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**Critical Factors in Transnational Oil  
Companies Localisation Decisions –  
Clusters and Portfolio Optimisation**

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**Critical Factors in Transnational Oil Companies Localisation Decisions**  
**– Clusters and Portfolio optimisation\***

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**Abstract**

Enhanced understanding of the factors determining transnational companies' localisation decisions is important for regulators and other stakeholders concerned about maintaining current activity levels in a petroleum producing country. This article discusses localisation decisions in the context of theories of industrial clusters and real portfolio optimisation theory (materiality), which we argue are two fruitful lines of explanation for transnational companies' behaviour. The industrial cluster literature is concerned about the level of positive externalities associated with geographic clustering of related production activities. The concept of materiality, implying that investment projects in an oil province must be of a certain minimum size in order to be interesting for oil companies, is evaluated empirically and compared to predictions of mainstream economic theory.

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## 1. Introduction

As the Norwegian Continental Shelf is approaching a status as a mature oil province, the issue of continued presence of transnational oil companies is becoming more pressing. There are several factors that make the presence of these companies attractive. Because of their resources and experience, transnational companies can develop and operate petroleum fields efficiently, and thereby generate a large tax revenue base for the government. In addition, they have created highly paid jobs, and are large customers for domestic offshore suppliers, both in Norway and abroad. Through their purchase experiences in Norway, transnational companies act as international door openers, either as direct customers or reference customers in other oil provinces. Furthermore, it may be beneficial to have a large number of competent oil companies operating in Norway to ensure competition and supply of capital and new technologies. One should add that the Norwegian oil companies Norsk Hydro and Statoil have become transnational, and a significant share of their investments are allocated to other countries.

It is important to understand the factors explaining transnational oil companies' localisation decisions in order to be able to ensure the presence of both large oil companies and smaller companies specialising in marginal fields and tail production. To shed some light on this issue we will exploit two theoretical approaches – the theory of industrial clusters and materiality theories. These two approaches both represent potentially fruitful explanatory models for localisation decisions.

The literature on industrial clusters discusses the possibility of *positive externalities*, or *agglomeration economies*, which give rise to geographical clustering of related production activities. The size of the externalities is typically *a function of the size* of the industry, and the externalities lead to competitive advantages, e.g. costs reductions, which are not obtained outside the geographical cluster. Agglomeration economies in the Norwegian petroleum sector may lead to reduced costs in exploration, development and production, and thereby increase the attractiveness of the Norwegian continental shelf for transnational companies as long as these economies are still present. A petroleum cluster may include oil companies, offshore suppliers, parts of the maritime sector, consultancy firms, research institutions and universities.

The concept of materiality is linked to selection of investment projects when the firm has a given investment budget and have limited organisational and human capital resources, such as management and highly specialised expertise (e.g. geologists and engineers).

Materiality implies that projects must be of a certain minimum size in order to be interesting investment objects for transnational companies. This is supported by statements from large oil companies suggesting that they will reduce their activity in Norway if the after-tax values of new projects, or ownership shares in these, become too small.

## **2 The importance of agglomeration forces for investment and localization decisions**

The dimension of the Norwegian petroleum sector, and its ability to attract high-competent foreign firms, has been closely connected to the allotment of licenses and platform constructions on the Norwegian continental shelf. However, this linkage has become less strong as Norwegian petroleum companies and suppliers have increased the scale of their foreign activities and developed specialized knowledge that is demanded by multinational petroleum firms.<sup>1</sup> This development has partly been caused by substantial reductions in the technical costs of trading petroleum services, and a less protectionist attitude in most countries. As the Norwegian continental shelf matures, it thus becomes increasingly important to analyze the consequences of both inward and outward investments connected to the Norwegian petroleum sector (broadly defined).

It seems to be particularly central to take the extent of trade liberalization in services and the strength of the alleged agglomeration forces in the petroleum sector into account when discussing the investment and localization decisions of multinational petroleum companies. In the following we shall focus on how these factors may affect

- (i) the competitiveness of the Norwegian continental shelf in particular, and the prospects for profitable development of petroleum fields in general.
- (ii) the ability of Norwegian petroleum companies and their suppliers to compete in other petroleum regions.

Major technological innovations, and development of a large variety of specialized intermediate goods, are required in order to make it profitable to invest in marginal petroleum fields on the Norwegian continental shelf. Additionally, the sizes of the stages in the value chain (e.g., R&D and engineering) must be above some critical level. One reason for this is that R&D is a stochastic process where the probability of success tends to be increasing in the

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<sup>1</sup> See Osmundsen (1999a, 1999b, 1999c) for a more detailed discussion on contractual and organizational arrangements related to exploitation of petroleum fields on the continental shelf.

number of research centres, the degree of interaction between different research centres, and the interaction between research centres and end-users (downstream and upstream firms in the petroleum sector). Since the Norwegian continental shelf is relatively exceptional with respect to weather conditions, water depth, and structure of the reservoirs, among other things, the use of knowledge capital from other petroleum regions is only possible to a limited extent. The knowledge that is created within the Norwegian petroleum sector, on the other hand, may prove to be an important competitive factor in future developments of complex and technologically demanding petroleum fields in, for instance, Azerbaijan, Kazakhstan, Brazil and West Africa (Dalen et al, 1999).

