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Optimal adaptations to thin-capitalisation rules: The case of the Norwegian petroleum sector

A theoretical approach

Authors: Kasper Thoring Fellkjær and Maria Hesla Steinum

Supervisor: Dirk Schindler

Norwegian School of Economics

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Abstract

The high marginal tax rate of 78 per cent in the Norwegian petroleum sector gives the petroleum companies a strong incentive to finance themselves by both external and internal debt. This can lead to situations where the companies are financed largely by debt relative to equity, also referred to as thin capitalisation. Because the interest expense on debt is tax deductible, extensive use of debt reduces the petroleum companies' taxable income substantially. As the tax from the petroleum sector accounts for over half of the Norwegian State's total revenue from the petroleum sector, different rules have over time been put in place to reduce the problem of thin capitalisation.

There have been three different thin-capitalisation rule regimes with the first one being introduced in 1994. In this thesis, we elaborate on the three regimes and develop three corresponding theoretical models that describe the petroleum companies' optimal capital structure under each regime. We find that under the 1994 regime, the derived optimal capital structure implied that all companies should have a debt-to-asset ratio of at least the defined threshold using both external and internal debt. After the introduction of the second regime in 2002, we find that petroleum companies should have either the same capital structure as under the 1994 regime, or decrease leverage to below the threshold if the net gain of exceeding the threshold was insufficiently large. Finally, we find that under the current 2007 regime, the optimal capital structure is qualitatively similar, but not equal, to the 2002 regime.

In the last part of the thesis, we present some empirical observations showing that the total-debt-to-asset ratio has increased significantly since 1993 and converges to 90 per cent by 2007. In addition, there has been a drastic increase in the use of internal debt since 2005.

Acknowledgements

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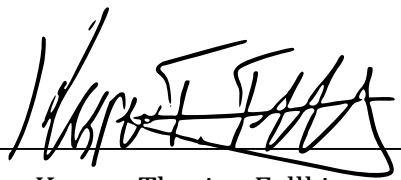

Kasper Thoring Fellkjær

Maria Hesla Steinum

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Chapter 1: Introduction

1.1 Background

In July 2013, OECD published a report named "Action Plan on Base Erosion and Profit Shifting". The report states that the globalisation of the national economies and markets is increasing, leading to a larger cross-country integration of firms. This global integration enables multinationals to exploit tax differentials between countries in order to shift profits from high-tax countries to low-tax countries. Together with the increasing sophistication of tax planners in identifying and exploiting legal arbitrage opportunities, this development has enabled multinationals to greatly minimise their tax burden. This is what OECD refers to as *Base Erosion and Profit Shifting* (BEPS) which harms stakeholders like national governments due to the reduction in corporate tax income.[1]

There are two main strategies that multinationals utilise to shift profits. The first is related to transfer pricing where multinationals under and over-invoice intra-firm trade.[2] This thesis, however, focuses on the second strategy which is borrowing and lending among related affiliates, also referred to as internal debt shifting. By loading affiliates located in high-tax countries with debt from affiliates in low-tax countries, a multinational can reduce its overall tax payments, and thereby increase its total profits. The mechanism at play in this strategy is that the interest expense charged on the internal debt is deducted from the high-tax affiliates' tax base, transferred to the internal bank and taxed at a lower tax rate. Because the tax deduction in the high-tax country is larger than the tax payment in the internal bank, this results in a net gain for a multinational (i.e. a tax arbitrage).[3]

The use of internal debt shifting has been extensively documented empirically, and in a study by Ramb and Weichenreider (2005) on German inbound foreign direct

[1] OECD (2013).

[2] See e.g. Gresik and Osmundsen (2008) or Lund (2002), where the latter provides an application of transfer pricing to rent taxation and natural resources.

[3] Schindler and Schjelderup (2012), p. 635.

investments in the non-financial sector, cross-border intra-company loans were found to (on average) account for 25 per cent of the balance sheet total in 2001.[4]

As noted in Ruf and Schindler (2012), non-regulated internal debt shifting can be used as a vehicle of tax arbitrage as long as there is positive taxable income. Several countries have therefore implemented thin-capitalisation rules that aim to reduce the strong debt-financing incentives and the corresponding negative impact on their corporate tax base.

Weichenreider and Windischbauer (2008) empirically analyse the effect of German thin-capitalisation rules and find that after a tightening of the rules in 2001, foreign affiliates reacted by reducing internal debt and increasing equity. However, they also found that the magnitude of the effects were limited. A similar study is done by Buettner et al. (2012) with a database containing a large number of foreign affiliates of German multinationals. As Weichenreider and Windischbauer (2008), they find that thin-capitalisation rules reduce internal debt shifting, but in addition, they find that the rules also result in higher external debt.

In the Norwegian petroleum sector, thin capitalisation is a particularly important issue due to the high marginal tax rate of 78 per cent, which incentivises both the use of internal as well as external debt. As the tax from the petroleum sector is a significant source of income for the Norwegian State, thin-capitalisation rules have been implemented in order to curb excessive debt financing. However, as opposed to most of the thin-capitalisation rules that have been studied in research (including the two studies mentioned in the previous paragraph), the rules in the Norwegian petroleum sector restrict both internal and external debt. This, combined with the sector's extraordinarily high tax rate, makes it a particularly interesting case to study. This has led us to the following overall question that we seek to answer with this thesis:

"From a theoretical perspective, how have the thin-capitalisation rules in the Norwegian petroleum sector restricted the use of internal and external debt?"

[4] See also Desai et al. (2004) who, inter alia, show that internal debt shifting is especially sensitive to tax rate changes.

1.2 Thesis structure

This thesis is structured as follows: Chapter two serves the purpose of giving the reader an introduction to the Norwegian petroleum sector. First, we provide an overview of parts of the administration and the licensing system before presenting some historical aspects of the sector, as well as explaining how value from the sector is transferred to the Norwegian State. We then proceed to the petroleum tax system where we elaborate on the extraordinary tax rate and the different thin-capitalisation rule regimes that have existed in the sector.

In chapter three, the main part of this thesis, we first present the standard theory on capital structures as well as the specific framework that we adopt for internal debt shifting and thin-capitalisation rules. We then incorporate the features of the different thin-capitalisation rule regimes in the Norwegian petroleum sector into the presented framework and model our own theoretical approach. The optimal capital structure under each rule regime is then presented and discussed. In the end of the chapter we make some empirical predictions based on the results from our models.

Chapter four presents some empirical observations with respect to different debt variables, and the observations are discussed and compared to the empirical predictions. We make our concluding remarks in chapter five and state what we believe are interesting areas for further research.

1.3 Limitations

In chapter two, providing a fully exhaustive presentation of the petroleum tax system is naturally outside the limits of this thesis. Our goal has rather been to provide the reader with a general economic understanding of the tax system, and specifically the different thin-capitalisation rule regimes. For accounting or judicial purposes, we refer to our sources for a thorough review of the rules.

When modelling the different rule regimes in chapter three, our goal has not been to create models that try to explain all the economic effects of the rules, but rather select what we believe are some of the rules' most important features, and provide an economic understanding of how these features influence petroleum companies' capital

structure choices. A natural effect of this is that some of the omitted features may bias or alter our results.

Finally, chapter four is naturally limited by the fact that this is a theoretically focused thesis. Our goal with the chapter is to provide some interesting facts on the development of debt usage in the Norwegian petroleum sector, as well as have some empirical data that both we and the reader can relate our theory to.

Chapter 2: The Norwegian petroleum sector

Since its inception in 1969, the Norwegian petroleum sector has added more than 9,000 BNOK to the Norwegian GDP and played a vital role in the Norwegian economy. Today, the sector accounts for almost a fourth of Norway's value creation and is by far Norway's largest industry.[5] In 2013, the Norwegian State's income from the sector is estimated to around 400 BNOK, which is over 30 per cent of the Norwegian State's total estimated income in 2013.[6]

In 2011, Norway exported 660 million barrels of oil and 97 billion standard cubic metres of gas. By comparison, the respective amounts for Russia, the world's largest oil and gas exporter, were 2,255 and 194. This made Norway the world's seventh largest oil exporter and third largest gas exporter – an impressive fact considering the country's relatively small size.[7]

Although the total petroleum production in Norway has decreased following the financial crisis in 2008, this is expected to turn into a slow increase in the coming years, before slowly declining in a long-term perspective. As such, the petroleum industry will likely continue to be an important contributor to Norway's economy in the years to come.[8]

In the following, we introduce the Norwegian petroleum industry with an emphasis on the features relevant for this thesis. In section 2.1, we give the reader a brief overview of the administration and licensing system, the historical development of the sector as well as how value from the Norwegian petroleum sector is transferred to the Norwegian State. The most relevant parts of the Petroleum Taxation Act, with an emphasis on the thin-capitalisation regulations, are then described in section 2.2.

[5] Norwegian Petroleum Directorate (2013a), p. 20.
[6] Meld. St. 1 (2012-2013), p. 168.
[7] Norwegian Petroleum Directorate (2013a), p. 20.
[8] Norwegian Petroleum Directorate (2013a), p. 20.

2.1 The Norwegian petroleum sector at a glance

2.1.1 Introduction to the sector

Administration of the sector

The Norwegian petroleum resources are managed by a governmental organisation, ensuring that the Norwegian population benefits from the country's resources. We will not describe the whole organisation, but rather select and present the parts of the administration that are most relevant to this thesis.

