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TIME CONSISTENCY IN PETROLEUM TAXATION - THE CASE OF NORWAY

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Time consistency in petroleum taxation - the case of Norway*

by

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Abstract

Because of a long time frame, irreversible and specific investments, incomplete contracts and political constraints, it is generally difficult for governments to commit themselves in a credible way to a fixed petroleum tax regime. Many controversial renegotiations and tightenings of such systems have occurred internationally over the past couple of years. By contrast, Norway has succeeded in building credibility as a reasonable tax collector because the government initially tailored the rates imposed to economic, geological and technological conditions, and then gradually changed into a neutral and stable tax system. This chapter applies game theoretic models on commitment and time consistency to petroleum taxation, and identifies special conditions in this industry which complicate a credible commitment. The Norwegian tax system is used as a case. The Norwegian model of petroleum resource administration is outlined, and it is discussed under what conditions this may represent a good system.

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1. Introduction

Operating as they do in some of the world's more unpredictable and unstable countries, petroleum companies face considerable political risk. A hot topic in the energy sector at present is the expropriation of investment by host states. According to Erkan (2008), direct expropriation has been rather exceptional over the past two decades and has been replaced by indirect (creeping and regulatory) expropriation.

The question of the ability and willingness of governments to commit themselves to a fixed policy is relevant to a number of aspects of economic policy. It is particularly important in relation to industry's long-term frame conditions.

Many central banks conduct monetary policy in accordance with a fixed rule, typically the stabilisation of inflation. Kydland and Prescott were awarded the Nobel Prize for economic sciences in 2004 for demonstrating how the effects of expectations about future economic policy can give rise to a *time consistency problem.* If economic policymakers are unable to commit in advance to a specific decision-making rule, they will often fail to implement the most desirable policy later on[1]. Kydland and Prescott's results offered a common explanation for events which, until then, had been interpreted as separate policy failures - when economies become trapped in high inflation, for instance, even though price stability is the stated objective of monetary policy. This research shifted the practical discussion of economic policy away from isolated policy measures towards the institutions of policymaking, a shift which has largely influenced the reforms of central banks and the design of monetary policy in many countries over the past decade. The concept of time consistency in planning is general, however, and also applies to taxation of natural resource industries like petroleum and mining.

In so far as it is feasible, commitment also represents a desirable quality in petroleum taxation. The major challenge in attracting petroleum investments is the high level of frond end loading of investments. After petroleum companies have made large irreversible investments in production and distribution facilities, a government can achieve a short-term gain by increasing taxes above the level which the companies were led to expect when development began. The problem facing the government, however, is that oil companies may expect this type of tax

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[1] Kydland and Prescott (1977).

behaviour.Thus, it is important to apply a dynamic economic analysis in this case. The dynamics here will lie in the expectations of the companies about a government's future tax policy. An unexpected tax increase is likely to lead to an upgrading of company expectations about the taxation of future developments. Moreover, an opportunistic and state-contingent tax policy will increase uncertainty about the future level of rates. The companies will now face political as well as technical and financial risk; political risk not only counting dramatic changes in tax and regulatory regimes, but also minor deviations from announced policies.After upgrading both the expected size of and level of uncertainty about the tax burden, the companies will be less interested in participating in future licences. It is also reasonable to assume that they will change their attitude to existing fields in the direction of a more short-term approach. The emphasis will shift towards faster pay-back at the expense of long-term reservoir utilisation. Taken together, these considerations will –for reasonable discount rates - reduce future tax revenues by a greater amount than the short-term gain.

Special conditions in the petroleum industry which inhibit credible commitment are discussed in section 2. Section 3 applies existing literature on the commitment issue (principal-agent theory and signalling games) to the petroleum industry. Efforts are made to characterise Norwegian policy in section 4 along the commitment-opportunism dimension, and I discuss the opportunities available to the government to commit itself to a fixed tax policy on the Norwegian continental shelf (NCS). With the exception of section 3, which is technical, the chapter is written so that it would be accessible to a broad group of readers. It is also written so that readers may skip section 3.

2. Special conditions in the petroleum industry

Credible commitment on future tax policy is generally important in providing the right investment incentives. Fears of future tax rises can yield welfare losses as a result of under-investment. In this context, under-investment can take two forms: 1) the overall development of the NCS falls below the level that an optimum pace of production would indicate and 2) spending on individual fields could be below the desirable level - in other words, the balance between investment and operation expenditure is sub-optimal. Welfare (deadweight) losses from distortions in the form of under-investment represent a particularly important problem in a capital-intensive industry such as

petroleum production. An additional problem for recovery of non-renewable resources is that the absence of a credible tax policy can also yield losses in the real economy by distorting production decisions. Examples of the latter is that absence of credibility could lead to a speed-up in production and thereby sub-optimum reservoir management and a low recovery factor (i.e., a lower fraction of the overall reserves will be extracted) For the sake of simplicity, the presentation below will focus on the problem of under-investment (the problem of speeded-up production is analogous). The relative size of the problems of underinvestment and sup-optimal reservoir drainage will depend on the level of monitoring and control by the resource authorities. Sub-optimal reservoir drainage can to some extent be detected by the resource authorities. Underinvestment is perhaps less detectable, as some of the investment options may not be known to the government. The problems associated with the lack of credible commitment by the government with respect to taxation bears resemblance to the problems of weak property rights. Bohn and Deacon (2000) show empirical evidence of slow extraction in oil as a consequence of weak property rights.

