much as 74% of the *value* remains under the sea bed, due to expected higher future oil price (Myrholt, 2012). However, the amount of input per unit petroleum extracted will also be higher as the remains will be found in less attractive areas; unexplored areas further away from existing infrastructure, deeper waters, under harsher conditions and in smaller reservoirs. All these factors are pointing to more marginal offshore projects in the future.

If the assumption that companies systematically undervalue the tax allowances is correct, the implication for sub optimal resource allocation is mainly dependent on two factors. (1) The difference in the employed discount rate and the risk free rate. (2) The share of marginal projects that will be affected and not realized. The first factor is the difference of perception between the state and the industry. It will indicate the interval of profitability or income which investments theory suggests will be realized, but are considered unprofitable by the industry. If one assumes that the risk free rate and required rate of return is correlated, this interval should be somewhat constant and given by the risk premium of operating on the NCS. The second factor is related to the development on the continental shelf. If the NCS had an abundance of highly profitable investments, which historically has been the case, the problem would not have any significant implications for the resource allocation. However, with more marginal projects in the future, more projects that in theory are profitable will be perceived as unprofitable by the industry. This will imply sub-optimal resource allocation.

Major discoveries done on the NCS in 2011 have revitalized the oil province, and these discoveries raise some doubt about the maturity of the NCS as a oil province. There are still

vast unexplored areas that will be subject to extractive activities in the future. Large discoveries here will require substantial investments from oil companies that have financial strength and skills to get large projects on stream. Reducing the benefits in the PTA to make the system more neutral, could reduce their interest for the NCS. However, our analysis shows that that the current system will result in too high capital intensity for projects on the margin. This could lead to substantial welfare loss if the current system is withheld. Great uncertainty in both estimates of resources on the NCS and the size of future discoveries, it is understandable that the state is reluctant to change the system.

Given by the number of new entrants on the NCS, the state has achieved its goal in lowering the fiscal barriers to entry. The PTA is no longer discriminatory with regards to tax position. A stable fiscal regime and systemic features to ensure certainty of future tax allowances, makes it reasonable for the state to compensate loss offset based on risk free rate after tax. However, scheduling of tax allowances will have effect on the capital structure for companies. It is therefore not unreasonable that companies require further compensation to be indifferent to the accruals of tax allowances in the PTA. We have found no recent studies on this topic. A possible reason can be that tax allowances are not based on book values, only fiscal written down values due to the changes in the deductions of financial costs. The authorities are therefore less focus on how the tax systems affect the capital structure of the companies.

In terms of the refund scheme for exploration costs, this is considered neutral from both perspectives. The system has proven to be a great success, something that was shown previously with the emergence of exploration companies on the NCS after 2005. State guarantees of the tax values of exploration costs have made this possible. New and smaller companies with limited financial strength are now able to operate on the NCS due to easier access to capital. It is not in the scope of this thesis to address whether the number of companies is synonymous with success, but there are those who question these companies's cost efficiency and their ability to make producible discoveries. What is probably more pressing is that the substantial number of exploration companies seize large shares of scarce input factors, drilling rigs one of them. In turn this may have contributed to the increasing cost levels on the NCS and a central question is then if exploration activity is done on behalf of other (drilling) activity (Olje- og Energidepartementet, 2010, pp. 31-33).

7.2. Relevance of our Findings

As the conclusion from the industry's point of view is inconclusive, it will be wrong to speculate of the relevance of our findings. Based on our model, the PTA seems to be neutral, but other assumptions may apply. To make any justified conclusion, more insight in the actual discount rate employed on the NCS is required. Finding representative discount factors is one thing, but what is necessary is to get empirical evidence of whether companies actually risk adjust the discount rate to incorporate risk free tax allowances. This section will therefore focus on the relevance of the findings from the state's point of view.

Favourable treatment in the PTA compared to onshore taxation, is a known fact since the tax commission published their report in 2000. Despite this, the only measures taken in regards to the onshore/offshore-distortion have been the treatment of financial costs and the change in the accruals of the uplift. With a shorter scheduling of the uplift, this change is detrimental to the tax commission's conclusion. However, the change has marginal effects in net present value terms. *Financial value added* in the PTA has been significantly reduced since 2007. This is not considered in this thesis, but even without taking this into consideration, a distortion towards offshore investments is still found. Including financial costs would only amplify our findings.