It is interesting to analyze the petroleum sector in relation to knowledge externalities. Indeed, there are several reasons why the extent of interaction between agents– and therefore the potential for knowledge externalities – may be expected to be larger within the petroleum sector than within most other sectors. First, a number of remedial actions have been undertaken with respect to organization and communication in order to reduce transaction costs between different petroleum agents. Second, geographical co-localization is widespread in the petroleum sector. Third, there are some aspects of the division of labour within this sector that indicate a tight integration between petroleum companies and their suppliers. For instance, even though the firms have changed to turnkey deliveries, the petroleum companies still have sizeable staffs of engineers that work closely with the suppliers. In some circumstances this cooperation is even formalized as common project organizations. It should further be noted that parallel working processes, time-critical supply chains and mutually dependent R&D call for tight coordination between the different agents (petroleum companies, turnkey suppliers, and sub-contractors). These characteristics of the petroleum sector indicate complex organizational relationships that allow for major changes during the development and manufacturing process. Accordingly, there are substantial management and coordination challenges.<sup>2</sup>

Below, we shall first discuss why investment decisions in industries where there exist agglomeration forces may be fundamentally different from those in traditional industries, and why there may be a coordination problem between different investors. We shall then go on to show how the agglomeration forces may influence the choice of localization for multinational

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<sup>2</sup> This is in contrast to some kinds of conventional shipbuilding, for instance, which is characterized by large physical distance between customer and suppliers, low R&D intensity, sequential working processes, and few changes during the production process.

petroleum companies, and in particular discuss possible consequences of trade liberalization in petroleum-related services. Finally some policy related issues will be discussed.

## 2.1 Coordinated investment decisions

Traditional economic theory predicts that a given industrial sector is less profitable the larger the number of active firms, other things being equal. If we observe that firms in a particular sector typically have a return on invested capital below average, we thus have an indication that there is an over establishment of firms. In a situation like this, we should certainly not expect to observe new entries. On the contrary, we should expect firms to exit the market until there are so few competitors left that the remaining firms achieve the same profitability as those in other sectors. But suppose that there are agglomeration forces in the sector that we consider. In this case the story above may almost be reversed: if a sector is unprofitable, the reason may actually be that there are too *few* active firms. Up to a critical point, increased entry may therefore be a premise for a sufficiently high profitability.

In order to understand why the existence of agglomeration forces may imply that we have a 'reversed' relationship between the number of firms and sector profitability, it is useful to imagine that we have only one factor of production that is mobile between the sectors – labour – and two possible industries; the petroleum sector and the 'traditional' sector.<sup>3</sup> Assume further that there are agglomeration forces only in the petroleum sector, while we follow neoclassical theory and assume that there are decreasing returns to scale for labour in the traditional sector. The latter implies that the wage ability of the traditional sector is higher the lower the level of employment in the sector. This is illustrated by the curve labelled T in Figure 1, where we measure wages on the vertical axis, and employment in the traditional sector from the right to the left. Employment in the petroleum sector is accordingly measured from the left to the right, and the wage ability of this sector is illustrated by the curve labelled P. This curve is upward-sloping, reflecting the fact that the higher the employment in this sector, the higher the wage level it is able to pay. This is in sharp contrast to neoclassical theory, and the explanation for this, as will be discussed below, is the presence of agglomeration forces.<sup>4</sup>

Before we enter into a more detailed discussion of what Figure 1 really tells us, and the implications for investment decisions, it is useful to look at some of the characteristics of the

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<sup>3</sup> This labour force is not meant to include the complete labour force of the country. It is presumably most relevant to consider technologically highly skilled labour, which is used intensively by the petroleum sector.

<sup>4</sup> See Matsuyama (1991, 1995) for a formal analysis.

petroleum sector. According to Nordås and Kvaløy (1999) the petroleum sector is among the most R&D intensive sectors in Norwegian manufacturing, with very high expenditures on research and development per worker in some of the segments. A large share of these costs can be ascribed to external purchases of highly specialized intermediate goods (typically on the form of services); the share of external purchases for the petroleum sector is as high as 43 per cent, compared to an average of 20 per cent for all industries exclusive of petroleum. Nordås and Kvaløy (op cit) and Nordås (2000) further argue that these intermediates are complementary, in the sense that the higher the agglomeration of specialized intermediate goods, the higher the productivity of each single good. Thereby the market value for any given intermediate good, and thus the sustainable wage level, is increasing in the number of other specialized intermediates that are already produced. Making the reasonable assumption that there is a positive relationship between employment in the petroleum sector and the agglomeration of intermediate goods producers, we consequently end up with the upward-sloping curve P in Figure 1.