A number of conditions in the petroleum industry make it particularly difficult for a government to achieve credible commitment where taxation is concerned. One obvious problem is the long time frame for both individual fields and overall activity. Exploration operations are time-consuming, field development takes several years, and a reservoir may produce petroleum for more than three decades. The planning horizon for an individual field is accordingly very long. Moreover, expectations of new discoveries mean that the time frame for the industry as a whole is substantially longer. This lengthy planning horizon for both government and companies means that dynamic aspects are more important than in most other industries.

Other relevant considerations are a high petroleum rent and the lock-in of major investments, which make it particularly tempting for governments to secure short-term gains. Capital spending on production installations and transport systems account for the bulk of costs on the NCS. These are tailored facilities with a low alternative value[2]. After specific and irreversible investments have been made on the NCS, the government could impose high taxes without suffering appreciable static deadweight losses. The tax base is relatively inelastic. However, such a policy would incur a

[2] If removal costs are taken into account, the alternative value could be negative.

dynamic welfare loss through changed expectations by the companies about the government's future tax policy.

Another aspect of the commitment issue is that the government is limited to incomplete contracts. Full commitment would mean complete long-term contracts. Long-term commitment is constrained by institutional conditions, as discussed below. Complete contracts would have to specify tax rates for all possible future conditions. All future renegotiations of the tax system would then be unnecessary, as the tax contracts would contain conditions regulating cases of both extremely low and extremely high oil prices, extreme variations in resource potential, extreme cost variations; and different combinations of all those contingencies.The petroleum industry is characterised by a high level of economic and technological complexity. It would thus be impossible to predict all future outcomes relating to costs, technology, reserve estimates and prices. Such extensive contracts would also involve substantial transaction costs.

A problem related to incomplete contracts is that a great many petroleum tax instruments have been developed by the government over the years. Even if central rates were fixed, ex post rises in the tax burden could be achieved by adjusting one or several other factors which are significant for assessed taxes. One example could be changes to tax-free allowances. New rules could also be adopted on which expenses are deductible. Such deductions include many estimated costs and non-standard input factors which have no established market price. These are often delivered by companies in the same group. It is difficult to develop clear rules in advance for such discretionary deductions. Companies also run the risk that the government will introduce new types of taxation in the future to supplement existing forms. All sorts of environmental taxes are a case in point.

An important institutional constraint on the government's opportunities for credible commitment in tax policy is provided by the constitutional principle that today's elected representatives cannot bind a future Storting (parliament). This issue is common for all forms of taxation, but is perhaps particularly important for the petroleum sector because of the size of the government's tax take and the long-term nature of the business. The petroleum sector is so significant for the Norwegian economy that making very strong commitments on the future taxation of this industry could be a matter of democratic concern, even though they might enjoy broad support in today's Storting.

In addition to the provisions of the constitutions, the government will also face political constraints on possible attempts to establish a credible committed petroleum tax regime. A relevant consideration in this context is that Norwegian voters dislike big profits and high dividends at private petroleum companies (perhaps particularly when these are foreign-owned). This gives the impression that a national natural resources which belongs to the community is under-taxed. The government accordingly faces problems in committing itself in a credible way not to introduce extraordinary taxation when times are particularly good. An underlying media reality is that, as oil prices and the US dollar exchange rate against the Norwegian krone rise, it will be tempting for journalists to assert that private interests and foreigners are capturing an excessive share of Norway's petroleum wealth. The fact that the same investors lose money in bad times is not such an interesting subject to write about.

These features of political constraints are by no means unique to the Norwegian petroleum sector - which has a very favourable score on indices of political risk. The principles apply generally to petroleum and mining countries.

3. Economic theory on commitment applied to the taxation of non-renewable natural resources

In this section, I will apply established models from game theory and regulation theory in order to illustrate the problem of commitment faced by the government on the NCS[3].

3.1 Repeated game

The Norwegian government has chosen a policy of gradual recovery for the country's petroleum reserves, and very largely the same companies submit applications in each licensing round. The licensing process can therefore be regarded as being close to a repeated game. The first best tax policy will be for the government to commit to a fixed approach. After the companies have made specific and irreversible investments in period one, however, the government will have incentives to raisetaxation in period two. This is because its assumed goal of maximising welfare means that it wishes to secure a given tax take with a minimum of distortions, and taxing irreversible

[3] The focus will be on the problem of commitment in the taxation of non-renewable resources. A broader treatment of the credibility issue in economic policy is provided by Persson and Tabellini (1990).

investments does not cause (static) deadweight losses. The problem with the commitment game lies in the fact that it is not renegiotiation proof (not subgame perfect). Because the government will wish to re-optimise in period two, the first best tax policy - which involves commitment - is not credible (not dynamically inconsistent[4]). As a result, the companies will not regard the government's attempts at commitment as credible and will expect it to behave opportunistically in each period. Given these expectations, this is also the best approach for the government. The equilibrium which arises in such simple models for repeated games is characterised by under-investment on the NCS.