The Ministry of Petroleum and Energy (MPE) ensures that the management of the sector is according to the desire of the Parliament, implying that the MPE has the overall responsibility for managing the Norwegian petroleum sector. In addition, the MPE has ownership responsibilities as a result of state ownership[9] in the sector. The Norwegian Petroleum Directorate, reporting to the MPE, is a governmental specialist directorate and administrative body. This means that the directorate provides advice to the MPE, and it is also responsible for exercising the administrative authority of the MPE.[10]

The Ministry of Finance has the overall responsibility for collecting taxes and fees from the petroleum activities. The Petroleum Tax Office reports to the Ministry of Finance, and is specifically responsible for ensuring correct levying and payment of taxes according to the tax policies enacted by the Parliament.[11]

The net cash flow from the petroleum sector received by the Norwegian State is transferred in its entirety to the Government Pension Fund Norway.[12] The Ministry of Finance is the formal owner of the fund and has the overall decision authority related to the fund's investment strategy. However, the Norwegian Central Bank has the responsibility of managing the fund as well as being an advisor to the Ministry of Finance with respect to investment decisions.[13]

[9] E.g. fully-owned Petoro and partially owned Statoil described in greater detail in section 2.1.2.
[10] Norwegian Petroleum Directorate (2013a), p. 15.
[11] Norwegian Petroleum Directorate (2013a), p. 16.
[12] Norwegian Petroleum Directorate (2013a), p. 20.
[13] Norges Bank Investment Management (2011).

The licensing system

In order to ensure that the most suitable companies operate on a field, a licensing system is developed and described in The Norwegian Petroleum Act[14]. § 3-3 in the act states that the permission to extract includes the sole right to explore and extract the petroleum in an area. In addition, the owner of the license is also the owner of the petroleum resources in the specified area. Each year, the MPE typically announces the production licences containing one, several or parts of different blocks, and individual players or joint ventures can apply. Each license has a deadline and the applicants apply with the details specified by the MPE. The MPE then considers the application, and a selection is made after an evaluation of objective criteria and specific requirements stated in the announcement text. The permission is limited in time and can be arranged for a period of up to 10 years.[15]

2.1.2 Historical development

The initial discoveries

After the discovery of gas in Groningen in the Netherlands in 1959, the global petroleum industry's attention shifted to the North Sea as a potential source of petroleum resources. As a result, the first licensing round in Norway was announced in 1965. This ultimately led to the discovery of the well-known Ekofisk field in 1969 with production starting in 1971, marking Norway's definitive step into the global petroleum industry.[16] Following the Ekofisk discovery, the exploration attention was focused on the most promising areas, leading to the discovery of major fields such as Statfjord, Oseberg and Troll. Due to the inaccessible nature of offshore petroleum resources, a whole infrastructure needed to be established in order to effectively extract, transport and distribute crude oil. This enabled the tie-in of smaller fields, gradually leading the Norwegian petroleum production to be spread among a large number of fields.[17] As of March 2013, 76 fields were in production.[18]

[14] The Norwegian Petroleum Act regulates the petroleum activities on the Norwegian shelf. Among other things, the act concerns both exploration and production of petroleum, as well as development of fields. *Source: Store Norske Leksikon (2013).*

[15] Norwegian Petroleum Directorate (2013a), p. 14.

[16] Ministry of Petroleum and Energy (2013).

[17] Norwegian Petroleum Directorate (2013a), p. 10.

[18] Norwegian Petroleum Directorate (2013a), p. 20.

Norwegian participation

During the industry's first years, the Norwegian authorities chose an exploration and extraction model where foreign petroleum companies operated the petroleum activities. This naturally led to a foreign-company domination on the Norwegian continental shelf with Norsk Hydro being the only Norwegian player in the sector.[19]

Due to the petroleum industry's growth and increasing importance to the Norwegian economy, it was desirable to increase the Norwegian involvement. As a result, the Norwegian State became the majority owner in Norsk Hydro in 1971. In the following year, the Norwegian petroleum companies Statoil and Saga Petroleum were established, with the former being fully owned by the Norwegian State and the latter being privately owned. The State maintained its majority in Norsk Hydro until 1999 when Norsk Hydro acquired Saga Petroleum by stock issuance. The State ownership share in Statoil has also been reduced since its establishment. In 2001, the Norwegian Parliament reduced the required State ownership share in Statoil to 67 per cent. This was further reduced when Statoil merged with Norsk Hydro in 2007, but a stock purchase in 2009 restored the ownership share to the previous 67 per cent.[20]

Aside from direct State involvement through the state-owned Norsk Hydro and Statoil, a policy named *The State's Direct Financial Interest (SDFI)* [21] was created in 1985, which required the Norwegian State to have an ownership share in each production license. Since 2001, a dedicated separate governmental entity called Petoro AS has been responsible for the administration of SDFI.[22] Petoro's mandate does not include operatorship, and thus the company is not an operating entity such as Statoil.[23] As of 31 December 2012, 50 petroleum companies had production licenses on the Norwegian continental shelf – a number that has been relatively stable the last years. Out of the 50 operating companies, Statoil and Petoro are the most prominent non-foreign players.[24, 25]

[19] Norwegian Petroleum Directorate (2013a), p. 10.
[20] Norwegian Petroleum Directorate (2013a), p. 10.
[21] SDFI is described in further detail in section 2.1.3.
[22] Norwegian Petroleum Directorate (2013a), p. 10.
[23] Olje- og energidepartementet (2013).
[24] Norwegian Petroleum Directorate (2013b).
[25] An overview of these companies is provided in section 6.1 in the appendix.

2.1.3 How value is transferred to the Norwegian State

The Norwegian State's net cash flow from the petroleum activities is channelled through three main sources: Dividends from state ownership in Statoil, The State's Direct Financial Interest (SDFI) and the petroleum tax system (i.e. ordinary and extraordinary tax from petroleum companies). Each channel's cash-flow contribution in 2011 is shown in figure 2-1 below:

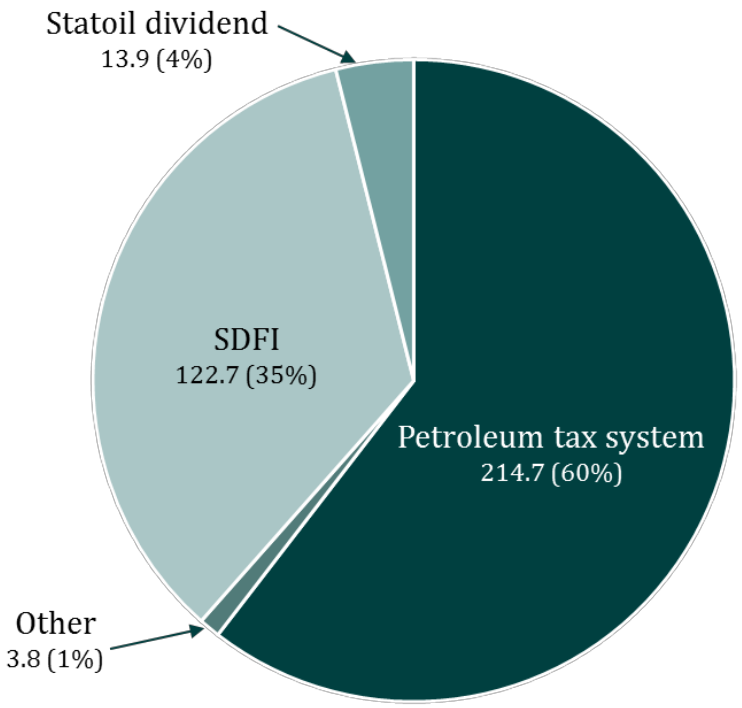

Figure 2-1: Distribution of Norwegian State's net cash flow from the petroleum sector in 2011

Source: Figures from The Norwegian Petroleum Directorate (2013a), p. 22, own illustration

As can be seen from the figure above, the petroleum tax system, SDFI and the Statoil dividends account for 99 per cent of the Norwegian State's net cash flow from the petroleum activities. The remaining one per cent denoted as "Other" consists of environmental fees and area fees.[26]

Dividends from Statoil

The share of dividends that the Norwegian State receives from Statoil corresponds to its ownership share which is currently at 67 per cent.[27]

[26] Norwegian Petroleum Directorate (2013a), p. 22.
[27] Statoil (2013).

The State's Direct Financial Interest (SDFI)

As previously mentioned, The State's Direct Financial Interest (SDFI) is a policy adopted in 1985, implying that the Norwegian State participates as an investor in production licences on the Norwegian continental shelf. As an investor, the Norwegian State pays a share of all investments and operating costs corresponding to its ownership share in each field, and is naturally entitled to a matching share of the revenues generated from the fields. Until 1993, SDFI was required to own a 50 per cent share in each production license. However, this principle was changed in 1993 and SDFI now makes an individual assessment of each production license with respect to ownership.[28] In addition, SDFI now also has direct financial interests in joint ventures for pipelines and onshore facilities.[29]

As of 31 December 2012, the Norwegian State had ownership shares in 158 production licences[30], and per 1 January 2012, Wood Mackenzie estimated the value of the SDFI portfolio to some 1,140 BNOK.[31] As can be seen in figure 2-1, SDFI accounted for 122.7 BNOK or around 35 per cent of the total net cash flow from petroleum activities in 2011.