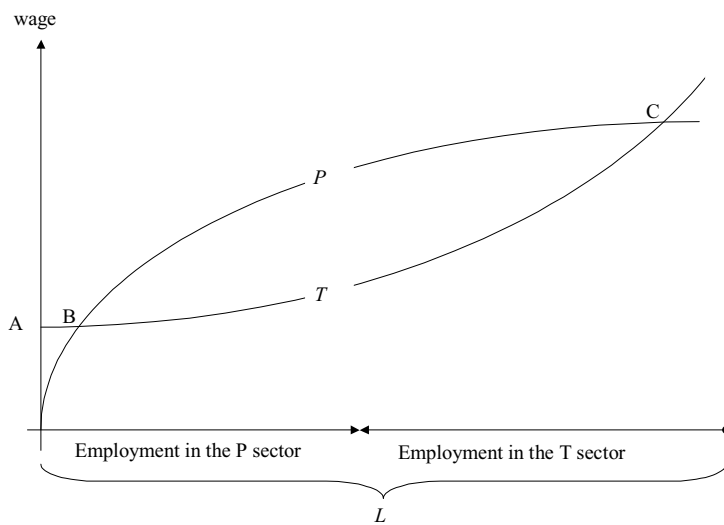


Figure 1: Agglomeration forces in the petroleum sector.

In order to find possible equilibrium allocations of labour in Figure 1, and thereby the size and wage ability of the petroleum sector, we assume that labour is employed in the sector that pays the highest wages. We further assume that each intermediate good in the petroleum sector is produced under increasing returns to scale, due to significant investments in R&D.<sup>5</sup>

As a point of departure, suppose that the economy is initially at point A. Here the whole labour force is employed in the traditional sector, and therefore wages are relatively low (due to the fact that there is decreasing returns to labour). Nonetheless, the wage level in the traditional sector is higher than in the petroleum sector; despite the low wage level it is not profitable for this sector to employ workers and develop specialized intermediate goods. However, the Figure shows that at point B – where the wage level is higher than at A - the petroleum sector is actually able to pay the same wage level as the traditional sector. There are two things that are worth noting here. First, the traditional sector employs a smaller share of the labour force than at point A, and therefore has higher wage ability. Further, the size of the petroleum sector is so *large* in B that also this sector is able to pay relatively high wages. More precisely, the supply of specialized intermediate goods is so large in B that the productivity of this sector is high enough to be able to compete against the traditional sector for labour. Second, it should be noted that B is a so-called unstable equilibrium: if the employment in the petroleum sector is a bit larger, it will have a wage ability that is higher than the traditional sector. If point B is passed, the agglomeration forces therefore imply that there are highly profitable petroleum investment opportunities. In this case the petroleum sector will continue to grow endogenously until the economy reaches point C, where the wage ability in the traditional sector once more is equally high as in the petroleum sector. In practice this implies that the positive agglomeration forces are exhausted, and that further investments in the petroleum sector are unprofitable. We thus have two stable equilibria in Figure 1. The economy will either be at point A, where the petroleum sector is not operative, or at point C, where a relatively large share of the labour force is employed in the petroleum sector. The wage level, and presumably also national welfare, is highest in the latter equilibrium.

The above analysis is, of course, highly stylised, but it underscores that the existence of agglomeration forces may turn out to be a double-edged sword. On the one hand, the agglomeration forces may imply that the profitability of investing is very high if the activity

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<sup>5</sup> Note that we are actually considering economies of scale at two different levels. First, each single firm produces under increasing returns to scale due to large investments in R&D. Average costs are thus falling if production increases. Second, the complementarity implies that there are economies of scale at a sector-wide level, since the productivity increases when the number of differentiated intermediate goods increases.



level is sufficiently large, but on the other hand it may be unprofitable to invest unless a sufficiently large number of other firms also invest. Consequently, there may exist a coordination problem between firms that are capable of making intermediate goods. This problem seems to be particularly relevant for the petroleum sector, not least since a high share of the intermediates is bought externally rather than produced internally in each firm. In other industries, where there is a smaller need for specialized intermediates, each single firm may be able to produce the intermediates on their own if the goods do not exist on the market. In the latter case there will be no coordination problem small.

The need for a coordinated entry may help explain why some republics of the former Soviet-Union and other inadequately developed countries have problems in exploiting potentially rich oil fields. Besides obvious political risks and lack of experience with market economies, it is a fact that domestic entrepreneurs are short both of financial and human capital and that they are poorly coordinated. On this background the countries are interested in attracting foreign petroleum companies. However, the petroleum sector is so intensive in knowledge, and requires such large varieties of intermediate goods and specialized services, that it is typically not profitable for just one or a few multinational petroleum companies to operate on their own. The governments therefore need a policy that induces a coordinated entry of foreign firms, a task that becomes particularly difficult when political and juridical institutions are weak and unpredictable.