To reduce the problem of under-investment, the government will want to commit itself in a credible way to a reasonable level of taxation. In principle, this can be achieved by developing a reputation for sticking to a non-confiscatory tax rule or by creating institutional arrangements which penalise the authorities if they depart from such a rule. Reputation or institutional arrangements can be a partial substitute for long-term state-contingent contracts and reduce to some extent the problem of under-investment.

One institutional arrangement proposed in Norway to enhance the government's credibility in terms of commitment is to use the constitution. The idea is that a constitutional provision will effectively commit the authorities since amending the constitution is time consuming and requires a qualified majority in the Storting. However, the long planning horizon required in the petroleum industry means that a four-year process to amend the constitution will not be much help. Nor will the requirement for a qualified majority necessarily be any great assistance because of the temptation to secure a high tax take in the short term. To all intents and purposes, therefore, the government will have to concentrate on reputational effects in a possible attempt to create a credible commitment to the petroleum tax regime.

Simple models for repeated games predict an opportunistic tax policy with the absence of credible opportunities for commitment. Taking this to its logical conclusion could mean, for example, nationalisation of locked-in investment made by foreign companies on the NCS. Since Norway has an open economy and is an integrated member of the international community, the companies will not regard this as a likely pattern of action. Although the Norwegian government is not expected to implement drastic nationalisation measures, and thereby has greater credibility

[4] This concept derives from macroeconomics. See Kydland and Prescott (1977).

than politically unstable countries with a smaller degree of international integration - or countries where nationalistic aspects are more dominant than pragmatic rent collection - it will still be necessary to build a reputation for abstaining from more drastic measures which provide an ex post increase in the tax burden.

In analysing the dynamic taxation problem, I will consider two categories of games: those with complete and incomplete information about what type of tax collector the Norwegian government is. The latter is by definition free to re-optimise in each period - in other words, credible commitment is basically regarded as unattainable[5].

In a game with complete information, the companies are assumed to know the government's goal: to capture the largest possible share of the petroleum rent while simultaneously taking account of the fact that the tax system will affect the size of this rent. In a simple model with a finite time frame (T periods), sub-optimum investment will be unavoidable in the equilibrium state. The explanation is as follows. The government's policy in period T cannot affect future tax revenues. Period T is therefore in reality a one-period game, and the government will choose the dominant strategy with high ex post taxation. The petroleum companies, who are assumed to have complete information, will foresee the government's strategy in period T. As a result, equilibrium in period T-1 will not influence the future. The government will again choose the dominant strategy, and through backward induction equilibrium is characterised by high taxation and sub-optimum investment in each period.

In a model with an infinite time frame, the under-investment problem can be reduced by adopting suitable trigger strategies. Strictly speaking, the game between the government and the petroleum companies will not have an infinite time frame, since petroleum is a scarce non-renewable resource. An infinite time frame can nevertheless be defended by assuming a stochastic end date for operations on the NCS. This is a reasonable expectation given that exploration yields the discovery of additional reserves and production experience leads to the upgrading of estimated reserve in existing fields.

Characterised by the following expectations, it is possible to achieve a sequentially rational equilibrium without under-investment. The companies expect a reasonable level of taxation if this has been observed earlier. Should the government deviate from that pattern of behaviour, heavy

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[5] For an introduction to game theory, with the emphasis on applications, see Gibbons (1992).

taxation is expected for the following *n* periods. The government will not now choose the dominant one-period policy of heavy taxation, since the gain in the present period is not sufficiently large to offset the loss of tax revenues as a consequence of under-investment in the following *n* periods.

The companies may have incomplete information about the government's preferences over petroleum taxation. That could be the case with a change of government, for instance. By observing actual tax policy over time, however, the companies will form a picture of the government's priorities. A model which solves the problem of under-investment is a finite time-frame solution where the government is one of two possible types - weak or tough - and where the companies are assumed to have incomplete information about which type it is. The weak type will give the companies a reasonable return in each period, while the other alternative's preferences take the form of a ruthless pursuit of revenues. In the final period, it is pointless for the government to develop a reputation as a reasonable tax collector. The tough type will accordingly opt for high taxes. Earlier in the game, however, the tough type will have an incentive to pass itself off as weak in order to encourage investment on the NCS. This imitation strategy involves imposing a reasonable tax burden and thereby building a reputation as a reasonable tax collector. A high level of taxation would have yielded high revenues in the short term, and thereby an immediate efficiency gain in that taxes which cause distortions in other sectors could be reduced. This short-term gain must be balanced against the long-term cost of under-investment as a consequence of revealing that the government is a tough type. If the government has a good reputation at the start of the signalling game and is a patient player, it might be willing to accept a short-term loss of tax revenues in order to build and entrench a reputation.

3.2 Dynamic regulation models

Regulation theory presumes asymmetrical information between the various parties in a contractual relationship. Through their activities, the companies acquire private information - in other words, information not directly available to the government (asymmetric information). Examples of asymmetric information about relevant economic conditions include development and operating costs, reservoir estimates by the companies and their required rates of return.