Petroleum tax system

Since the petroleum companies with production licences gain free access to a resource with an extraordinarily high return, an extraordinary tax rate of 78 per cent is levied on revenue generated from the petroleum resources. The extraordinary tax rate contributes to ensuring that the Norwegian population, as owners of the petroleum resources, can reap the benefits of the petroleum resources. As seen in figure 2-1, the petroleum tax system contributes to a substantial share of the Norwegian State's total income from the petroleum sector.

Figure 2-2 on the next page shows the annual development of the three main revenue channels in addition to the intra-year revenue distribution from 1993 to 2011. The figure illustrates that the taxes from the petroleum sector have been a substantial part of the revenue from the petroleum sector over the last 20 years. The importance of a well-functioning petroleum tax system is then evident.

[28] Norwegian Petroleum Directorate (2013a), p. 10.
[29] Petoro (2013).
[30] Petoro (2013).
[31] Wood Mackenzie (2012).

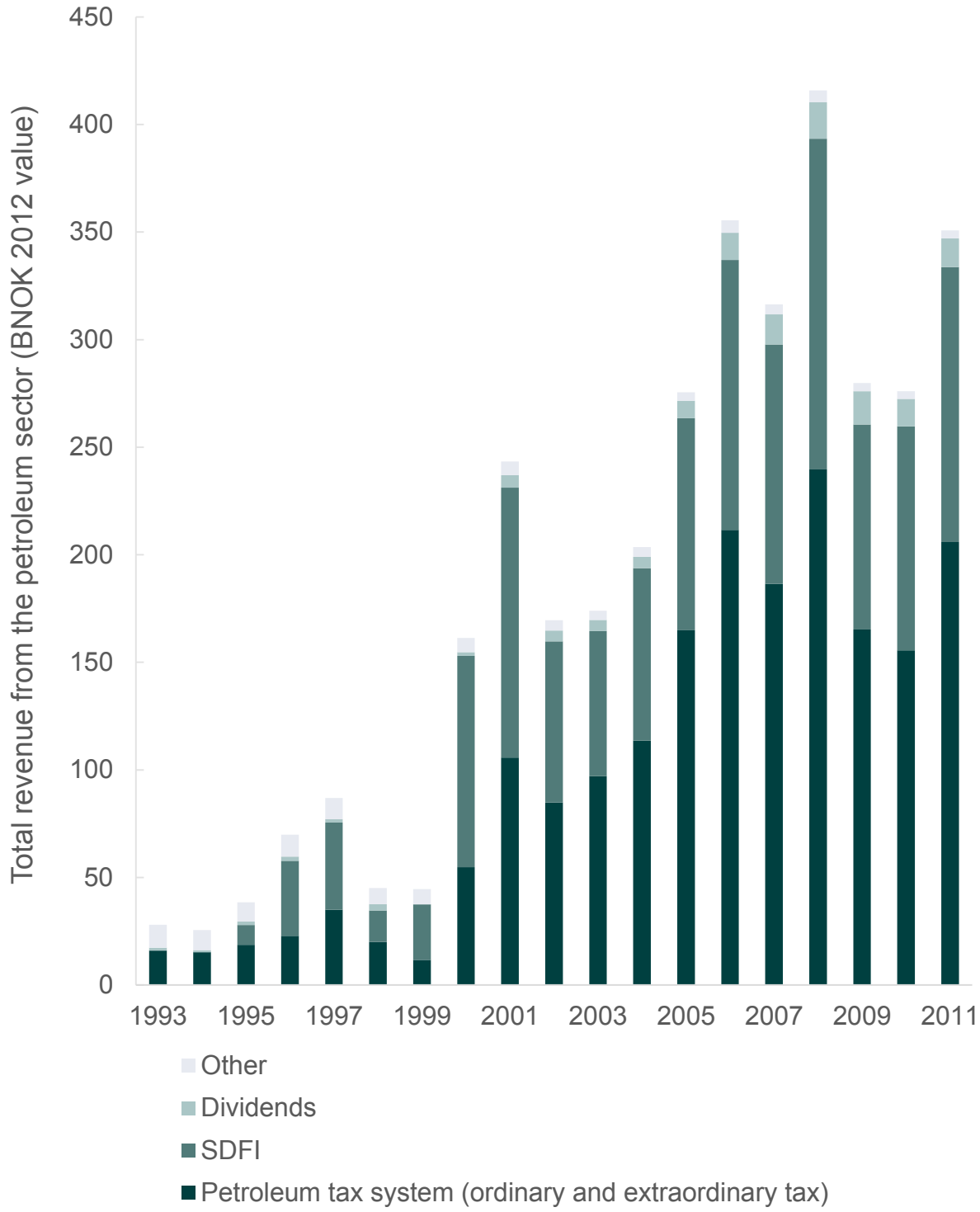

Figure 2-2: Development of Norwegian State revenue from the petroleum sector from 1993 to 2011

Source: Figures from The Norwegian Petroleum Directorate (2013a), p. 138, own illustration

2.2 The Petroleum Taxation Act

2.2.1 Extraordinary tax rate

The Norwegian Petroleum Taxation Act was enacted in 1965 and concerns taxation of exploration and extraction of subsea petroleum resources, and associated activities including pipeline transport of extracted petroleum.[32] The first revision of the act stated that the petroleum companies were to be taxed according to the principles of the general tax law, but in addition, they were subject to pay certain fees. The reasoning for the lack of an extraordinary tax rate was that there was still great uncertainty with respect to the amount of petroleum resources on the Norwegian continental shelf. Accordingly, there were high risks involved in exploration activities at the time, and the authorities wanted to avoid extraordinary taxation in order to stimulate investment.[33]

After the first year of ordinary petroleum production in 1975, it was clear that the Norwegian continental shelf was much more valuable than first anticipated. Together with rising petroleum prices, the need for investment stimulation was therefore no longer prevalent. This enabled the authorities to introduce an extraordinary tax rate of 25 per cent on revenue generated from petroleum extraction and subsea transport. Together with the corporate tax rate of 50.8 per cent at the time, the petroleum companies faced a marginal tax rate of 75.8 per cent.[34]

After 1975, the extraordinary tax rate was subject to several changes. During the 1980s, it was both increased and decreased due to fluctuating petroleum prices. In 1992, when the corporate tax rate in Norway was changed to today's 28 per cent, the extraordinary petroleum tax rate was increased to 50 per cent. This meant that the petroleum companies faced a marginal tax rate of 78 per cent.[35] This is also the case today, and the calculation of the net income taxable by 78 per cent is shown in figure 2-3 on the next page.

[32] Petroleum Taxation Act, § 1.
[33] NOU 2000: 18, p. 112.
[34] NOU 2000: 18, p. 112.
[35] NOU 2000: 18, pp. 112-114.

Operating income	
-	Operating expenses
-	Linear depreciation for investments (6 years)
-	Exploration expenses, R&D and decommissioning
-	CO_2-tax, NO_x-tax and area fee
-	Net financial costs
=	Corporation tax base (tax rate: 28%)
-	Uplift (7.5% of investment for 4 years)[36]
=	**Special tax base (tax rate: 50%)**

Figure 2-3: Deriving net income taxable by extraordinary tax rate

Source: The Norwegian Petroleum Directorate (2013a), p. 17

The capital taxation in Norway is based on the symmetry principle, implying that revenues and corresponding costs are treated equally when it comes to periodization, tax rate and deductibility.[37] As stated in The Petroleum Taxation Act § 5, income allocated offshore is taxable by 78 per cent. From the symmetry principle, it then follows that corresponding costs are also deductible by 78 per cent, including interest expense on debt (as seen in figure 2-3).

The 78 per cent tax deductibility on interest expense makes financing by debt a strongly favourable instrument to reduce overall tax payments. This can motivate to so-called thin capitalisation where a company has a high proportion of debt in relation to equity.[38] The issue of thin capitalisation in the Norwegian petroleum sector has been a governmental concern for decades, and different thin-capitalisation rules that aim to reduce the strong debt-financing incentive have been in place since 1994.[39, 40]

[36] The uplift deduction is designed to shield normal return on investment from the extraordinary tax, amounting to 7.5 per cent per year for four years, totalling 30 per cent of the investments. *Source: Norwegian Petroleum Directorate (2013a), p. 16.*

[37] St. meld. nr. 29 (2003-2004), p. 49.

[38] Dourado and de la Feira (2008), p. 1.

[39] NOU 2000:18, pp. 114 and 163.

[40] In Norway, the issue of thin capitalisation due to intra-company borrowing outside the petroleum sector has recently gained increased attention. In April 2013, Ministry of Finance sent out a hearing where they proposed the implementation of thin-capitalisation rules to restrict the use of internal debt in all Norwegian companies except for companies in the petroleum sector. *Source: Finansdepartementet (2013).*

2.2.2 Interest deductibility and thin-capitalisation regulation

Thin-capitalisation rules aim to reduce the problem of thin capitalisation typically by denying tax deductibility on debt exceeding a permissible threshold.[41] Three different thin-capitalisation rule regimes have been applied to the Norwegian petroleum sector, and in the following they will be presented in chronological order.