That the distortive system prevails may have three possible explanations that are not mutually exclusive; (1) it is desirable, (2) potential distortions are prevented through the regulatory framework and SDFI and (3) we are in a tax reform which will end in a situation with higher total welfare, but some steps may temporary lead to distortions.

The first possibility could be seen as a way of maintaining an investor friendly environment to preserve the interest of large international companies and investors. If the authorities believe in new large discoveries in immature areas in the future, this will require large investments and competent companies. Keeping their interest could therefore be worth the cost of the distortions, as it will yield high returns from taxation in the future. According to the state's estimate, one third of the expected recoverable reserves are not yet proven (The Norwegian Petroleum Directorate, 2011, p. 11). A substantial amount (~37% of the expected values) is believed to be found in the Barents Sea, which is classified as immature. The potential resources surrounding Jan Mayen and eastern parts of the Barents Sea[32] are not

[32] These areas are not yet opened up for petroleum activity. Norway and Russia agreed on a boarder in the Barents Sea 27.04.2010, which now can be made available for economic activity (Prime Minister's Office, 2010).

included in this resource estimate (The Norwegian Petroleum Directorate, 2011, pp. 11-12). Lund (2001, p.13) does on the other hand highlight that Norway has historically attracted foreign capital and companies. This has been the case even if the tax burden has been higher compared to similar oil provinces, e.g. UK. Keeping the taxation favourable to maintain investors and companies should thus be unnecessary.

The second possibility could be seen in connection with the first. State approval of all developments offshore will prevent obvious tax motivated decisions (cf. section 3.2). It does however require substantial resources and competence from the authorities in monitoring the companies. Monitoring costs related to principal-agent problems will be high in systems which provide undesirable incentives. These are also likely to increase as the shelf matures and more investments become marginal, with the danger of being unprofitable under onshore taxation. The state may perceive the costs as acceptable compared to losing foreign investors and competence, as the state also carries the risk of the resources never being produced. Window of opportunity can also be lost due to certain resources being of a time critical nature. In the unlikely scenario that the authorities could prevent all tax motivated decisions at a reasonable cost, a more severe problem arises. If the system give incentives for too high capital intensity for all projects, this would be more difficult to observe and prevent, due to information asymmetry.

The third possibility (a current tax reform) could be seen in light of Sandmo's (1989, pp.327-329) framework for optimal tax reform. The cash flow treatment of exploration costs could then be interpreted as a step towards a neutral system based on cash flow taxation. Equal fiscal treatment of development costs is suggested by Noreng & Wollebæk (2010). If however the goal indeed is increased neutrality, simpler matters suggested by the official report could have been taken (NOU, 2000, pp. 219-220). These changes would, however, disfavour the companies and thus increase the perceived political risk of operating on the NCS. This would damage the reputation the Norwegian state has spent decades to build. As the competition amongst host countries has increased, keeping an investor friendly climate could be the reason for the prevailing favourable treatment.

As the state was made aware of the distortion in 2000 and are assumed to have analyzed the effects of recent changes, they must also know that the distortion still prevails. Thus, our findings may not seem all that relevant. However, our contribution is the analysis from both points of view. Our model and analytical framework is a tool to analyze and understand how

the industry might *perceive* the tax system, and show the effects from it. It can also provide indications of how changes to the fiscal regime will affect the adaptation.

7.3. Alternative Assumptions and Shortcomings in the Analysis

As relevant research suggests, neutrality properties are found to be sensitive to the assumptions made. Other assumptions than ours could well be justified and hence give different results and conclusions. This will be discussed here in addition to shortcomings with our analysis.

7.3.1. Company Behaviour and Materiality

The analysis in this thesis is based on neo-classical theory suggesting profit maximization and value additivity, and this is also the prevailing assumption done in literature applied in this thesis[33]. Different valuation techniques have been applied to incorporate different views on investment decisions and valuation methods. One problem with the literature that has been applied is that they do not address *how* the single discount rate is computed. It might be that companies actually adjust the discount rate to account for the risk free tax allowances. This is a point of uncertainty in our findings with regards to the discount rate that ensure neutrality in section 5.3.1. We do, however, illustrate sensitivity to the discount rate by comparing to Lund (2012).