Private information would not represent a problem if it were possible to ask the companies for relevant data and expect a truthful report. However, it is worth noting that their assumed efforts to maximise shareholder return could give company representatives incentives to report strategically. That means not reporting their best estimate at different stages of the life cycle of the petroleum field (e.g., resource estimates at the licensing stage and cost reports at the production stage), but selecting the outcome which will serve the company best. Strategic reporting should not be understood here as deceit or illegal behaviour. Petroleum operations are highly complex, both financially and technologically. Companies accordingly often operate without exact costs or reservoir sizes, but rather with qualified estimates of these. The data and measurement methods to be used can be open to discussion, and we are usually unable to relate to an objective truth. In these circumstances, the companies can opt not to report their best estimates but rather to act strategically by drawing on the datasets and measurement methods which best serve their interests. Legislation and regulations for the petroleum sector often contain formulations such as "best estimate", but assumed breaches of such provisions are generally impossible to prove.

Asymmetric information is a genuine problem in most taxation and regulatory circumstances, but a number of special aspects of the petroleum industry mean that the government's information problem is greater here than in other sectors - a) because of the petroleum rent, the *incentives* for strategic reporting are greater on the NCS, and b) a vertically-integrated multinational petroleum company has greater *opportunities* for such behaviour[6]. State participation and national oil companies can in part be seen as means for weakening the information asymmetries.

To illustrate the problem associated with private information in the petroleum sector, we can first assume that the government has the same information as the companies (symmetric information). It will then be in a position to capture the whole petroleum rent without causing distortions in company dispositions. In other words, it will be able to levy a tax of 100 per cent on the net cash flow or financial profit, and this will

represent the optimum level of taxation. In reality, the tax system we observe is not like that.[7] At the same time, we see that a substantial staff has been built up in the petroleum tax office and the Norwegian Petroleum Directorate in part with the aim of checking company reporting of financial

[6] For more details, see Olsen and Osmundsen (2001, 2003) and Osmundsen et al (1998).

7 One reason is that such an accurate handling of costs of revenue is not possible so that the tax system exactly collects the resource rent, e.g., with incomplete cost deductions the calculated rent is not exact - it actually includes the return to some variable factor.

and technical data. In other words, the assumption of symmetric information is unrealistic. Tackling the information imbalance is one of the biggest challenges facing the resource management authorities.

The problem of asymmetric information in the petroleum industry is analysed by Osmundsen (2005, 1998, 1995). It is argued here that the tax regime on the NCS has emerged to a much greater extent than on land as the result of a bargaining game between the companies and the government. This game is analysed within the framework of principal-agent theory (also known as regulation or incentive theory)[8]. Petroleum deposits on the NCS are a collective resource which belongs to the whole community. In administering this resource, the Ministry of Petroleum and Energy acts as a principal on behalf of the Norwegian population. The petroleum companies are agents who are awarded production rights. In exchange, they pay taxes which benefit the community. The challenge for the government is to devise a tax and licensing system which collects a large proportion of the petroleum rent for the community while simultaneously giving the agents incentives to pursue exploration, development and production in an optimum manner from the principal's perspective.

According to regulation theory, credible commitment is a great advantage. This is because an inability to make commitments reduces the government's opportunities to secure the revelation of the private information held by the companies, or means that such revelation will be costly for the government in the form of a lower level of taxation[9]. The explanation lies in the ratchet effect.

On the basis of private information, companies with low recovery costs (which may reflect high productivity or large petroleum reserves) will secure an information rent. This is because, instead of reporting their real costs, they can choose to pretend to be (imitate) a high-cost producer, e.g., by means of strategic transfer pricing. This will yield an economic rent on the basis of the efficient company's absolute cost advantage. In a static model, the optimum under reasonable assumptions will be characterised by revelation (separating equilibrium). The company will be indifferent to whether it chooses revelation or imitation, and receives an information rent equal to the economic rent of the imitation strategy. In the transition to a dynamic model, a low-

[8] For a good overview of this subject, see Laffont and Tirole (1993).
[9] I will concentrate in the following on the extreme cases of no commitment and fully credible commitment. An intermediate case covered in regulation theory is a condition with long-term committed contracts, in which the parties are unable to undertake not to renegotiate. Problems with access to information also often arise in this case. See Laffont and Tirole (1993).

cost producer will fear that revealing information in period one will mean heavier taxation and the elimination of the information rent in all future periods (the ratchet effect). If the government lacks opportunities to make credible commitments, the companies will therefore be unwilling to reveal their private information today. It is generally the case that a principal achieves the maximum welfare if they have opportunities to make credible commitments. This is because the commitment can be regarded as an extra means for bargaining. The opportunity set is widened, since commitment makes it possible to duplicate every contract which can be concluded without a credible commitment, and welfare increases.

Because of the problem of the ratchet effect, a general outcome in regulation theory is that the optimum approach for the principal - if it has credibility - will be to undertake not to take advantage of the information revealed in the first period. This emerges from a model by Baron and Besanko (1984), where the private information parameter is not correlated over time and which shows that the optimum approach with commitment is to repeat the static (one-period) contract in each period. However, this model has limited relevance for the petroleum sector because it does not include the dynamics which relate to physical values.

A more realistic approach in dynamic models for the production of non-renewable natural resources is for private information parameters to be correlated over time. Possible examples of private information parameters include the company's efficiency and quality or the size of the reservoir, and it is reasonable to assume that this information has a similar impact on production costs in the various periods[10]. As discussed in section 2, it is also reasonable to assume that the government will lack credibility for an attempt to lock tax policy completely for the whole planning horizon.