## **2.2 How trade in services may affect the choice of localization**

Consider two countries that are initially symmetric, and assume that they have large as well as small (marginal) petroleum fields that potentially may be set into production. Should we expect that the network of sub-contractors will be of the same size in the two countries, or should we expect to observe a relative concentration into one of the countries (which then goes on to export services and other inputs to the other country)?

The answer to this question is in many ways given if the countries have restrictive requirements on local content in deliveries to the domestic petroleum sector: the two countries will remain symmetric, and have the same size of their petroleum related activities. However, due to WTO agreements and other international accords most countries have become less protectionist over the last years,<sup>6</sup> at the same time as technological progress has made trade in

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<sup>6</sup> In the case of Norway, this is reflected by the fact that the new Petroleum Law of 1996, in contrast to the Petroleum Law of 1985, does not explicitly require that Norwegian suppliers must be chosen if they are “competitive”.

intermediate goods (not least services) profitable to a larger extent than was previously the case.<sup>7</sup> However, for most intermediates the level of international trade costs will still be significant. And it is precisely the fact that transaction costs are higher between than within petroleum agglomerations which implies that increased trade may have large consequences for the localization choices of petroleum companies. Actually, it may happen that one of the two intrinsically symmetric countries is only able to profitably invest in the largest petroleum fields, while the other country may find it profitable to invest in even relatively marginal petroleum fields. The point of departure for the discussion that follows is a theoretical field of economics labelled New Economic Geography, which was developed by Paul Krugman and Anthony Venables in the early 1990s.<sup>8</sup>

In what follows we have to distinguish between upstream and downstream activities. Downstream firms purchase specialized intermediate goods from a number of different suppliers. As discussed above, investments in, e.g., R&D and the need for complementary inputs imply that there are economies of scale internally for each firm as well as externally. We further assume that there are transaction costs related to trade in upstream goods, and that many of the petroleum fields have only a marginal profitability. This means that we have demand and cost linkages, which possibly implies that trade in intermediate goods will have dramatic consequences.

In Figure 2 trade costs (transaction costs) are measured on the horizontal axis, while the *share* of the total petroleum related activity that takes place in country 1 is measured on the vertical axis. If trade costs on intermediate goods are very high, the two countries will to a large extent be self-sufficient and have exactly 50 per cent each of the total petroleum related activity in the two countries.<sup>9</sup> The solid line to the right of  $t_{high}$  in Figure 2 illustrates this situation. There may be some trade in intermediates between the countries, but net export will be equal to zero. In short, there will be a unique symmetric equilibrium when trade costs are high.

Since the countries are assumed to be intrinsically identical, the symmetric equilibrium will certainly always exist. However, as trade costs are reduced it becomes more profitable to export and less important to serve each market locally. Therefore the symmetric equilibrium

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<sup>7</sup> See also Nordås and Kvaløy (1999) for a discussion on the relationship between technological changes and liberalization of trade in petroleum related services.

<sup>8</sup> Our discussion will be informal; see Venables (1996) and Fujita, Krugman and Venables (1999) for formal analyses.

<sup>9</sup> Requirement on local content – as was prevalent in the previous Norwegian Petroleum Law – implies de facto that trade costs for certain intermediates are infinitely high.

may become unstable when trade costs are sufficiently low, and one of the countries may end up with a much larger petroleum sector than the other. To see the intuition for this, assume that country 1 for some exogenous reason is able to attract a few more upstream firms than is country 2. This tends to make country 1 a net exporter of petroleum related services, and to reduce the cost level for downstream producers in country 1. Thereby it may be profitable to invest in more marginal petroleum fields in country 1 than in country 2 (given that trade costs are positive). Since the upstream firms produce under increasing returns to scale (decreasing average costs), such that the size of the market matters, the subsequent increased demand in country 1 possibly makes it even more profitable to invest in this country. Thereby we may end up in a situation where self-reinforcing agglomeration forces lead to a flourishing of the petroleum sector in country 1, with investments taking place in increasingly more marginal petroleum fields and domestic production of a larger and larger set of specialized intermediate goods.<sup>10</sup> In Figure 2 we have illustrated this by assuming that country 1 ends up with 70 per cent of the total petroleum related activities when  $t < t_{high}$ .<sup>11</sup> Note also that we have drawn a solid curve that indicates that country 1 has only 30 per cent of the activity. The reason for this is that we assumed that the countries are intrinsically symmetric, such that it is more or less accidental which of the countries ends up with the largest activity in the petroleum sector. We will comment further on this below, when discussing the importance of the public policy towards the petroleum sector.

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<sup>10</sup> Note that we are here considering the same kind of mechanisms as in Figure 1.

<sup>11</sup> In principle it is possible that the countries end up with the same structure again if trade costs become sufficiently low. The reason is that if it is approximately costless to trade intermediates internationally, then geographical location is relatively unimportant. However, when transaction costs of the petroleum sector are taken into consideration, this possibility seems to have a larger theoretical than practical interest.