Assumptions of company behaviour other than ours can also be justified, and when other assumptions are applied, this is often with reference to market failures. The main alternative would be to assume that the companies for various reasons behave risk averse. Resource Rent Taxation (RRT) illustrated by Garnaut & Clunies Ross (1975) is an example of literature that assumes risk aversion, and Lund (2009, p. 303) also point to the fact that neutral cash flow taxation is possible given risk aversion. However, recent research has also introduced the concept of *materiality* to describe company behaviour in the petroleum industry (Osmundsen, et al., 2000, p. 1)[34].

Materiality is in this paper defined as a demand for strictly positive NPV. This means that international oil companies require a certain financial volume above a critical value for a project to be of any interest. If valid, small projects can be ignored even though they yield a high IRR. A positive NPV is argued to be a necessary but not a sufficient condition for an investment to be made. Osmundsen et al (2000, p.3) argue that for projects with low NPV,

[33] This is because our theoretical approach is in line with Boadway and Bruce (1984), Fane (1987), Summers (1987), Sandmo (1989), NOU(2000:18) and Lund (2001) to mention some.
[34] *Materiality* is also discussed by Lund (2001 p.14) and the tax commission (NOU:2000:18, pp.265-270).

subsidiaries of international companies on the NCS struggle to get funding from parent companies, despite high IRR for the project. This also applies to Norwegian companies as their interest for international opportunities grow. Reasons mentioned for materiality is that intangible costs are not deductible in the tax base. One example is externalities. Certain individuals are vital for a company's success and the cost of acquiring, developing and keeping these intangible *resources* are argued not to be fully reflected in the deductible costs, e.g. wages. As the *most competent personnel* are limited to one certain project, an increased return and financial volume is required. Other examples expressed by Osmundsen (2011) is that oil companies seek the portfolio of projects globally which yields the highest total NPV, given resource and capital constraints. Scares input factors, fixed costs and divisibility problems will favour projects with high materiality (Osmundsen, 2011, p. slide 8).

With direct involvement by the state, materiality is also affected. Even though *the total* investment could yield a substantial NPV, the materiality seen by the companies are limited to their shares of the license. The Norwegian system is based on taking substantial shares in licenses with expected high profitability (cf. section 3.3). Even though SDFI is neutral in the sense that the IRR is the same before and after tax, the materiality is reduced. Thus materiality is in contradiction to the prevailing theories on neutral taxation. Tax rates would have a similar effect, as it is the after tax financial volumes that determine an investments materiality.

Materiality is not well documented in theory, hard to measure and therefore hard to prove. It is however often referred to and discussed in recent Norwegian publications and reports[35]. However, it is not unlikely that successful large oil companies with international opportunities will allocate and focus their resources to the provinces which yield the highest return, both human and financial. As the special tax in the PTA is targeted to all returns above what is defined as normal, there will be incentives to allocate all competitive advantages in human capital to tax-regimes where they yield the highest returns. The above argumentation could very well be an expression for what we have defined as undervaluing of the tax benefits, or even hurdle rates.

Another important point which could explain the demand for materiality on the NCS is that the PTA fails to isolate the *resource rent*. As previously explained, the special tax is

[35] See for example Kon-Kraft (2003) and Lund (2009).

supposed to be levied on the excess returns derived from the inherent value of the petroleum resources. The system today cannot identify where the excess returns is derived from. Thus extraordinary profits from successful management, exploration or portfolio management will also be taxed at a higher rate. The returns from these resources are then subject to a higher marginal tax rate than under the onshore tax regime and *materiality* could then be an expression for compensating for this.

Materiality is an interesting theory, but the lack of empirical evidence and support from research makes it hard to justify in relation to company behaviour in our analysis. It is also interesting to note that the authorities have responded to materiality by lowering the fiscal barriers to entry. By increasing the diversity of companies on the NCS, this is believed to lower the materiality requirements (The Minestry of Finance, 2004, pp. 89-105).

7.3.2. Risk Free Rate

Furthermore, the analysis is based on a risk free rate after tax when discounting tax benefits. Several academics acknowledge that this is the *theoretical* correct rate but raise the question if it is applicable to actual conditions. That the rate is after tax is justified by the fact that this is the rate of return an investor would yield on an alternative risk free investment. In Norway the alternative investment is found onshore, thus adjusted by the onshore marginal tax rate. However, as discussed by Lund (2001, p. 15), different foreign investors face unequal tax rates and hence different after tax returns from risk free investments. An investor from a country with lower marginal tax rates than Norway would require a higher after tax return than given by the PTA. However, finding one representative rate for provision for loss offset is difficult, and in the end, this depends on what investors the authorities wants to attract.