Laffont and Tirole (1988) show that it is difficult to achieve clear results in models with no commitment and correlated information parameters. This is because of the ratchet effect. Since the government cannot commit itself to abstain from collecting the whole information rent after information is revealed in the first period, the company - in order to have adequate incentives to reveal its information - must be given a high information rent in the first period to compensate for future loss of profit. It could now be optimum for a company with poor efficiency or reserves to imitate a low-cost operator in period one and terminate its operations in period two when a more

[10] The case of independent cost parameters can be descriptive of a regulation position where the private information relates to factor prices, which are independent over time.

demanding contract is offered. The incentive constraint now binds in both directions, and not only upwards as in the static model or in one with commitment or independent information parameters[11]. This gives very complex equilibrium properties. That applies to an even greater extent to petroleum regulation because of the additional dynamics provided by the resource constraint - high production in period one yields reduced reservoir pressure and thereby higher production costs in period two. As a result of this reserve effect, production costs are inter-temporally correlated.

Two articles model dynamic regulation of non-renewable natural resources under asymmetric information on production costs, and find unique equilibria by making simplified assumptions which eliminate the ratchet effect. In an article on mine operation, Gaudet et al (1995) assume uncorrelated information parameters - in other words, information on production costs in period two is assumed to be symmetrical at the date when the contract is concluded. This simplification allows the authors to analyse the case with an absence of credible commitment. In the other model, Osmundsen (1998) assumes credible commitment in order to be able to analyse a dynamic regulation problem in the petroleum industry with correlated information parameters. These two works also differ with regarded to modelling the inter-temporal effects which follow from resource taxation. While Gaudet et al impose a resource constraint which binds for certain parameter values, Osmundsen introduces a reserve-dependent and asymptomatic cost function (production costs decline with rising residual reserves, and move towards infinity as the resource base contracts towards zero) which implies that the resource constraint does not bind[12]. This realistic assumption substantially simplifies the analysis.

Both models yield the result that, because information is asymmetric, the optimum approach (in relation to solutions with symmetric information) will be to distort both the overall scope and the pace of production in order to tax a larger proportion of the economic rent. In the case with commitment, this deviates from the well-established result that the optimum solution for the principal is to repeat the static contract - in other words, to distort overall production but not the

[11] The incentive constraint ensures that the company reports truthfully. In the static model, a high-cost producer must be prevented from pretending that it has low costs in order to secure lower tax. We then say that the incentive constraint commits upwards. As noted, dynamic models with no commitment and correlated information parameters can also commit downwards - in other words, low-cost producers can have incentives to imitate high-cost ones.
[12] We will see an interior solution due to strongly increasing cotst. The proportion of the resource base pumped up from the reservoir is normally 20-60 per cent. It is technically possible to improve recovery even further, but this will be very expensive.

production profile. See Baron and Besanko (1984). The reason why it will be optimal to distort the production decision is as follows: the difference in information rent for two companies with differing efficiencies is provided for a given quantity by the absolute cost difference for the relatively more efficient company. Assuming that not only average but also marginal costs decline with greater efficiency, we see that the relative cost difference and thereby the information rent are rising in quantity. As a consequence, the government can reduce the information rent for the companies (increase the tax rate on the economic rent) by reducing the quantity. The gain from reducing the information rent must be balanced against the loss incurred from sub-optimum production adjustments (distortions in overall quantity and production tempo)[13].

As a result of the inter-temporal coupling of production costs owing to the resource constraint, it would not be optimal to repeat the static contract even with symmetric information. Moreover, in order to improve tax opportunities under asymmetric information, the optimum approach is to distort the production tempo because of type-dependent dynamics in production costs. Osmundsen (1998) assumes that the reserve effect is type-dependent - a reduction in production costs as a result of an increased holding of resources is greater for inefficient producers than for efficient ones. In other words, the level of efficiency and the residual holding are substitutes (dynamic single crossing property).

Under certain circumstances, the models proposed by Gaudet et al and Osmundsen deviate with respect to the sign on the distortion in production pace. With a binding resource constraint in Gaudet et al (1995), it would be optimal for a set of company types to increase their pace of production. In Osmundsen (1998), however, the optimal approach is to reduce the pace of production for all types except from the most efficient. Gaudet et al find that it could also be optimal to distort the production decision for the company with the lowest costs.

A two-period production model implies that tax paid at the beginning of period one is a function of the production level in both periods - in other words, that we have a three-dimensional tax function. Through a generalisation of Laffont and Tirole (1986), Osmundsen (1998) shows that the optimum inter-temporal contract can be implemented with a menu of tangent plans generated by licence fees and royalty for each period. Traditional theory on resource taxation advises against

[13] The optimal approach is to distort the production decision to the point where the expected marginal deadweight loss from the distortion corresponds to the expected reduction in marginal deadweight loss in other sectors of the economy which is made possible by increased tax revenues from the production of natural resources.

production-distorting royalty. This theory, which assumes symmetric information, prescribes neutral tax[14]. With asymmetric information, however, we are in a next-best situation where a distorting tax could be optimal, as the distortion of the companies' production decision alleviates the information problem.

4. The Norwegian model for resource management and taxation[15]

Norway has a discretionary licensing system. A regulatory framework has been established whereby oil companies have ideas and carry out the technical work necessary to recover the resources, but their activities also require approval from the authorities. Such approval is needed at all stages from exploration drilling through plans for development and operation to decommissioning proposals for fields.