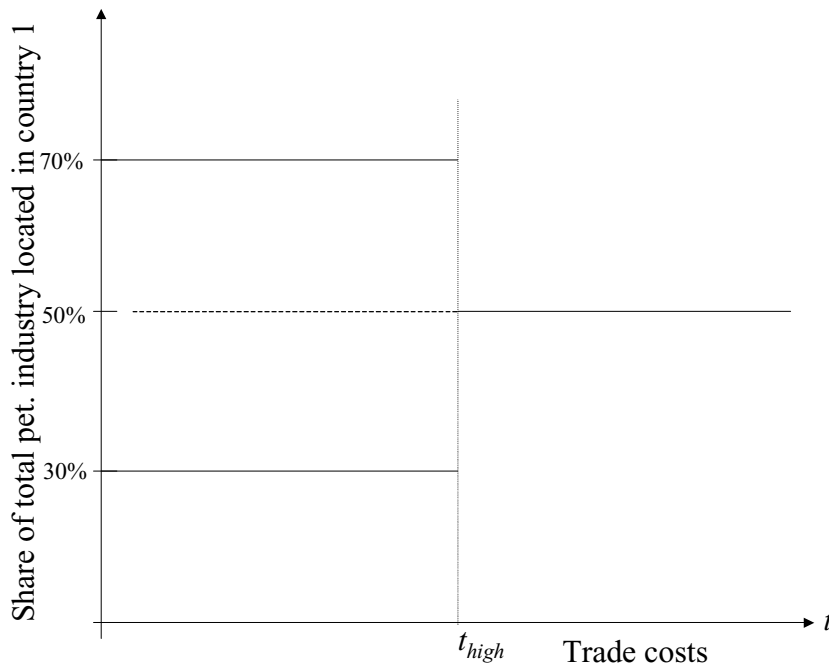


Figure 2: Consequences of increased international trade in intermediate goods.

### 2.3 Public policy

The political milieu has become increasingly concerned over the importance of developing and maintaining industrial agglomeration through an attractive public policy, not least within sectors such as petroleum, shipping and ICT-related industries. The discussion above makes it clear that it is important to focus on policy issues in such industries. Tax policy, for instance, may be decisive for whether it is country 1 or country 2 that ends up with the largest petroleum agglomeration in Figure 2. However, the sensitivity towards the tax policy should not be exaggerated. Actually, if a self-reinforcing petroleum agglomeration is established, the tax policy may turn out to be relatively unimportant. The reason is that the agglomeration forces create a kind of pure rent for the firm (in addition to the petroleum rent), such that the advantages of being located in an agglomeration are larger than the disadvantages of relatively high taxes. It is further important to stress that the maximum tax rates can indeed be higher if the transaction costs outside the agglomeration are reduced. The intuition for this result, which may seem a bit surprising, is that with lower international transaction costs it becomes less beneficial for other countries to set low taxes in order to attract the agglomeration. This is a fact that the government in a country that hosts an agglomeration can utilize by increasing the tax rate. Thereby it is possible that Norway, for instance, will be able to impose high taxes on the petroleum sector even if international trade costs on petroleum services fall (see Kind,

Knarvik and Schjelderup, 1998 and 2000, for a more detailed discussion). However, as shown by Venables (1997), a tax rate that is only slightly too high may imply that the whole agglomeration breaks down. This indicates that it is better to be on the safe side by setting a relatively low tax rate, due to the negative welfare effects of losing an industrial agglomeration.<sup>12</sup>

### **2.3.1 Concentration versus dispersion**

The possibility of a self-reinforcing petroleum agglomeration has normative implications for the public policy towards localization. Since many of the positive linkages between petroleum firms are related to geographical proximity, it is important that the policy in general, and the regulation policy in particular, aims at a certain geographical concentration of the petroleum sector. Since agglomeration effects are based on externalities, it follows that each single petroleum firm will not internalize all effects of their choice of localization. It is therefore possible (though not necessarily true) that a stronger geographical concentration than the petroleum companies tend to prefer is socially optimal. What we have seen in Norway, however, is that the government, due to an active regional policy, instead has followed a policy of spreading the petroleum sector more than what would be the market outcome. This is perhaps one reason why the Norwegian petroleum sector seems to have weaker linkages than the British petroleum sector (see Reve and Jakobsen, 2001).

### **2.3.2 A smoother investment trend**

The Norwegian petroleum sector is characterized by large fluctuations in the activity level. This has implied that the cost budgets have been significantly overstepped during booms, as discussed by Osmundsen (1999c). The reason is that when the firms are beyond their natural capacity limits they will have to hire workers (often with insufficient skill levels) at high wage rates, they will have to use less qualified sub-contractors, and the administrative management becomes too thin and spread over too many activities. When the activity level is low, on the other hand, we observe that high-competent labour migrate to other industries. The stock of human capital specific to the petroleum sector erodes, and it is difficult to find enough skilled labour when the activity level increases again. Large fluctuation in the activity level thus

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<sup>12</sup> The research literature on agglomeration uses the term "catastrophic scenario" to describe cases where a small increase in the tax rate implies that the agglomeration dissolves and the pure rent disappears. Note that we shall never have such catastrophic scenarios in "traditional" industries, where a marginal increase in the tax rate has only a marginal influence on the activity level.

reduces the possibility of building up a strong and knowledge intensive petroleum agglomeration.