Before 1994

Before 1994, the allocation of interest expense between offshore and onshore activities was regulated by § 3 d in the Petroleum Taxation Act. This stated that the net financial costs (i.e. financial costs less financial income)[42] should be proportionately allocated according to the net income[43] in each district. In practice, this meant that the share of interest expense allocated offshore corresponded to the offshore activity's share of the company's total net income. The remaining share was allocated onshore.[44]

There were no explicit thin-capitalisation rules at the time, but § 13-1 in the Norwegian Taxation Act stated that the tax authorities could make a discretionary evaluation of a company's income and balance sheet in the cases where a company had common interests with another party. If applicable, this meant that a company's income or balance sheet was adjusted as if there were no common interests.[45, 46]

In the petroleum sector, § 13-1 would typically be used in cases of abusive transfer pricing or thin capitalisation resulting from extensive use of internal debt. In the case of thin capitalisation by internal debt, the internal debt could be reclassified to equity if the debt exceeded the amount of debt a company could obtain in the market.[47]

[41] See Dourado and de la Feira (2008), table 1.

[42] NOU 2000:18, pp. 169-170 states special cases of financial income that should not be included in the net financial costs. This was for example dividends from other companies where the stocks were not directly related to petroleum extraction.

[43] The Petroleum Taxation Act defined *net income* as *income after deduction of offshore losses*. This is explained in further detail in NOU 2000: 18, p. 108.

[44] NOU 2000: 18, pp. 169-172.

[45] Prop. 1 LS (2013-2014), p. 105.

[46] This regulation is still in place today under § 13-1.

[47] Prop. 1 LS (2013-2014), p. 105.

The 1994 regime

In 1992, a new tax reform was enacted in Norway. The tax reform, together with an accounting reform enacted in the same year, turned out to have unintended effects as they led petroleum companies to increase their leverage substantially.[48] As a result, the first explicit thin-capitalisation rule in Norwegian tax law was enacted in the form of § 3 h in the Petroleum Taxation Act in 1994.[49] The regulation stated that companies subject to the extraordinary tax rate were required to have a fiscal equity-to-asset share of at least 20 per cent (equivalent to a total debt-to-asset ratio of maximum 80 per cent). If a company had a total debt-to-asset share over 80 per cent, only a proportionate share of the *net financial costs* (as defined before 1994) allocated offshore would be eligible for the 78 per cent tax deduction. This share was then calculated by the following formula:

$$Offshore\ deduction = \frac{Net\ financial\ costs}{allocated\ offshore} \cdot 80\% \cdot \frac{Total\ capital}{Debt}.$$ [50]

As stated above, the 1994 thin-capitalisation rule applied to net financial costs *allocated offshore*. Thus, the allocation rule in § 3 d allocating interest expenses between offshore and onshore was still in effect, meaning that the new thin-capitalisation rule was applied after a company's net financial costs had been adequately allocated offshore.

In addition, the third paragraph in § 3 h stated that if the company in question was financed by debt from related parties (i.e. internal debt), the tax authorities first had to decide whether § 13-1 in the general tax law was applicable. If § 13-1 implied that some or all of internal debt was to be considered as equity, the corrected annual report would then be the basis for the thin-capitalisation rule in § 3 h.[51] If the company still had a debt-to-asset share of over 80 per cent, the interest expense on the exceeding debt would be reduced accordingly.

To clarify the effects of the 1994 rules, a simple example with arbitrarily chosen numbers may be helpful: Company A has a total capital of 100, with 90 being debt[52] and the remaining 10 being equity. Its net income related to offshore activities is 40, while

[48] Innst. O. nr. 17 (1994-1995), section 1.

[49] NOU 2000:18, p. 114.

[50] Ot.prp. nr. 1 (2006-2007), p. 103.

[51] Note that this correction was only for taxation purposes and thus the affected companies' official accounts remained unchanged.

[52] To keep things simple, we assume that this is only external debt so that § 13-1 does not come into play.

net income related to onshore activities is 10. Additionally, it pays 10 per cent interest on its debt and has financial income of 2.

Company A's resulting net financial costs amount to $10\% \cdot 90 - 2 = 7$. Using § 3 d, the share of this allocated offshore amounts to $7 \cdot \frac{40}{40+10} = 5.6$. Since company A has an equity-to-asset share of less than 20 per cent, the thin-capitalisation rule in § 3 h must be applied. Using the formula on the previous page gives us

$$Offshore\ deduction = 5.6 \cdot 80\% \cdot \frac{100}{90} \approx 5.$$

As opposed to before 1994 where company A would get a 78 per cent deduction for 5.6 of its net financial costs, the 1994 thin-capitalisation rule reduced this to 5 since company A was thinly capitalised.

The regulations under 1994 regime can be summarised by figure 2-4 below.

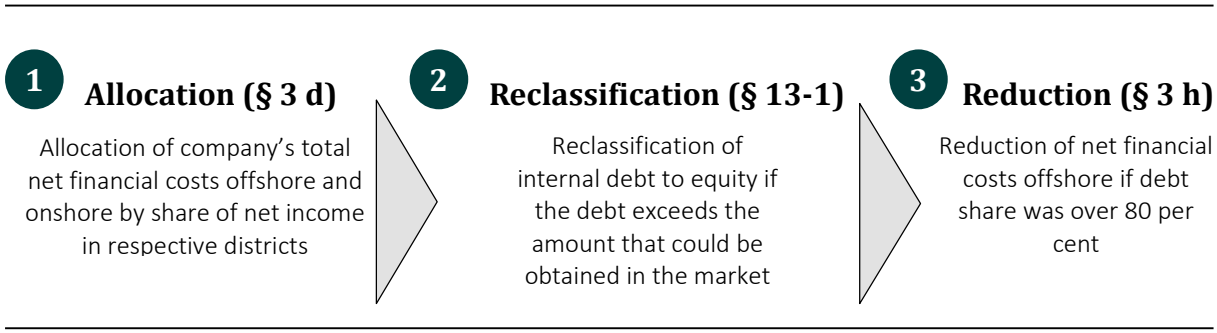

Figure 2-4: Allocation, reclassification and reduction of net financial costs under the 1994 regime
Source: Own illustration

§ 3 d allocated the total net financial costs between the offshore and onshore districts. If applicable, § 13-1 could reclassify internal debt to equity and finally § 3 h reduced the deductible net financial costs offshore if the total debt-to-asset ratio was over 80 per cent.

The 2002 regime

Due to the extraordinarily high return on investment from offshore activities, the allocation rule in § 3 d based on net income in the respective districts was often biased in relation to the actual capital invested offshore. This often enabled the companies to get a full interest deduction offshore, even for interest expenses that in reality were associated with onshore activities.[53] To remove this allocation bias, the allocation rule in § 3 d was modified in 2002. The allocation would now be proportionate to a specified share of asset values offshore and onshore.[54] Since debt is most often incurred to finance investments which in turn create asset values, the new allocation rule based on asset values was therefore viewed as an improvement over the old one.[55]

In addition to the new allocation rule, § 3 h was also modified. Previously, the amount of deductible net financial costs was reduced if a company had an equity share below 20 per cent. This reduction rule was also in place under the 2002 regime, but in addition, if a company had an equity share *over* 20 per cent, the amount of deductible net financial costs would be *increased.* The offshore deduction following such an increase was calculated using the following formula:

$$Offshore\ deduction = \frac{Net\ financial\ costs}{allocated\ offshore} \cdot \frac{Interest\text{-}bearing\ debt + Equity\ over\ 20\%}{Interest\text{-}bearing\ debt}.$$ [56]

This formula for upwards adjustment was similar, but not parallel to the unmodified reduction formula from 1994. The main difference in the case of an increase was the use of *interest-bearing debt* instead of total debt. Additionally, the numerator in the fraction was not total capital, but instead interest-bearing debt plus the amount of equity above the 20 per cent equity-to-asset limit. Note also that the upwards adjustment was naturally limited to 100 per cent of a company's total net financial costs offshore and onshore.[57]

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[53] Ot.prp. nr. 86 (2000-2001), p. 29.

[54] The formal definition of the allocation parameter was the *"amortised value of specified assets used for taxation purposes"* or *"skattemessig nedskrevet verdi av nærmere angitte formuesobjekter*" in Norwegian. *Source: Ot.prp. nr. 1 (2006-2007), p. 102.*

[55] Ot.prp. nr. 86 (2000-2001), p. 31.

[56] Ot.prp. nr. 1 (2006-2007), p. 103.

[57] Ot.prp. nr. 1 (2006-2007), p. 103.

To see the effects of the modified § 3 h thin-capitalisation rule as well as the new allocation formula in § 3 d more clearly, we illustrate with another example with arbitrarily chosen numbers: Company B has a total capital of 100, with 70 being debt[58] and the remaining 30 being equity. We assume that 60 of its total debt is interest-bearing debt and 10 is non-interest-bearing. It pays 10 per cent interest on its interest-bearing debt and has financial income of 2. Its specified asset value used for the allocation rule offshore is 60 while the corresponding figure onshore is 15.