7.3.3. Capital Structure

The analysis is further based on actual accrued cash flows, and do not consider how fiscal items are recorded and treated in financial reporting regimes. Deferred tax benefits may be considered a tax credit provided by the State, which can be used as collateral for financing purposes. This may lead to fiscal adaption of capital structure, both regarding debt, equity and real capital. However, our thesis is not analyzing neutrality in regards to capital structure.

7.3.4. Simplifications and Lack of Empirical Testing

Our analysis has been done from two extreme points of view. We either assume one or the other; theoretical correct (state) on the one side and the industry practice on the other. This is chosen to illustrate the points we want to make. A solution somewhere in between can be

argued to be more in tune with reality. This binary approach is also reflected in other assumptions we make.

The model employed is meant to illustrate the effects highlighted in the literature in an intuitive and understandable manner. Simplifications have been made in regards to constant rates, no uncertainty of income, perfect correlation between costs and production and none financial costs or capital gains/losses. Furthermore, only one initial investment over the entire lifetime of the project is analyzed. That we do not consider uncertainty to the flow of income is especially a weakness when analyzing the PTA's treatment of companies outside tax position. By this assumption we cannot analyze the risk of falling out of tax position due to a fall in the oil price or production stop. In other analyses where companies are assumed to always be able to utilize the deductions as they are allowed, uncertainty would not affect the valuation of the tax benefits.

Due to the complexity of neutral taxation, when considering different opinions and practice, this thesis has not tried to quantify any of the findings with regards to the socio economic implications. We have therefore applied more of a qualitative framework for which neutrality can be analyzed, compared to a quantitative study of neutrality and socio economic consequences. The reason for not including this element is that the PTA is only a part of the Norwegian system to ensure efficient resource allocation. The totality of the Norwegian system is how the State have chosen to both maximize the government take and ensure optimal resource allocation relative to both onshore and activities on the NCS. Any indications of too high/low capital intensity offshore or in a specific activity on the NCS, may therefore be neutralized when considering both the concession system and the SDFI.

Furthermore, as the thesis analyze changes the last 12 years, empirical significant results from real data may not be possible. Real data from actual field developments have also proven difficult to model with respect to the changes made. Our focus has therefore been on developing an intuitive and illustrative model to illustrate results from the literature. Due to the weaknesses and simplifications, our conclusions have to be interpreted as indications and suggestions for further analysis and research, not facts.

8. Conclusion

This thesis has addressed the neutrality properties of the Norwegian Petroleum Tax Act (PTA). More specifically, we have answered if the PTA is neutral in investment decisions and treatment of companies with respect to tax position. The choice of topic is motivated by

an Official Norwegian Report published in 2000, finding distortive aspects detrimental to optimal resource allocation on the Norwegian Continental Shelf (NCS). In the aftermath, several changes have been made. It was therefore of interest to see if the authorities have succeeded in promoting efficiency in the resource rent taxation. This topic is also motivated by the different opinions regarding how the petroleum tax system ensures optimal allocation of resources. Industry, state and independent groups are not aligned in their views, and this is often expressed in the public discourse.

Prominent literature on neutral taxation has been employed in a descriptive analysis of the PTA. We found that the systemic properties are in place, also under uncertainty. The reason is symmetric treatment of costs and income due to full certainty regarding redemption of tax allowances. Since the net present value of any scheduling of used tax allowances are the same, when valued as risk free cash flows, companies are in theory indifferent to when tax allowances are received. Companies may, however, perceive the alternative cost of the tax allowances differently than the state. Furthermore, the PTA is found *not* to be aligned with theory when it comes to shielding the normal return from the special tax. The applied analysis has therefore investigated if investment decisions are equal in the onshore and offshore tax regime and furthermore if they are dependent on tax position.

The main differences between a capital investment offshore compared to onshore are the *additional* special tax (50%) and beneficial deductions (tax credits) offshore. Tax credits include both faster depreciation allowances and uplift. Financial value added, as a consequence of favourable financial cost deductions, is not considered in this thesis. This is a weakness in our analysis, but would not change the conclusion, only the neutral rates (threshold values). Furthermore, to include how tax allowances affect the capital structure of a company, and to what degree this is essential for investment decisions, would increase accuracy.