The government receives significant revenues from the petroleum industry, with 31 per cent of its total income deriving from this sector in 2007. According to the revised national planning budget for 2008, the estimated value of remaining petroleum reserves on the NCS is NOK 3 790 billion in 2008 money. The government receives a large share of the value created through:

- taxation of oil and gas activities
- royalties and fees
- direct ownership in fields on the Norwegian continental shelf (through the State's Direct Financial Interest - SDFI)
- dividends from its shareholdings in the StatoilHydro oil company[16]

Petroleum taxation is based on the Norwegian rules for ordinary corporation tax. Owing to the extraordinary profitability associated with production of Norwegian petroleum resources, a special tax is also levied on income from these activities. The ordinary tax rate is 28 per cent, the same as for land-based activities, while the special tax rate is 50 per cent. When calculating taxable income for both ordinary and special taxes, an investment is subject to depreciation on a linear basis over six years from the date it was made. Companies may deduct all relevant expenses for exploration,

[14] See, for example, Garnaut and Ross (1975).

[15] This section is based on *Facts 2008 - the Norwegian petroleum sector* by the Ministry of Petroleum and Energy and the Norwegian Petroleum Directorate.

[16] StatoilHydro is an international oil company in which the Norwegian state holds the majority of the shares.

research and development, net finance, operation, decommissioning and so forth. Consolidation between fields is permitted.

In order to shield normal return from the special tax, an extra deduction - the uplift - is allowed in the calculation base for special tax. This amounts to 30 per cent of investment (7.5 per cent per annum for four years from the year the investment was made). The uplift is designed so that the marginal tax on cost (in net present value terms) is equal to the marginal tax of income. Companies which are not in a tax position may carry forward their losses and the uplift with interest. An application may also be made for a refund of the fiscal value of exploration costs in the company's tax return.

The petroleum tax system has been designed to provide neutrality, so that an investment project which is profitable for an investor before tax will also be profitable after tax. This makes it possible to harmonise the desire to secure significant revenues for the community with the requirement to provide sufficient post-tax profitability for the companies.

5. Government commitment opportunities and today's Norwegian practice

As discussed in section 2, a number of special conditions in the petroleum industry make it difficult for the government to commit to a fixed tax policy on the NCS. Nor do any international institutional relations exist which could solve the problem. In section 3 I discussed, on the basis of the theory of repeated games, whether the government could achieve an effective commitment through reputational effects. A common denominator of repeated game models is that they depend on the government being a patient player if it is to overcome the problem of under-investment fully. A sitting government may perhaps be patient while in office, but the length of that stay is uncertain. Because of the long planning horizon on the NCS, the period a government is in office - even if its re-election is expected - will probably be short in relation to the relevant time frame for petroleum investment.

However, the economic models which have been reviewed cover only the extreme points: where possible, the principal will want to make a full commitment in tax policy; if not, it will want to conduct a fully opportunistic policy - in other words, confiscatory taxes will be levied on irreversible and specific investments. Reality will undoubtedly lie somewhere between these extremes, and variations in policy can be seen between different resource-owning countries.

A pragmatic approach to economic theory on commitment could be that the highest possible consistency over time in taxation is desirable, even in conditions where full commitment is not possible. Future taxation of an individual field should therefore be as predictable as possible, and efforts should be made to avoid frequent ad hoc changes in the tax regime. Similarly, efforts should be made to avoid ratchet effects.

The large scale of private investment and the substantial number of new licence applications indicate that the Norwegian government has succeeded in establishing a credible commitment to a reasonable level of taxation for the petroleum industry. It can hardly be claimed today that overall investments are too low - the level of activity is at record levels, first of all by massive investments to increase production from the existing fields (increased oil recovery). Determining whether unexpected tax changes might have prompted selective under-investment or speeded-up production on individual fields is more difficult. Exploration activity, which provides the best indicator of confidence in future frame conditions, has been weak for a number of years, and new stand-alone developments are few. As always, it is difficult here to distinguish between the effect of fiscal termsand company assessments of the prospectivity of the NCS in a more mature phase. It would in any event be relevant to ask whether the same development and production could have been achieved - but with a higher tax take - if a greater degree of commitment in tax policy could have been established.

Norwegian petroleum tax policy has been entirely stable in recent years, despite the dramatic rise in the oil price. That contrasts with most other producer countries, even ones like the UK, where we have seen several considerable ad hoc tax increases. The stability of Norwegian frame conditions must accordingly be regarded as an important element underlying the fact that the country has succeeded in maintaining the level of activity on the NCS - with an unchanged level of taxation - even though the prospectivity (i.e., the amount, quality and extraction costs of oil and gas in the remaining reservoirs) of parts of these waters has declined. In today's economic setting, stable frame conditions will represent an important competitive edge for the NCS. The new system of cash refunds for the fiscal value of exploration costs in company tax returns has proved effective in attracting new players to the NCS. This is because the capital required for making a commitment in Norway has been substantially reduced in that the government directly refunds around three-quarters of exploration expenditures, i.e., the companies do not have to be in a tax-

paying position to receive the government's part of the investment. For a sector which is currently very concerned with reserve replacement, this system can yield good additions to reserves in relation to the effective capital outlay. The Norwegian framework also allows companies to book the entire reserves in a field, unlike the position in countries with production sharing agreements where only cost and profit oil can be booked.