Company B's resulting net financial costs amounts to $10\% \cdot 60 - 2 = 4$. Using the new allocation rule in § 3 d, the share of this allocated offshore amounts to $4 \cdot \frac{60}{60+15} = 3.2$. Since company B has an equity share above 20 per cent, the upwards adjustment rule in § 3 h must be applied. Using the formula on the previous page gives us

$$Offshore\ deduction = 3.2 \cdot \frac{60 + 10}{60} \approx 3.7.$$

We see that in comparison to the 1994 rules, a company would now get its net financial costs allocated according to a different parameter, and be eligible for an upwards adjustment of the net financial costs allocated offshore if its equity-to-asset ratio was above 20 per cent. Thus, with the upwards adjustment rule in § 3 h, one could argue that the strong debt-financing incentive was to a certain extent diminished.

The regulations under the 2002 regime can be summarised by figure 2-5 below.

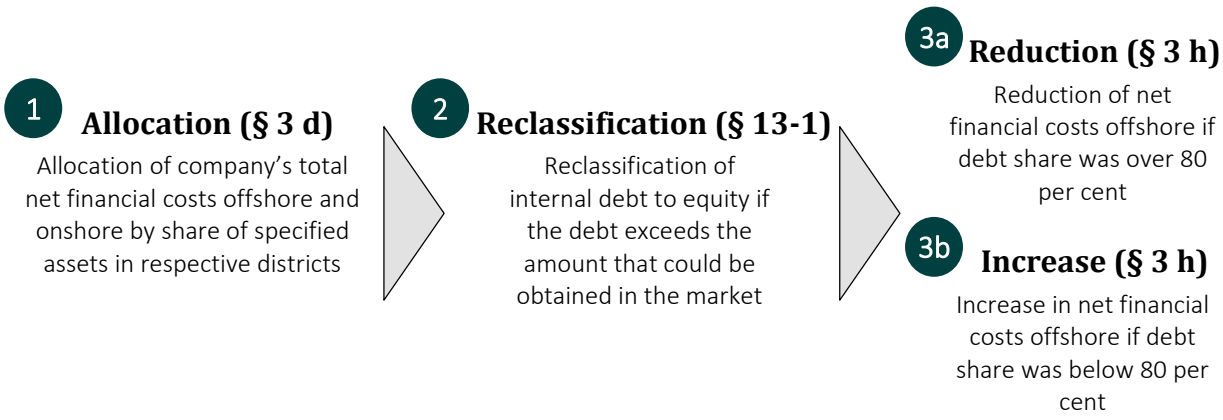

Figure 2-5: Allocation, reclassification and reduction or increase in net financial costs under the 2002 regime

Source: Own illustration

[58] Again, to keep things simple we assume that this is only external debt so that § 13-1 does not come into play.

The 2007 regime

Despite the modification of the thin-capitalisation rule in § 3 h and the allocation rule in § 3 d, both rules still had weaknesses: The allocation parameter introduced in 2002 was complex and hard to define in practice, and both § 3 d and § 3 h were directly tied to accounting figures. This gave the petroleum companies incentives to influence their accounting in a way that could affect tax payments.

Since the thin-capitalisation rule in § 3 h was based on accounting figures, petroleum companies could conduct equity transactions in order to increase offshore deductions. For instance, a company could pay out its dividends payable as an extraordinary dividend payment before the end of the fiscal year. Since the reduction rule in § 3 h was based on total debt, the reduction in dividends payable increased the company's offshore deductions.[59]

Finally, the thin-capitalisation rule did not take potentially large non-interest-bearing liabilities (for petroleum companies, typically deferred tax and provisions)[60] into account. In some cases, this led to a situation where a company with a debt-to-asset ratio above 80 per cent would get a greater interest deduction offshore than a comparable company with a debt-to-asset ratio of 80 per cent. The following example from Ot.prp. nr. 1 (2006-2007) illustrates this problem:

Balance company A			
Offshore assets	100	20	Equity
		40	Non-interest bearing debt
		40	Interest-bearing debt (4%)
	100	100	

$$Offshore\ deduction = 40 \cdot 4\% = \mathbf{1.6}$$

Balance company B			
Offshore assets	100	10	Equity
		40	Non-interest bearing debt
		50	Interest-bearing debt (4%)
	100	100	

$$Offshore\ deduction = 50 \cdot 4\% \cdot 80\% \cdot \frac{100}{90} = \mathbf{1.78}$$

By substituting equity with interest-bearing debt, company B increased its interest expenses, but was at the same time subject to the thin-capitalisation rule in § 3 h, which decreased the offshore deduction. However, there was a net increase in offshore deduction compared to company A because the relative increase in interest expenses was larger than the relative increase in total debt. Thus, not taking the composition of

[59] Ot.prp. nr. 1 (2006-2007), p. 103.

[60] See e.g. annual reports for A/S Norske Shell and Total E&P Norge AS.

the liabilities into account meant that a petroleum company in some cases had an incentive to be thinly capitalised (i.e. a debt-to-asset ratio of over 80 per cent).[61]

These weaknesses contributed to the removal of both the allocation rule in § 3 d as well as the thin-capitalisation rule in § 3 h in favour of a new rule which now follows from § 3 d in the Petroleum Taxation Act: "*Net financial costs incurred on interest-bearing debt are deductible. These shall comprise the sum of interest costs and foreign exchange losses, less foreign exchange gains, pertaining to such debt. The deductible shall equal such proportion of the net financial costs of the company as corresponds to 50 percent of the ratio between the value, net of tax depreciation as per 31 December of the tax year, of assets attributed to the shelf district and the average interest-bearing debt over the tax year. A corresponding proportion of net financial income shall be recorded as income if foreign exchange gains exceed the sum of interest costs and foreign exchange losses pertaining to interest-bearing debt.*"[62, 63]

The new § 3 d implies that the petroleum companies can claim a 78 per cent tax deduction on a share of their net financial costs[64]. The share of the costs that is deductible offshore is decided by the relation between 50 per cent of end-of-year specified asset values offshore[65, 66], net of tax depreciation, and total interest-bearing debt for the whole company (offshore and onshore). More mathematically, this can be stated as

$$Offshore\ deduction = \begin{pmatrix} Interest\ expenses - \\ net\ currency\ gains \\ on\ interest\text{-}bearing\ debt \end{pmatrix} \cdot \frac{50\% \cdot Assets\ offshore}{Average\ interest\text{-}bearing\ debt}.$$ [67]

[61] Ot.prp. nr. 1 (2006-2007), p. 104.

[62] English translation from Ministry of Finance (2008).

[63] Original text from The Petroleum Taxation Act, § 3 d: «*Det gis fradrag for netto finanskostnader påløpt på rentebærende gjeld. I dette inngår summen av rentekostnader og valutatap fratrukket valutagevinster på gjelden. Fradraget settes til andelen av selskapets netto finanskostnader som svarer til 50 prosent av forholdet mellom skattemessig nedskrevet verdi per 31. desember i inntektsåret av formuesobjekter tilordnet sokkeldistriktet og gjennomsnittlig rentebærende gjeld gjennom inntektsåret. Hvis valutagevinster overstiger summen av rentekostnader og valutatap på rentebærende gjeld, skal en tilsvarende andel av netto finansinntekter tas til inntekt.».*

[64] With net financial costs defined by the legal text in § 3 d as interest expenses less net currency gains on interest-bearing debt.

[65] For an elaboration on which assets are included in this definition, see the third paragraph in the Petroleum Taxation § 3 d.

[66] Henceforth "assets offshore".

[67] Note that "average interest-bearing debt" in the denominator is the average interest-bearing debt over the fiscal year for the whole company.

This formula implies that if the value of a petroleum company's assets offshore is twice as large as the company's total average interest-bearing debt, the fraction will equal one and thus 100 per cent of net financial costs are eligible for 78 per cent deduction. However, if total average interest-bearing debt is over 50 per cent of assets offshore, the fraction will be smaller than one and the offshore deduction will be reduced. Conversely, if average interest-bearing debt is under 50 per cent of assets offshore, the fraction will be larger than one and the offshore deduction will be increased. Thus, the new rule adjusted the offshore deduction both upwards and downwards depending on the leverage, implying that the new rule incorporated both the reduction formula and the upwards adjustment in the 2002 regime with a threshold for interest-bearing debt at 50 per cent of assets offshore.[68] As with the upwards adjustment rule in 2002, the upwards adjustment was in 2007 also limited to 100 per cent of a company's total net financial costs.[69]

An important thing to notice about the 2007 rule is that contrary to the definition of net financial costs in 1994 and 2002, the 2007 definition did not include financial income. This meant that financial income would always be taxed at 28 per cent, which represented a tax relief for the petroleum companies.[70, 71]

The reasoning behind the 50 per cent figure is stated in the preparatory work for § 3 d. The legislators argued that this would imply that the Norwegian State's total petroleum tax revenue would largely be the same as before. [72] This meant that in principle, the new rule was not intended to increase the State's total petroleum tax revenue – only remove the weaknesses and reduce the complexity of the old rules.

We can illustrate the 2007 rule by a simple example (again with arbitrarily chosen numbers): Company C has assets offshore worth 100, financed (on average) by an

[68] Note that this threshold targeted interest-bearing debt in relation to assets offshore while the 80 per cent threshold under the 1994 and 2002 regimes targeted total debt in relation to total capital. Thus, these two thresholds cannot be directly compared.

[69] Ot.prp nr. 1 (2006-2007), pp. 110.

[70] Ot.prp. nr. 1 (2006-2007), p. 109.

[71] An exception (stated in the last sentence in the law text on the previous page) was if foreign exchange gains exceeded the sum of interest costs and foreign exchange losses.