From the analysis, we have shown how a higher tax rate in one sector will have a disincentive on investments and that counteracting measures are necessary to ensure neutrality between capital allocation onshore and offshore. The analysis has determined under what conditions the special tax is proportional to the tax credits, and thus when investment decisions are not distorted by tax regime. By assuming value additivity, we have separated cash flows according to their inherent risk, and applied a DCF model to assess how tax regime and tax position affects an equity based capital investment.

Since the state assumes tax allowances to be risk free, while the industry may have different perceptions, both perspectives have been compared in the analysis. Why the industry do not value tax allowances as risk free, can both be the perceived risk (systemic features in the Norwegian system) or it may be due to valuation method. Summers (1987) and other more recent studies finds that companies base investment decisions on DCF-models using a *single* discount rate on the *net* cash flow. Companies do not necessarily risk adjust the discount factor to incorporate risk free tax allowances. The latter, represent the industry's point of view in our analysis. When analysing neutrality from different perspectives, we have shown the difference between *perceived* and *theoretical* neutrality, and this is a perspective that is often forgotten in the public discourse. However, we have analysed two extreme points of views, and a middle point may be more in tune with reality.

From the state's point of view, our findings suggest that investment decisions are the same regardless of tax position, but the system gives an investment incentive offshore on the margin. The latter is caused by too beneficial deductions. These reduce the ordinary tax base as well and cause lower effective tax rates offshore than onshore on marginal capital investments. Considering a maturing shelf with evidently more marginal investments, it is unfortunate to have such incentives in the PTA.

We find that the industry's perception is dependent on the employed discount rate. For rates below 11.7 percent, the offshore tax regime is favourable and above there is found an investment incentive onshore. 11.7 percent represents the intersection of the IRR-curves and thus neutrality. The industry is likely to perceive an advantage for companies in tax position. Exploration investments are neutral regardless of tax position as they are immediately reimbursed, thus representing a *Brown tax* cash flow-element in the PTA.

The conclusion is that the problems described in the official report in 2000 still prevails with respect to the investment incentive offshore from a theoretical point of view. The reasons are still too favourable tax deductions. However, this can be *perceived* differently by the industry, depending on valuation method and the discount rate employed. If it is above 11.7 percent, the two points of view will have opposite conclusions. As the analysis shows, the conclusion is sensitive to the assumptions we make, and a recent study by Lund (2012) had a different conclusion than ours. Our findings should therefore be regarded as indications, rather than facts.

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10. Appendix

10.1. Glossary and definitions

CAPEX	Capital Expenditure – costs of capitalized assets
CF	Cash Flow
DCF	Discounted Cash Flow
GDP	Gross Domestic Product
GTA	The Norwegian General Tax Act (Skatteloven)
IRR	Internal Rate of Return
MAP	Modern Asset Prising
NCS	Norwegian Continental Shelf
NOU	Norsk Offentlig Utredning (Official Norwegian Report)
NPV	Net Present Value
OPEX	Operational Expenditure – immediate deductible against tax base
PTA	The Norwegian Petroleum Tax Act (Petroleumsskatteloven)
PV	Present Value
WACC	Weighted Average Cost of Capital

Continuity:	Fiscal values (tax liabilities and benefits) are not affected upon M&A, sales and cessation of operations.
Economic rent:	The excess return derived from a competitive advantage such as skilled labour or technology.
Harmonization:	Companies are allowed to consolidate their operations from one license (area) to another. Fiscal treatment of the entity and not single licenses.
Neutrality:	Taxation that does not distort investment decisions.
Resource rent:	The excess return derived from the inherent value of a resource, in this thesis petroleum.
Ring fencing:	Opposed to harmonization, each project is treated as an independent tax subject, meaning that a company is not allowed to consolidate their operations from one license (area) to another.
Symmetry:	Equal fiscal treatment of costs and income.
Tax credits:	The excess benefits from deductions when comparing offshore to onshore taxation, i.e. the difference in deductions.
Tax position:	A company with positive tax base after deduction of tax allowances are in tax position. A company with negative tax base after tax allowances are not in a tax position. Losses are then carried forward.