There are certain factors beyond the control of the petroleum firms that govern the fluctuation of the activity level on the Norwegian shelf, such as the government's allotment of investment licences across time. The government should try to reduce rather than increase these fluctuations (parallel investments in several large gas fields are one explanation for the investment boom in 1998). However, one should be careful in implementing new criteria in allocation mechanisms that are primarily meant to serve other needs. There are many examples of public interventions in the economy that are intended to reduce the cycles, but that have actually increased the fluctuations because the interventions have been implemented too late. Fine-tuning of the petroleum activity level, as for the economy in general, is unlikely to be successful.

### **3. Materiality**

To secure the presence of large transnational oil companies on the Norwegian continental shelf, as well as to promote entry of smaller companies specialised in developing marginal fields and to undertake tail-end production, it is vital to understand factors that determine the transnational companies' allocation of activity among countries. In discretionary licensing decisions, it is not sufficient for authorities only to ascertain the companies' competence. They must also take into consideration the after-tax remuneration each individual company requires to operate in the country. To the extent that the best companies also are the ones with the highest requirements, there may be a trade-off between competence on the one hand and remuneration on the other hand. This is of particular interest for marginal fields, where the materiality potential may be insufficient for large companies at the general fiscal conditions.

Materiality is a concept which is linked to selection of investment projects when the company has a given investment budget and limited resources in the form of management and employees with specialised competence. Materiality - also referred to as financial volume or critical mass - implies that projects need to be above a certain size (in terms of after-tax net present value) in order for them to be interesting to multinational oil companies. A small project can be unattractive even if it is able to show a high expected return (internal rate of return).

Materiality requirements - requirements for minimum level of after-tax net present value - can be justified on the basis of different academic disciplines. Corporate strategy, accounting, corporate finance, management and investment analysis can all provide arguments for there to be a certain critical mass in connection with investment decisions. The petroleum companies' increasing materiality requirement is closely connected with their focusing strategies. They concentrate scarce resources on fewer activities, focus on those areas where they have comparative advantages. In return, they demand larger contributions after tax, measured in absolute value, from each of these selected activities. Thus, a positive net present value is, in connection with such allocation strategies, only an entrance ticket to transnational companies' ranking of projects on a global basis. It is a necessary yet not sufficient condition for realisation. The materiality requirements may also be looked upon from a finance and management theory setting. There is an increasing recognition that corporations incur certain amount of costs that for different reasons are not included in the expected project cash flow. One way to make allowances for these extra costs generated by a project is to demand a certain minimum size for the present value of projects.<sup>13</sup> One may envisage far more sophisticated methods by which to rectify this problem, but simple, implementable management systems are often the preferred solution by companies.

Materiality requirements may also follow directly from traditional economic decision analysis, if one recognises the fact that the real decision problem is non-linear and non-divisible, with a number of scarce factors and fixed costs. This is shown in Osmundsen, Emhjellen and Halleraker (2001); a portfolio analysis employing data from actual petroleum projects on the Norwegian Continental Shelf.

Materiality is particularly important in the petroleum industry, an industry dominated by a few profitable players. Through their international mobility and access to private information<sup>14</sup> these companies succeed in capturing part of the resource rent generated from scarce petroleum resources. The taxation never reach 100 per cent, the companies keep a mobility rent and an information rent; see Osmundsen, Hagen and Schjelderup (1998). This is also valid for industries that exploit non-mobile natural resources, since the input factors and the companies are mobile<sup>15</sup>. Large discoveries in new basins, opening of established, producing countries for transnational petroleum companies, and a reduction in the number of

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<sup>13</sup> See for instance Zimmerman (1979).

<sup>14</sup> See Osmundsen (1995, 1998).

<sup>15</sup> The companies do not need to move all of the operations physically. The transnational oil companies' international activity is to a considerable extent managed from the head office.

players through mergers and acquisitions, have increased competition between different producing countries to attract the most competent companies.<sup>16</sup> This is likely to make the fiscal terms more important, particularly in countries where the remaining acreage over time must be expected to yield economically marginal fields, i.e. where the resource rent experiences a decreasing trend.

However, there are factors that are balancing this picture. Mergers among the largest oil companies might open up for new entrants, which may increase the relative bargaining power of governments in a bargaining game between governments and companies over the resource rent. Seen from the perspective of governments, it may be optimal to reduce entry barriers. Moreover, countries where large new discoveries are made, are likely to impose high taxes to capture a large fraction of the rent. Several of these countries are also associated with political risk. The obvious threat to the oil companies is the imposition of higher taxes than expected after large irreversible investments have been sunk. In the last year, reports have been made on a tougher regulatory regime in Angola, and tax increase have been announced in the Caspi area.