5.1 Changes to tax policy over time

Norway's earlier petroleum tax policy was to tailor taxes and licence requirements to prevailing economic conditions in the industry - in other words, to adapt the tax system to developments in costs, technology, proven recoverable reserves, foreign exchange rates and petroleum prices. The policy of tailoring the tax system could give the impression of being a political rule which effectively commits the government on petroleum taxation. This is not entirely the case, since the policy is discretionary and accordingly does not represent a complete state-contingent contract. The purpose of this implicit contract is to attract new investment. Since the price of petroleum measured in Norwegian kroner has the highest volatility among these economic factors and moreover represents a systematic risk, tax changes have typically occurred in the event of price rises (tax increases in 1975 and 1980) and reductions (tax cuts in 1986); all of them applying both to existing and new projects. However, each of these tax revisions has also taken account of changes in costs and technology as well as new estimates of recoverable reserves; on a sector basis.

Lund (1971) argues that the most important reason why tailoring the tax system is necessary is that it is not fully neutral. In cases of neutrality, the tax base will be identical with the petroleum rent, and will therefore exercise no distorting effects on development and operational decisions. A non-neutral system produces distortions, and these become more serious when prices fall. An important example of this in the previous Norwegian petroleum tax system was the non-linearity provided by incomplete tax deductions for losses. The latter can be carried forward, but are not compensated for the alternative cost of the capital. This is a particular problem in the petroleum industry because of the long time lag between exploration and the start to production. If the company fails to reach a taxable position, losses could never be deducted.

Another reason for choosing a tailored tax system is the political constraints imposed by voter dislike of large profits and high dividends at private petroleum companies. That places effective constraints on how much risk the government can transfer to the companies. A full commitment in tax policy would probably have meant high profits and dividends for the private companies in good times. To avoid this, the tax system is tailored in such a way that company profits are more evened-out. This gives the impression of efficient taxation. However, a substantial proportion of the risk is transferred to the government[17].

The earlier petroleum tax regime on the NCS resembles the equitable mechanism described in Baron (1989). This mechanism lies between full commitment and pure opportunism. In Baron's model, the private company is free to withdraw from the business relationship in each period, and the government is unable to commit to a fixed future policy. The parties conclude a voluntary agreement, whereby the company renounces the right to withdraw from the business relationship, and the principal in return places restrictions on its opportunism. Because of major irreversible and specific investments on the NCS, the companies do not have opportunities for withdrawing from the business. Instead, they can refuse to participate in new licensing rounds. Until the NCS has been completely developed, the government will therefore have an incentive to limit its opportunism.

The equitable mechanism can represent an opportunity in conditions where full commitment in the form of fully state-contingent contracts is not possible. It is worth noting that this mechanism does not entirely resolve the commitment problem, since it requires that the principal is in a position to give credible guarantees on non-negative profits to the companies after they have revealed their information on costs and reservoirs, or after an irreversible and specific investment has been made. Baron's response to this is to assume that the equitable mechanism takes the form of a written contract between the parties, and that procedural demands and legal precedence limit the government's opportunities to change this ex post. This could be relevant in our context, since procedural requirements in Norwegian law protect companies on the NCS from arbitrary and opportunistic action by the regulator. However, key elements in the regulation of the petroleum sector do not take the form of explicit legal contracts, but are instead implicit contracts between the ministry and the industry. Rather than binding legal agreements, Norway's international

[17] Optimal risk sharing between government and companies under financial, information and political constraints is an important subject which deserves closer study.

obligations can protect the companies to some extent against arbitrary treatment. Similarly, the threat of diplomatic problems and economic penalties from other countries can have a disciplinary effect on tax policy towards foreign companies.

The controversial issue of asymmetric treatment of old and new fields with regard to royalty is relevant to the discussion on commitment. As noted by Lund (1991), a negative royalty was introduced in the 1986-87 tax reform following a drop in the price of petroleum. However, this applied only to licences with a development plan approved after January 1986. That represents an asymmetry, since the tax increases of 1975 and 1980 (which were implemented in the wake of price increases) embraced all fields. This recalls the ratchet effects described in section 3, and can be regarded as an opportunistic policy - high tax on irrevocable investments. This practice undermines the credibility of the government's implicit tax contract. The problem is that tax changes are made on an ad hoc basis. If progressivity is an important goal for the government, it would be better from that perspective to construct a clearly defined and stable progressive tax system.

Lund (1991) concludes that this asymmetric tax policy will, all other factors being equal, reduce the interest of the companies in new licences. In order to maintain the level of investment, the government must reduce its required tax take. It would have been possible to maintain a higher level of taxes if the government avoided a reputation for asymmetric taxation. I support that conclusion, and would add that credibility in taxation is becoming ever more important as the number of fields remaining to be developed falls. It should be emphasised that this conclusion has been reached on the basis of a pragmatic attitude to established economic theory in the field.