10.2. Evidence of Neutral Taxation of Net Profit (Sandmo, 1989)

Assume that an investment project which cover two periods. Any capital gains/losses are disregarded for simplicity reasons. In the first period the investment of (*K)* is made. In the second period, the investment yields returns of (*X)*. The relationship between the capital input and returns is given by the production function *X = F(K)*, where the marginal productivity of the capital, *F'(K)*, is positive and diminishing. A share of the capital is lost through depreciation from the first to the second period, while the remaining capital is sold in the second hand market in period two. Total income in period two is then *F(K) + (1-δ)K.* If the discount factor is (*r)*, the net present value (NPV) of this investment project (*V*) can be expressed as:

(2.5) $$V = -K + \frac{1}{(1+r)}[F(K) + (1-\delta)K]$$

By differentiating the expression with regards to *K* and setting the equation equal to zero, we find the value of the investment that maximizes the NPV:

(2.6) $$F'(K) = r + \delta$$

To maximize the NPV, one should invest an amount of capital so that the marginal productivity is equal to the cost of capital. This is equivalent to the alternative cost of holding the capital in one period compared to investing it to the interest (*r).* The alternative cost of the marginal unit of capital is the interest loss (*r)* plus the depreciation (δ).

In a system with neutral tax on profits, there is no tax or tax credit in period one. In the second period the taxable profit is the value of the production less the capital cost. This equals the sum of interests and depreciations. The tax base is therefore *F(K) – (r+δ)K.* The NPV of the project after (a neutral) tax with a tax rate of t_0 is expressed as:

(2.7) $$V = -K + \frac{1}{(1+r)}[F(K) + (1-\delta)K] - \frac{1}{(1+r)}t_0[F(K) - (r+\delta)K]$$

Because of the neutrality, and as a proof of it, we differentiate the expression with regards to (*K)* and note that it is the same as in the situation without tax:

(2.8) $$F'(K) = r + \delta$$

The same condition for maximizing profits applies with and without tax. There is therefore no distortion and the tax system is neutral when it comes to investment decisions.

10.3. Why Neutral Taxation is Important with High Tax Rates

If a tax system gives beneficial treatment of costs relative to income (MC>MR), companies will end up being too capital intensive with the implication of costly and sub optimal resource allocation. On the other side, too low capital intensity will result in capital not being channelled to where it yields highest returns. Both cases are detrimental to optimal resource allocation, and with higher marginal tax, the distortive properties will be amplified, something we will show next.

Consider a cost (*C*) which generates a gross annual income given by a growing and concave function *F(C)*. To maximize the profit function, F(C)-C, the company will choose a (C), so that the derivative of the profit functions equals zero. The profit, given by the differential *F(C) – C*, is then maximized by choosing (*C)* so that *F'(C)* equals one[36]. If cost (*C)* is tax deductible at rate (*s)*, while income is taxed by the rate (*t)*, the company will now choose (*C)* so that:

(2.9) $F'(C)(1-t) = (1-s)$

This implies that the effects of the tax system can be measured by the fraction:

(2.10) $\frac{1-s}{1-t}$

The tax system in this case is only neutral if $t = s$, which implies that all relevant costs are deducted, and the tax base is equal to what the company identifies as net profits. This gives the fraction the value of one, which is the same adaptation (investment decision) as in the absence of taxes, described above. If this is not the case, there is a tax wedge due to unequal treatment of costs and income, giving leeway for tax motivated distortions, e.g. too high capital intensity/over investments.

Given that $t > s$, the fraction $\frac{1-s}{1-t}$, shows how the tax wedge is higher for high tax rates. For instance the fraction:

$$\frac{1-0.75}{1-0.78} = 1.136 > \frac{1-0.25}{1-0.28} = 1.042$$

This means that a tax wedge and subsequent distortions are amplified by an increasing marginal tax rate, thus the socio economic welfare losses.

[36] Max F(C)-C → F'(C)-1 =0 → F'(C)=1

10.4. Developed Model

The model was applied in MS Excel, and the following is the mathematical presentation of assumptions made and a description of how the cash flows are derived. The model is based on two investment cases, and both the state and the industry's perspective with regards to valuation of tax allowances will be incorporated. This will not be shown in the following as NPV element is not included. However, NPV values expressions are shown in the analysis when necessary. The first investment case is a company in tax position that can choose between investing onshore or offshore. The only difference between the investments is the tax regime. This allows us to see if marginal investments offshore are distortive compared to onshore investments. The second investment case is two companies, one in tax position and the other initially outside tax position, that invest in the same project offshore. This allows us to assess whether the PTA treats companies with regards to tax position differently.