[72] Ot.prp nr. 1 (2006-2007), pp. 114-115.

interest-bearing debt of 80[73] and equity of 20. Its onshore interest-bearing debt amounts (on average) to 50 and it pays 10 per cent interest on the interest-bearing debt both offshore and onshore. The net currency gain amounts to 2, resulting in net financial costs equal to $10\% \cdot (80 + 50) - 2 = 11$.

Using the new § 3 d and the formula on the previous page, the amount of net financial costs deductible offshore amounts to

$$Offshore\ deduction = 11 \cdot \frac{50\% \cdot 100}{80 + 50} \approx 4.2.$$

We see that the amount of net financial costs deductible offshore is significantly lower than 11 even though the majority of Company C's interest-bearing debt is offshore. This is due to the thin-capitalisation component in the 2007 rules that reduces the offshore deduction because of the relatively high total interest-bearing debt. The remaining net financial costs will be allocated onshore and thus tax deductible by the ordinary corporate tax rate of 28 per cent.

The regulations under the 2007 regime can be summarised in figure 2-6 below.

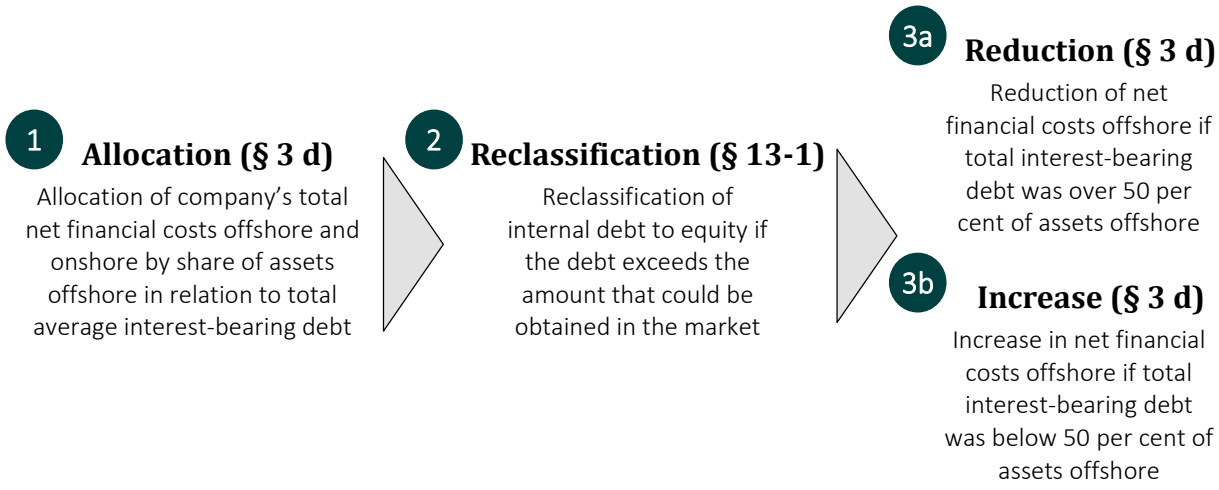

Figure 2-6: Allocation, reclassification and reduction or increase in net financial costs under the 2007 regime
Source: Own illustration

[73] Again, to keep things simple we assume that this is only external debt so that § 13-1 does not come into play.

Summary

There have been three thin-capitalisation rule regimes in the Norwegian petroleum sector. The thin-capitalisation rule introduced in 1994 reduced a petroleum company's deductible net financial costs offshore if its total debt-to-asset ratio exceeded 80 per cent. Under the 2002 regime, the reduction rule from 1994 was still in place, but in addition, the deductible net financial costs offshore would be increased if a petroleum company's total debt-to-asset ratio was below 80 per cent. Under both the 1994 and 2002 regimes, there were also allocation mechanisms in place that allocated the petroleum companies' total net financial costs offshore and onshore. Under the 1994 regime, the allocation parameter was based on the net income in each district, while under the 2002 regime the parameter was based on (specified) asset values.

The current regime introduced in 2007 combined both the reduction and upwards adjustment rule as well as the allocation parameter into one single formula. The allocation offshore is now decided by the share of (specified) assets offshore relative to a petroleum company's total average interest-bearing debt. If the total average interest-bearing debt is over 50 per cent of the value of assets offshore, deductible net financial costs offshore will be reduced. If the opposite is the case, deductible net financial costs offshore will be increased.

Chapter 3: Theoretical modelling

The chapter is organised as follows: In section 3.1 we present a brief overview of the standard theory on optimal capital structures and in section 3.2 we present a theoretical framework for the economic effects of thin-capitalisation rules targeting internal debt. This serves as the basis for section 3.3, where we adapt the standard theory to the features of the thin-capitalisation rule regimes in the Norwegian petroleum sector. The corresponding optimal capital structure under each regime is then presented and discussed in section 3.4. Finally, on the basis of our results, we provide some predictions on what we expect to see empirically in section 3.5. An overview of the notations in this chapter is provided in section 6.2 in the appendix.

3.1 Standard capital structure framework

3.1.1 Basis for theoretical framework

We largely adopt the same capital structure framework as Møen et al. (2011) with a price-taking multinational company (MNC) with affiliates in $i = 1, \dots, n$ countries. A basic overview of affiliate i is shown in figure 3-1 below.

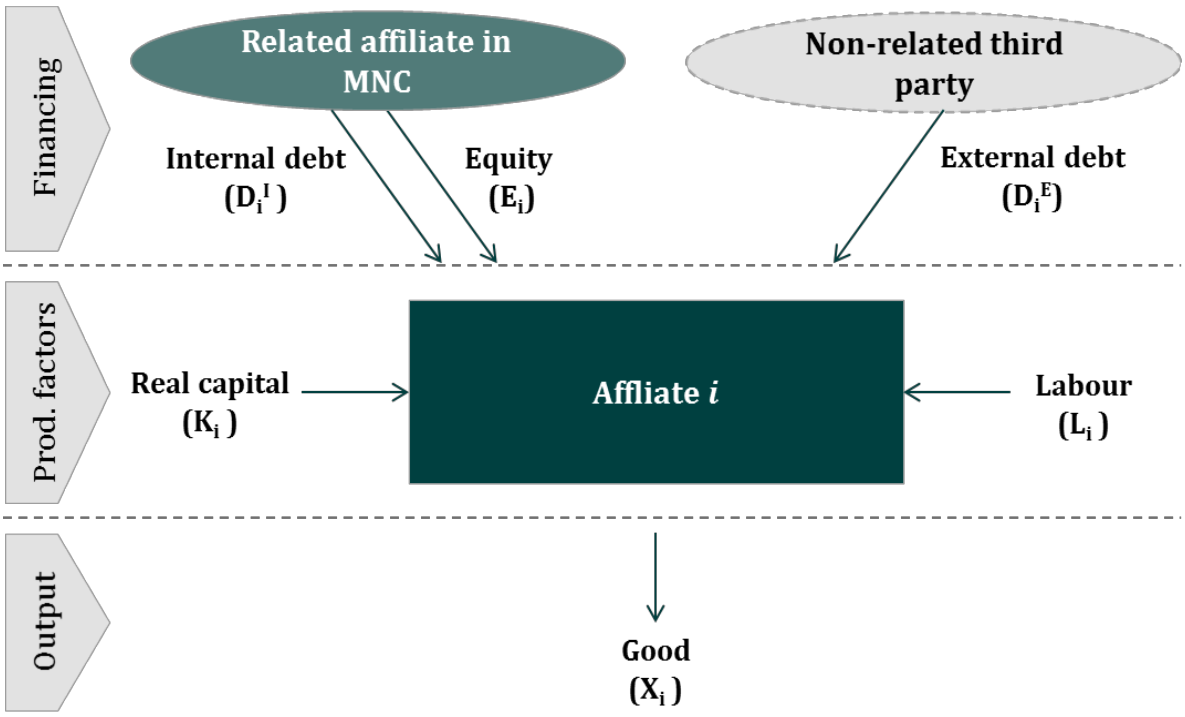

Figure 3-1: Basic overview of affiliate i in the multinational company used in the standard theory

Source: Own illustration

Each affiliate is financed by debt (D_i) and equity (E_i), where the debt can either be external (D_i^E) from non-related third parties or internal (D_i^I) from related affiliates within the MNC. The respective affiliates produce a homogenous good, X_i, with two fixed production factors: real capital (K_i) and labour (L_i). The parent is a pure holding firm domiciled in country p, and has direct and full ownership in all its affiliates, where each affiliate faces a country-specific corporate tax rate, t_i. Capital is assumed to be perfectly mobile, and the MNC provides each affiliate with the equity necessary to reach both a tax-efficient capital structure as well as the optimal level of real capital.[74]

3.1.2 Defining the features of equity and debt

In this section we build upon the basic framework above and describe the main distinctions between equity, external debt and internal debt, as well as their corresponding features.

The classic trade-off theory between equity and debt

In the choice between equity and debt in a world with perfect capital markets, the classic Miller-Modigliani capital structure irrelevance proposition (proposition I) argues that a firm should be indifferent between the two.[75] The model we use, however, incorporates the fact that there are real-world imperfections that bias this choice.