The principle of uniform taxation of all fields, old and new, which was established in Proposition no 12 (1991-92) to the Odelsting division of the Storting can be regarded as an attempt to secure a reputation for non-discrimination[18]. It must be emphasised that the problem of time-inconsistent taxation does not lie in the fact that different tax levels are assessed for *different* fields, but that taxation of the *individual* field is not consistent over time - in other words, that the tax system responds asymmetrically to price rises and falls over the production period. Taxes are increased when prices rise, but not reduced to the same degree when they fall. A lack of neutrality in the tax system would eventually necessitate a lower effective tax rate in order to secure the

[18] Despite this statement on uniformity, the differential treatment of fields developed before and after 1 January 1986 remains. On the other hand, no new asymmetries have been proposed.

development of marginal fields. If the tax take from existing profitable fields is simultaneously to be protected, a system of differentiated field taxation would emerge[19]. It is worth noting that making a credible commitment to equality of effective taxation of profitable and marginal fields can create the opposite of the ratchet effect. Through such a commitment, the companies would expect the government to reduce the tax burden in future in order to secure the development of marginal fields. With equal treatment, this would also apply to very profitable fields which are already in production. We could then get a position where the effective tax burden is higher in the development phase than during production - in other words, that development expenses are deductible from a higher rate of tax than is later levied on operating revenues. That could yield a socio-economic loss in the form of over-investment on the NCS.

A development has taken place in the Norwegian petroleum tax system over the past decade, from an approach tailored to the prevailing oil price to a fixed regime independent of that price. This trend towards a greater degree of commitment in frame conditions coincides with shifts towards an even more neutral tax system, which reduces the need for tax adjustments when oil prices move. Among the modifications which have yielded greater neutrality are the ability to carry losses forward with a risk free interest rate, opportunities for transferring tax-related losses when winding up companies, and direct payment of the government's share of exploration costs (tax refund)[20].

Conclusion

Although a number of special factors make commitment difficult in petroleum taxation, a certain degree of credibility can be achieved through practising stable and reasonable levels of taxes over time. An important reason why the Norwegian government has so far achieved credibility is that the desire to secure the development of a substantial number of new fields has had a disciplinary effect on the taxation of producing fields. As the NCS matures, with fewer new fields in line for development, the government will depend on a reputation as a predictable and reasonable tax collector to avoid under-investment. The signs are that the Norwegian government has succeeded in building a reputation for consistent field taxation over time. However, such reputation is easily

[19] Such variation has already been introduced by allowing the State's Direct Financial Interest to vary from field to field.
[20] See Bjerkedal and Johnsen (2005).

lost, and thus the Norwegian government continuously needs to take tax credibility into account in tax decisions. According to contract theory, a commitment of this kind - providing it is regarded as credible by the companies - will yield a higher tax take from the petroleum sector. Norwegian petroleum taxation has been very stable in recent years despite sharp oil price rises. Frequent tax increases in other resource-owning countries have thereby enhanced the competitiveness of the NCS.

We can say that Norway originally made an implicit promise to the oil industry concerning a reasonable level of taxation. This was achieved by adjusting tax rates at regular intervals and tailoring them to the industry's overall economic position. In other words, we can say that commitment exists in tax policy even if the level of taxation varies over time. The important consideration in this context is that the tax changes follow a specific rule and that they are symmetrical. If they are asymmetrical - in that taxes rise more readily with higher prices than they fall with lower prices - the implicit promise to the industry will have been broken. There have been few such breaches in Norwegian oil history. The problem with many of the tax changes we see today in a number of producer countries is that they do not follow a specific rule and are perceived in a number of cases as arbitrary. It should be noted that credibility is not necessarily at odds with progressive taxation, as long as the progressive elements are part of the initial tax contract. However, progressivity may in some cases have detrimental incentive effects.

Over the past decade, Norway has shifted to a policy of absolute commitment, where the tax system is unchanging. This has been made possible by changes which ensure that the regime is neutral. Changes to the tax system in response to distortions caused by the same system are thereby avoided. However, a number of industry participants and external analysts believe that the Norwegian government will have to reduce taxes if the oil price falls to a sufficiently low level.

Generally speaking, an underlying cause of frequent ad hoc changes in petroleum taxation is a distorting tax system which needs to be adjusted when the oil price moves substantially. Another reason for the lack of commitment and credibility in petroleum taxation may have been that this regime is governed by relatively short-term considerations, with great weight given to the tax take in the present budget year or in the government's period of office. A third cause of tax adjustments could be various national considerations which override pragmatic evaluations concerning the maximisation of the tax take from the petroleum sector.

On a general basis, the conclusion is that petroleum tax should be shaped in a long-term perspective with the emphasise on credibility and predictability. However, this does not mean that all the elements in the Norwegian petroleum tax regime are suitable for all types of producer countries. Norway's petroleum taxation has changed over time on a couple of significant points. The system has become more neutral, e.g., by tax refunds of exploration costs. As a consequence, the Norwegian government has steadily accepted more risk, which can be seen as a logical consequence of higher wealth. This calls for considerable financial strength, which not all producer countries possess. When operations began on the NCS, the Norwegian government utilised mechanisms such as carried interest and the sliding scale, which reduced its capital requirements and exposure to risk. The Norwegian model is also based on many detailed and discretionary contracts between the regulatory authorities and the oil companies on such issues as the determination of licence awards, norm prices[21], deductible expenses and production permits. This makes very heavy demands on the expertise and integrity of the government administration. If such expertise and integrity are not fully present, simpler and more transparent administrative models would be preferable.

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