We assume that the investment is made in year zero in all our analyses, but different lead times can be included. Lead time implies a time period from the investment transaction to the flow of income starts.

10.4.1. Cash Flows Before Tax

We set the cash flow before tax to be dependent on the peak production level and depletion ratio only. Environmental taxes and operating expenses are assumed to be perfectly correlated with the production and included in the net income.

The cash flow before tax at time (t) (CF_t^B) can then be expressed as:

(4.2) $$CF_t^B = \Omega(1-\gamma)^t$$

Where (Ω) is the peak production level and (γ) is the depletion ratio. Cash flow before tax is assumed to be the same irrespective of tax position and tax regime, hence the same projects being compared in the different investment cases/analysis.

10.4.2. Onshore Cash Flows Subject to the GTA

Onshore investments are only allowed when production is on stream. A binary variable indicating whether or not production has started is therefore defined:

(xx) $$\rho_t \begin{cases} 1, if\ CF_t^B > 0 \\ 0, if\ CF_t^B < 0 \end{cases}$$

The onshore tax regime allows annual depreciation allowances (geometric). The depreciation rate is (δ) of the initial investment and the depreciation at time (t) $(d_t{}^{on})$ can then be expressed as:

(4.3) $$d_t{}^{on} = [I(1-\delta)^{t-1}\delta]\rho_t \ ,$$

where (I) is the initial investment. The superscript *on* is to denote that it is onshore depreciation. (δ) is set to a constant rate of 10% in all cases. This equals buildings with an expected lifetime less than twenty years onshore (GTA § 14-43).

From the above, we have an expression for the onshore cash flow after tax at time (t):

(4.4) $$CF_t^A = CF_t^B - \tau_o(CF_t^B - d_t{}^{on}) \ ,$$

where (τ_o) is the ordinary marginal tax rate onshore. When onshore fiscal regime is analyzed, the investor is considered to be a consolidated company, thus always able to transfer any losses incurred to subsidiaries within the company. No losses or unused deductions are carried forward.

10.4.3. Offshore Cash Flows Subject to the PTA

The difference between the onshore and offshore tax regime are the allowed depreciation deductions, the uplift and the special tax.

Depreciation in the PTA is linear over six years, implying that one sixth of the initial investment (I) is deductible each of the first six years from the year the investment transaction is carried out. In the seventh year the deductions are zero. To compute this, we introduce a binary variable (θ_t):

(3.5) $$\theta_t \begin{cases} 1 \ if \ t \leq 5 \\ 0, if \ t > 5 \end{cases}$$

The investment is made in year zero and the last deduction is then in year five. The depreciation offshore at time (t), (d_t^{off}) can then be expressed as:

(3.6) $$d_t^{off} = I\frac{1}{6}\theta_t$$

The superscript *off* is to denote that it is the offshore depreciations under consideration. Uplift is also restricted to the first four years, so the binary variable (φ_t) is defined, in the same manner as for the depreciation, such that:

(3.7) $$\varphi_t \begin{cases} 1, if\ t \leq 3 \\ 0, if\ t > 3 \end{cases}$$

Uplift at time (t), (u_t) can then be expressed as:

(3.8) $$u_t = \mu * I\varphi_t \ ,$$

where (μ) is the allowed yearly uplift, currently set to $^{30\%}/_{4} = 7.5\%$ of the initial investment for the first four years. The cash flow after tax for a consolidated offshore company in tax position at time (t) can now be expressed as:

(3.9) $$CF_t^A = CF_t^B - \tau_o\left(CF_t^B - d_t^{off}\right) - \tau_s(CF_t^B - d_t^{off} - u_t),$$

where (τ_s) is the special tax rate offshore.