We assume that there is a positive and constant cost of capital ($r > 0$) given exogenously (i.e. the small country assumption).[76] However, costs of equity and interest expenses on debt are taxed differently since only the interest expense on debt is tax deductible. The resulting debt tax shield can be defined as the tax savings generated by the deductibility of interest expense on debt.[77] With a corporate tax rate of t, the debt tax shield can formally be defined as $t \cdot r \cdot D$.[78]

Since costs of equity are not tax deductible, there is a clear tax benefit of using debt due to the debt tax shield. This results in a trade-off between the debt tax shield and the costs of debt in order to establish an optimal debt level, leading to a higher level of debt

[74] Møen et al. (2011), pp. 5-6.
[75] Modigliani and Miller (1958), p. 268.
[76] Møen et al. (2011), p. 5.
[77] Ruf and Schindler (2012), p. 2.
[78] Berk and DeMarzo (2011), p. 480.

than without the debt tax shield.[79] The trade-off applies to both external and internal debt, but these two types of debt have certain properties that distinguish them from another as will be described in the following sections.

External debt

Using the general definition on the previous page, we define the debt tax shield for external debt in affiliate i formally as

$$t_i \cdot r \cdot D_i^E,$$

which is interpreted as the saved tax payments in affiliate i resulting from the tax deduction of interest expense on external debt.[80]

Aside from the debt tax shield, there are other benefits as well as costs associated with using external debt. Such benefits can be a reduction of the agency costs[81] that arise when the agents (i.e. the management of a firm) do not act according to the principals' (i.e. the firm's owners) best interests. For example, when companies generate substantial cash flows, managers can be tempted to invest in projects with a return below the cost of capital, reducing company value.[82] By issuing external debt, owners can reduce the cash flow available for investment, thereby decreasing the risk of management investing in unprofitable projects and thus also the agency costs.[83] However, the fixed claim represented by the interest expenses on the external debt can at the same time increase the risk of bankruptcy since the interest has to be paid regardless of the company's state (as opposed to equity costs).[84] For simplicity, we group these other benefits and costs (i.e. benefits and costs excluding the debt tax shield) under the term *net costs of external debt*[85], C^E.[86]

[79] Also called the "trade-off theory" as described by Kraus and Litzenberger (1973).

[80] Extracted from the profit functions in Møen et al. (2011).

[81] For an elaboration on agency costs, see Jensen and Meckling (1976).

[82] Also known as "the free cash-flow problem".

[83] Jensen (1986).

[84] Kraus and Litzenberger (1973).

[85] From here on referred to as "costs of external debt".

[86] Møen et al. (2011, p. 7) also include and define bankruptcy costs for the parent company as costs of external debt, since the parent is assumed to guarantee the debt of its affiliates. For simplicity we exclude this feature.

Using the same approach as Møen et al. (2011), we assume that the cost variable is convex for the external debt-to-asset ratio defined as $b_i^E \equiv \frac{D_i^E}{K_i}$, positive for all b_i^E and proportional to capital employed. The optimal external debt level in absence of taxation (b_i^{E*}) then lies at the point where the costs of external debt are minimised. The properties of the costs of external debt can therefore be summarised formally as

$$C^E(b_i^E) > 0 \text{ with } \frac{\delta C^E}{\delta b_i^E} < 0 \text{ and } \frac{\delta^2 C^E}{\partial (b_i^E)^2} > 0 \text{ if } 0 \leq b_i^E < b_i^{E*},$$

$$C^E(b_i^E) > 0 \text{ with } \frac{\delta C^E}{\delta b_i^E} \geq 0 \text{ and } \frac{\delta^2 C^E}{\partial (b_i^E)^2} > 0 \text{ if } b_i^E \geq b_i^{E*},$$

In order to reach an optimal level of external debt, the marginal cost of external debt is balanced against the marginal external debt tax shield (i.e. the marginal external debt benefit). Since the marginal external debt tax shield is positive, the optimal level of external debt taking taxation into account, b_i^{E**}, will therefore be larger than b_i^{E*} above.[87] This is shown graphically in figure 3-2 below.

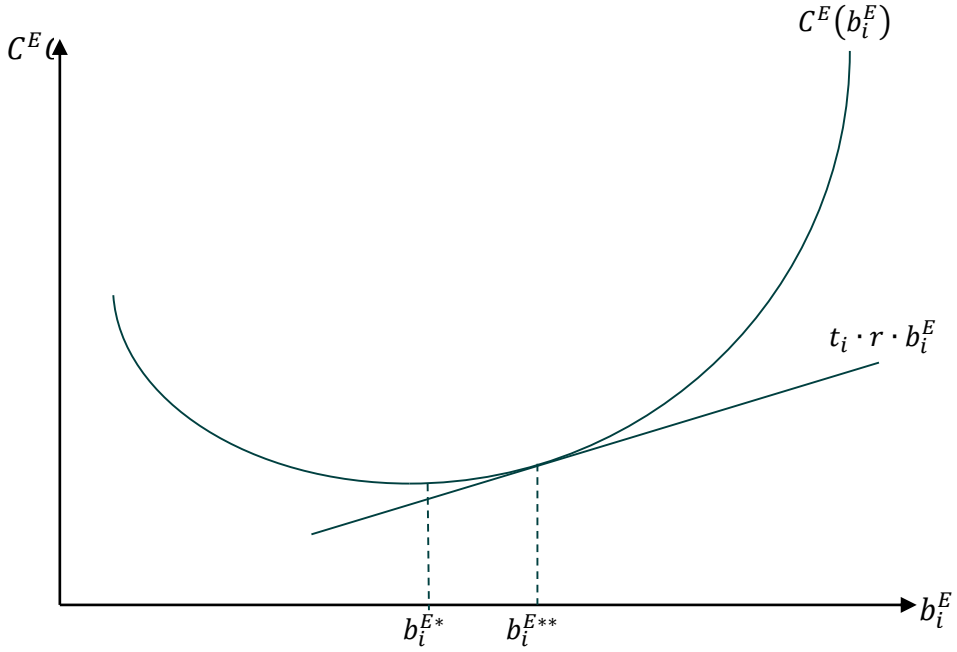

Figure 3-2: Optimal level of external debt with and without taxation

Source: Own illustration

[87] I.e. the standard economic result of $MR = MC$.

Internal debt

Buettner and Wamser (2013, pp. 66-67) group the motivation for the use of internal debt into two categories. As described in the section on external debt, the use of debt has certain benefits such as the debt tax shield as well as a reduction of agency costs. If an affiliate faces specific risks that limit its access to external debt, the MNC can resort to internal debt instead. One motivation for the use of internal debt is therefore to reap the benefits of external debt if access to external debt financing is limited.

The other category of motivation is the one we focus on in this thesis, namely tax arbitrage and profit shifting. Due to the different tax rates across the countries where the MNC has its affiliates, the MNC can increase its world-wide profit by letting an affiliate facing a relatively low tax rate provide loans to affiliates facing a relatively high tax rate.[88] The interest expense charged on the internal loans is deducted from the high-tax affiliates' tax base, transferred to the internal bank and taxed at a lower tax rate in the internal bank. Since the tax deduction is higher for the interest expense than the tax payment for the interest income, this results in a net gain for the MNC. This effectively enables the MNC to shift profits from high-tax affiliates to low-tax affiliates, thereby increasing its world-wide profit.[89] Defining the internal bank's country as country 1, we can then define the resulting internal debt tax shield as

$$(t_i - t_1) \cdot r \cdot D_i^I.$$ [90]

From this definition, we see that a profit-maximising MNC will maximise its profits when the tax rate differential between the internal bank and the borrowing affiliates is maximised. It therefore follows that the internal bank will be located in the country facing the lowest corporate tax rate.[91]

An important feature to note from the definition of the internal debt tax shield is that for the same amount of debt and interest rate, the external debt tax shield is always equal to or greater than the internal debt tax shield. This is because the shifted interest expense

[88] The equity in the borrowing affiliate is then substituted with internal debt.
[89] Buettner and Wamser (2013), pp. 66-67.
[90] Extracted from the profit functions in Møen et al. (2011).
[91] Buettner and Wamser (2013), p. 67.

must show up as interest income in the internal bank and is taxed according to the corporate tax rate in country 1.[92, 93]

In addition, since the sum of interest expenses over all borrowing affiliates (i.e. affiliates $i > 1$) must show up as equally large interest income in the internal bank, this also implies that the sum of total interest paid and received over all affiliates must equal zero. This gives us the following formal constraint:

$$\sum_{i=1}^{n} r \cdot D_i^I = \sum_{i=1}^{n} r \cdot b_i^I \cdot K_i = 0.\,^{94}$$

By shifting profits from affiliates in high-tax countries to an internal bank using internal debt, the high-tax affiliates' tax base will be reduced. This negatively impacts the corporate tax income in the countries where the high-tax affiliates are located. In many cases, an affiliate will therefore face government regulations that limit the benefits of internal debt. In order to conceal tax-evasion activities and circumvent these regulations, an MNC can therefore incur so-called concealment costs when using internal debt.[95, 96] In other words, there are also costs involved with internal lending. Typically, the regulations are either thin-capitalisation rules or controlled-foreign-company rules (CFC rules).[97] Since the latter are neither used in the Norwegian petroleum sector nor the focus of this thesis, we limit the following discussion to thin-capitalisation rules only.