### **3.1 Non-linear optimisation**

Materiality is not modelled in elementary investment analysis or in existing taxation theory. These models consider capital to be the primary scarce factor, in which case the internal rate of return becomes the relevant decision-making criteria. In conventional examples based on internal rate of return, however, a number of simplifying and unrealistic assumptions are made. One assumes that other scarce factors are fully reflected in prices, one assumes full divisibility of projects and that all relevant costs are included in the calculation. In reality, there is often a small number of larger projects, and many scarce factors and bottlenecks. One such relevant scarce factor is qualified experienced professionals. For example, only few individuals possess the necessary qualifications and experience to manage complex development projects in the North Sea. Furthermore, competent geologists and geophysicists are scarce. Usually, managerial capacity is also a scarce factor. The companies will, in consequence, look at what values (present value after tax) the companies can retain, compared to the input of professional resources and managerial capacity which could, alternatively, have been invested in projects in countries where the companies are allowed to retain a larger portion of the value created. The various projects also have to bear all area-dependent fixed

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<sup>16</sup> For a description of international tax and fiscal competition, see Zodrow and Mieszkowski (1986), Gresik (2000), and Olsen and Osmundsen (2000).



costs and make contributions to the payment of overhead costs at the corporate level. An analytical approach to this decision problem will be to use portfolio analysis to arrive at the portfolio of projects with greatest combined present value for the company, with consideration to fixed costs and resource and capital constraints. For practical reasons however, one often uses simpler decision-making tools. One important reason is that recommendations and often decisions are made, not at the corporate level, but at a divisional level where not all constraints and costs are known. A practical way of paying consideration to scarce factors and area-dependent costs is therefore for the head office to demand a minimum size for a project's net present value after tax. Even though portfolio models are not necessarily used explicitly to deduce the optimal investment portfolio, such considerations may - via materiality requirements - be underpinning the choice of what core geographical areas the companies wish to invest in and how large equity shares the companies wish to go for. Simple capital allocation models, like a fixed investment budget and requirements of a certain financial volume, may act as a proxy or as an implementation mechanism for more advanced portfolio models.

Why, then, are these inputs scarce? If managers or professionals create values beyond the costs generated by them, one would think the companies would hire more staff until the last employee just barely satisfies his or her marginal cost. One reason why this is not automatically possible is that scarcity often does not concern professionals or managers as a group, but those that are highly qualified. It is argued that companies typically have a limited number of professionals and managers that are crucial to success and others that are important in completing the task to be undertaken. Due to asymmetric information - the fact that the individual employee knows more about his or her own skills than potential employers - it may be difficult to provide new such staff as and when required. Most likely one has to overstaff in order to be reasonably sure to capture some of the best individuals. Given a relatively rigid labour market, this is an expensive strategy, which is why the companies prefer to keep their organisation slim. Due to fluctuating level of activity and costs of restructuring, one is reluctant to build up capacity that will subsequently have to be downscaled.

Not only present value per scarce factor is important when companies decide where to invest. Beside the obvious elements such as prospectivity, level of cost, tax burden and acreage availability, the costs associated with being present in a region or country may be substantial and therefore the minimum profitable activity must be of a certain volume. Furthermore, most companies learn that a simple structure with management focus on a few matters is important. Areas which as such are commercial, but which do not generate much

value after tax (make small contributions to payment of overhead costs) can thus be rejected so as to allow management and professional employees to focus on those areas where values are generated for the company. Reference is often made to materiality considerations, and there is reason to take these seriously. Norwegian branches or subsidiaries of transnational companies are arguing that projects of a small scale in a corporate context, often represented by expected present value after tax being low, have difficulties in attracting attention - and thus investment funds - from the head office. This line of reasoning has gained a foothold also in the Norwegian companies, in parallel with their growing international activity. Note that even though the total project may be large, materiality can nonetheless be limited viewed from the perspective of a large international corporation if the company holds a low equity share.

### **3.2 Factors determining the materiality of a project**

Materiality can be analysed at two main levels: 1) project level, and 2) basin level. Both issues are argued to be relevant. E.g., as far as the project level on the Norwegian Continental Shelf is concerned, there is a development towards smaller fields. In an international context, though, these fields will still be considered large. New Norwegian fields are, on average, several times the size of fields on the UK Continental Shelf. Recently, there has been a marked shift to positive exploration results, also including large discoveries.

The fact that there in a mature area gradually will be vacant capacity within processing and pipeline transportation, as established fields are phased out, may make it highly profitable to develop satellite fields. This presupposes that one is able to keep down the costs of operation and maintenance on old production facilities. However, in some new potential discovery areas, one is facing problems with long distances from existing infrastructure. Tightened cost control in development projects will also be of importance for the profitability of new field developments.