Company Outside Tax Position (Initially no Taxable Income)

Since the company considered here is initially not in tax position, the model must be extended to include situations where a company moves in and out of tax position. More specifically, the ability to carry deductions forward at the risk free rate after tax in times of negative or low profit has to be computed. To determine when deductions are not used, we set a binary variable to indicate when the company has income subject to ordinary tax. The superscript (*o)* denotes that it is the *ordinary tax* base that is under consideration:

(3.11) $$\lambda_t{}^o \begin{cases} 1, if\ CF_t^B - d_t^{off} - L_t{}^o > 0 \\ 0\ if\ CF_t^B - d_t^{off} - L_t{}^o < 0 \end{cases}$$

Where $(L_t{}^o)$ is the accumulated losses carried forward in the ordinary tax base to time (t). To express $(L_t{}^o)$ and ensure that it does not become negative, we define another binary variable:

(3.12) $$\eta_t{}^o \begin{cases} 1, if\ L_{t-1}{}^o + \Delta_t{}^o > 0 \\ 0, if\ L_{t-1}{}^o + \Delta_t{}^o < 0 \end{cases}$$

Losses carried forward to time *t* can now be expressed as

(3.13) $$L_t{}^o = \left\{\sum_{j=1}^{t} \Delta_j{}^o \left(1 + r_f\right)^{t-j}\right\} \eta_t{}^o,$$

where $(\Delta_t{}^o)$ is the *change* in loss carried forward in the ordinary tax base, expressed as:

(3.14) $$\Delta_t{}^o = -(1 - \lambda_t^o)\left(CF_t^B - d_t^{off} - L_t{}^o\right) - \lambda_t^o(CF_t^B - d_t^{off} - L_t{}^o)$$

Unused uplift can also be carried forward. It has to be treated separately as uplift is only deductible to the special tax. The binary variables from equation (3.11) and (3.12) are modified to state whether the company has revenues subject to the special tax as well. The superscript is changed to *s* to denote that it is the *special tax* base that is under consideration.

$$\lambda_t{}^s \begin{cases} 1, if\ CF_t^B - d_t^{off} - L_t{}^o - u_t - L_t{}^s > 0 \\ 0\ if\ CF_t^B - d_t^{off} - L_t{}^o - u_t - L_t{}^s < 0 \end{cases} \tag{3.15}$$

To express $(L_t{}^s)$, which has the same interpretation as $(L_t{}^o)$, only for the special tax base, we define a binary variable as above:

$$\eta_t{}^s \begin{cases} 1, if\ L_{t-1}{}^s + \Delta_t{}^s > 0 \\ 0, if\ L_{t-1}{}^s + \Delta_t{}^s < 0 \end{cases} \tag{3.16}$$

$(L_t{}^s)$ can now be expressed as:

$$L_t{}^s = \left\{\sum_{j=1}^{t} \Delta_j^s \left(1 + r_f\right)^{t-j}\right\} \eta_t{}^s, \tag{3.17}$$

where $(\Delta_t{}^s)$ is the change in the losses to be carried forward deductible in the special tax base:

$$\Delta_t{}^s = -(1 - \lambda_t^s)(CF_t^B - u_t - L_t{}^s) - \lambda_t^s(CF_t^B - u_t - L_t{}^s) \tag{3.18}$$

We can now derive an expression for the after tax cash flow at any time (t) for a company that changes tax position throughout the investments lifetime, with no other possibilities to utilize the deductions than against returns from the initial investment:

$$\begin{aligned} CF_t^A = {} & \lambda_t{}^o\left\{CF_t^B - \tau_o\left(CF_t^B - d_t^{off} - L_t{}^o\right)\right\} + (1 - \lambda_t{}^o)(CF_t^B) + \\ & \lambda_t{}^s\left\{-\tau_s(CF_t^B - d_t^{off} - L_t{}^o - u_t - L_t{}^s\right\} \end{aligned} \tag{3.19}$$

The first term on the right hand side is the situation where the company has income subject to the ordinary tax ($\lambda_t{}^o = 1$). It is equal to the consolidated case described in equation (3.9), except that previous losses are allowed for deduction ($L_t{}^o$). ($L_t{}^o$) is not included in x.9 since it is assumed to always be in tax position. The second term is when the company does not have income subject to ordinary tax $(1 - \lambda_t{}^o = 1)$. In this case, the cash flow after tax is the same as before tax (CF_t^B). The last term is when the company is subject to special tax as well ($\lambda_t{}^s = 1$). This is the same as the last term in equation (3.9), except that we here also consider previous losses in both tax bases which are allowed for deduction.

The contribution of the model is that it differentiates the cash flows and allows for different valuation of the cash flows, according to their inherent risk. It also allows us to analyze project with the same characteristics in both tax regimes and to evaluate under what assumptions and conditions there are distortions in capital allocation. Also, cash flows subject to offshore tax are differentiated according to tax position, thus allowing us to analyze possible distortions.