### **3.3 Improved fiscal conditions**

Other factors influencing materiality, both at project and basin level, are the scope and prospect of exploration acreage, the tax system and the distribution of equity shares in the licenses. A high marginal tax causes lower portions of the total cash flow to be retained by the companies. A similar reduction in cash flow is caused by the fact that companies most often hold a limited equity share in the license. Other companies' equity shares and the Norwegian

State share via the State's Direct Financial Interest (SDFI) reduce the share of the net cash flow (and the investments) to each individual company. This reduces the size of NPV to each company. The internal rate of return, however, remains unchanged provided the company is in a tax paying position. Taxation does thus not reduce the profitability of the investment, but is instrumental in scaling down the project for each individual company. This reduces net present value after tax and thus the materiality of the project. The present commercialisation of the SDFI (sale of equity shares from the State to privately run companies) could potentially - if escalated - help bring about a substantial improvement in materiality for the companies on the Norwegian Continental Shelf. A change in the licensing policies, involving larger equity shares for the privately run companies, has also improved the materiality conditions on the shelf.

There is reason to distinguish between localisation decisions faced by the company *before* and *after* they have built up a substantial organisation, infrastructure and specific competence in a certain producing nation. A company that has been present in a country for a long time and acquired substantial local competence may not have the same value in a different country. The company then have a number of irreversible investments that are immobile. The materiality consideration will therefore be different before and after a substantial activity has been established. This works in the favour of established producing nations. This argument however, should not be overvalued since mobility can still be high to the extent that there is a second-hand market for oil leases and infrastructure. Also, there might be substantial area-dependent annual (avoidable) fixed costs associated with being established in a country.

### **3.4 Entry**

Interesting to note, for governments, is that companies differ in their materiality requirements, with large companies typically having a higher demand for financial volume in projects than smaller companies. Thus, governments may be able to keep a larger share of the resource rent if they attract smaller petroleum companies. This is a policy currently pursued by Norwegian authorities. However, large and small companies differ in their financial strength and technical competence, and the authorities would have to trade off price (demand for financial volume) against quality (e.g., resource extraction rate).<sup>17</sup> We may expect to see a division of labour

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<sup>17</sup> One should not that a particular feature of the Norwegian tax code with a high marginal tax is that the learning costs of new entrants to a large extent will be borne by the state.

between larger and smaller companies, with the former developing larger reservoirs at deep water, whereas the latter focus on smaller, stand-alone reservoirs and tail extraction.

### **3.5 The behavioural hypotheses of tax theory**

Economic tax theory typically presumes that a company will realise any project with a positive net present value (materiality is irrelevant). If the capital is scarce, the company will allocate its investments where the profitability (internal rate of return) is highest. According to these behavioural assumptions<sup>18</sup>, the fact that the company's cash flow is scaled down should have no negative impact on the investment decision. However, somewhat more sophisticated portfolio investment theory does not prescribe the use of internal rate of return as decision-making criterion, but rather the use of portfolio models to arrive at the portfolio of projects with the largest accumulated present value to the company (with consideration paid to resource and capital constraints). This theory is also more in line with company practise.<sup>19</sup> Several scarce factors, fixed costs and divisibility problems may favour projects with good materiality. In order to secure the participation of competent companies one must - in situations of reduced expected basin profitability - give the companies higher equity shares and gradually lower average tax for new fields. This is simply to state that the tax and licensing conditions must be curtailed to the present level of resource rents generated.

## **4. Summary and conclusions**

Norway has succeeded in building a petroleum cluster, which includes oil companies, an offshore supply industry, parts of the maritime sector, consultancy firms, research institutions and universities. The degree of interaction between agents in the value chain, and consequently the potential for knowledge externalities, is larger in the petroleum industry than in many other industries.

The ability to develop marginal petroleum fields will to a large extent depend on the presence of a significant offshore supply industry. Large fluctuations in activity levels reduce the possibilities for maintaining a petroleum cluster, and thereby reduce the economic attractiveness of the Norwegian continental shelf. Through improved liquidity management in

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<sup>18</sup> This neutrality property is only valid if we can ignore the probability that the company, for instance due to low oil prices, falls out of tax position, or if the tax system has perfect loss offset. These conditions are not satisfied in practice.

<sup>19</sup> Simplified approaches - like NPV per unit of scarce factor - is in some companies used to rank investment opportunities.

the companies it is possible to reduce the importance of short-term liquidity considerations in investment decisions, and long-term investment programmes can be sustained.

Materiality considerations, leading to geographic concentrations of activities, is relevant for oil companies' localisation decisions due to limited management resources and other highly specialised expertise. The companies will choose regions with significant materiality. This may even be confined to regions within a country. Mergers and acquisitions have improved the materiality for companies operating in Norway. Changes in the Norwegian government's licensing policies and the partial sale of state equity share in licenses, leading to larger ownership shares for the oil companies, have also contributed in a positive direction.

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