[92] This can also be seen explicitly when formally comparing the internal and external debt tax shields:
$(t_i - t_1) \cdot r \cdot D_i^I = t_i \cdot r \cdot D_i^E$ if $t_1 = 0$ and $D_i^I = D_i^E$,
$(t_i - t_1) \cdot r \cdot D_i^I < t_i \cdot r \cdot D_i^E$ if $t_1 > 0$ and $D_i^I = D_i^E$.

[93] Ruf and Schindler (2012), p. 2.

[94] Møen et al. (2011), p. 8.

[95] Ruf and Schindler (2012), p. 7.

[96] Thus, as Schindler and Schjelderup (2012, p. 638) point out, both the costs and benefits of internal debt differ significantly from the costs and benefits of external debt, and internal debt can in fact be viewed as tax-favoured equity.

[97] Schindler and Schjelderup (2012), p. 637.

3.2 Thin-capitalisation rules

From a theoretical perspective, there are two normative approaches available when designing thin-capitalisation rules: specific rules and non-specific rules, where the rules typically define a permissible debt threshold and deny deductibility of interest on any debt exceeding the threshold.[98] Specific rules explicitly restrict internal debt while non-specific rules in most cases restrict debt in general (i.e. does not distinguish external debt from internal debt).[99] In addition, when modelling such rules, one can either assume that the rules are strict and unable to be circumvented, or that there is some leeway to work around them.[100]

Since the majority of thin-capitalisation rules are specific, this is also the area where the theoretical framework is most developed (as opposed to non-specific thin-capitalisation rules).[101] However, the thin-capitalisation rules in the Norwegian petroleum sector illustrate that the rules regulate and restrict the total debt-to-asset ratio and not internal debt specifically. We therefore start out by presenting the framework for specific thin-capitalisation rules, and then use this as a basis when we in section 3.3 develop our own theoretical approach for the non-specific thin-capitalisation rules relevant for the Norwegian petroleum sector.

3.2.1 Strictly binding thin-capitalisation rules

The internal debt-to-asset ratio is defined as $b_i^I \equiv \frac{D_i^I}{K_i}$. If the thin-capitalisation rules are strictly binding, there is a threshold for the internal debt-to-asset ratio defined as $\bar{b}_i^I$. As long as the internal debt is below the threshold, an affiliate will get full tax deduction on internal interest expenses. Any excessive internal debt above this threshold, however, would not be eligible for tax deduction. Since there is no tax deductibility given on internal interest expenses from internal debt exceeding the threshold, the internal debt

[98] See Dourado and de la Feira (2008), section II.1 and table 1.
[99] Ruf and Schindler (2012), p. 5.
[100] Ruf and Schindler (2012), p. 7.
[101] See Dourado and de la Feira (2008), table 1.

tax shield will become negative once the threshold is exceeded.[102] Thus, the incentive to use internal debt is eliminated when the defined threshold is reached.[103]

On the cost side, we assume that the concealment costs (C^I) are a function of the internal debt-to-asset ratio and proportional to capital employed. Additionally, we assume that as long as the internal debt is below the threshold, the concealment costs are zero since there is then no point in concealing the internal debt. When the threshold is reached, however, the marginal concealment costs go to infinity as circumvention of the regulations by concealment is impossible. This has the following formal implications for the internal debt costs:

$$C^I = C^I(b_i^I),$$

$$C^I = 0 \text{ with } \frac{\partial C^I}{\partial b_i^I} = 0 \text{ if } 0 \leq b_i^I \leq \bar{b}_i^I,$$

$$C^I > 0 \text{ with } \frac{\partial C^I}{\partial b_i^I} \to \infty \text{ if } b_i^I > \bar{b}_i^I,$$

$$C^I = 0 \text{ if } b_i^I < 0^{104}.$$

When the internal debt-to-asset ratio is below the threshold, the concealment costs are non-existent while the marginal benefit (i.e. the internal debt tax shield) is positive. However, when the internal debt-to-asset ratio exceeds the threshold, the marginal concealment costs go to infinity while the marginal benefit becomes negative. Thus, the MNC's optimal internal debt-to-asset ratio under strictly binding thin-capitalisation rules is exactly the threshold.[105]

[102] If the threshold is exceeded, $t_i \cdot r \cdot D_i^I = 0$, implying that the internal debt tax shield becomes $-t_1 \cdot r \cdot D_i^I < 0$.

[103] Ruf and Schindler (2012), p. 7.

[104] This is relevant for the internal bank where we assume that there are no costs involved with internal lending.

[105] Ruf and Schindler (2012), p. 7.

3.2.2 Thin-capitalisation rules with leeway

As in the case of strict rules, there is also a defined threshold for the internal debt-to-asset ratio if there are thin-capitalisation rules with leeway. However, with leeway it is possible to exceed the threshold and still be eligible for interest deduction on the exceeding debt. This can be done through tax engineering (e.g. hiring tax experts to find loopholes in the law), which is costly. By using internal debt over the threshold, an affiliate will therefore incur concealment costs associated with the tax engineering. The difficulty of circumventing the rules increases for each unit of internal debt over the threshold. The concealment costs C^I are therefore an exponential function of the internal debt-to-asset ratio when the internal debt reaches the threshold, and assumed to be proportional to capital employed.[106]

As thin-capitalisation rules can be changed over time or vary from country to country, this also implies that some rules are harder to circumvent than others. Using the same approach as Schindler and Schjelderup (2013), we define the parameter α_i[107] as a measure for tightness (i.e. how hard it is to circumvent the rules) of the thin-capitalisation rules in country i. This implies that the concealment costs are also a function of the tightness in the thin-capitalisation rules. We assume that the tighter the thin-capitalisation rules are, the larger will the increase in concealment costs be if the affiliate increases its internal debt. The features defined above can be formally summarised as

$$C^I = C^I(b_i^I, \alpha_i),$$

$$C^I = 0 \text{ if } 0 \leq b_i^I \leq \bar{b}_i^I,$$

$$C^I > 0 \text{ with } \frac{\partial C^I}{\partial b_i^I} > 0, \frac{\partial^2 C^I}{\partial (b_i^I)^2} > 0 \text{ and } \frac{\partial^2 C^I}{\partial b_i^I \partial \alpha_i} > 0 \text{ if } b_i^I > \bar{b}_i^I,$$

$$C^I = 0 \text{ if } b_i^I < 0^{108}.$$

[106] Ruf and Schindler (2012), p. 7.

[107] σ_i in Schindler and Schjelderup (2013).

[108] Again, this is relevant for the internal bank where we assume that there are no costs involved with internal lending.

As in the case of strict thin-capitalisation rules, the marginal concealment costs are assumed to be zero as long as the internal debt-to-asset ratio is within the threshold. Since it is possible to circumvent the rules, the internal debt tax shield is still positive when the threshold is exceeded. However, this must now be balanced against the marginal concealment costs. As long as the internal debt tax shield is larger than the marginal concealment costs, the affiliate will increase its profits by increasing its internal leverage. As the internal leverage increases, so will the marginal concealment costs, and an optimal internal debt-to-asset ratio will be reached when these are equal to the internal debt tax shield.[109]

[109] Note that if α_i goes to infinity (i.e. the thin-capitalisation rule becomes infinitely tight), the marginal concealment costs go to infinity. Thus, the leeway approach collapses into the strictly binding approach and the optimal level of debt is again exactly the threshold.

3.3 Adaption to the Norwegian Petroleum Sector

As described in chapter two, there have been three major changes to the thin-capitalisation rule regime in the Norwegian petroleum sector. In the following section, we evaluate the three non-specific rule regimes with respect to being strict or providing some leeway. We then combine this with the theoretical framework presented in the previous section, and model our own theoretical approach specifically for the Norwegian petroleum sector. The derived profit functions and resulting optimal capital structures are presented in the next section.

In the following we will impose some strict assumptions in order to limit the complexity of our theoretical models and keep the results intuitive. We ignore all financial income and let all financial costs be interest expense on interest-bearing debt. Moreover, we assume that all debt is interest bearing. Additionally, we ignore any activities onshore and thereby also the allocation of net financial costs offshore and onshore.[110] Finally, we assume that the optimal level of external debt is always below the defined threshold, and that the reduction mechanism under each rule regime is to a certain extent possible to circumvent through tax engineering.

3.3.1 The 1994 regime

The 1994 regime was introduced after governmental concerns regarding the extensive use of debt financing in the petroleum sector. As seen in figure 2-2, taxes accounted for over half of the Norwegian State's revenue from the petroleum sector in 1994 and were thus a crucial revenue-creating instrument. As mentioned in chapter two, reducing taxable income by debt financing was therefore a major issue at the time. For this reason, one could believe that the authorities had strong incentives to keep strict control with the new rule in order to ensure that the petroleum companies did not circumvent it (which would negatively impact the State's tax revenues).

Some of the most important arguments for the rule change in 2007, however, were the 1994 and 2002 regimes' weaknesses: As mentioned in chapter two, it was possible to increase offshore deductions by increasing the leverage beyond the defined threshold due to the lack of distinction between interest-bearing and non-interest-bearing debt.

[110] This implies that we focus only on the mechanisms of the rule regimes that decreased or increased the petroleum companies' interest expenses offshore.

Additionally, the reduction of offshore deduction could be partially avoided through equity transactions such as extraordinary dividend payments. These weaknesses can therefore be viewed as loopholes in the law, which coincides with the leeway approach described in section 3.2.2.

The leeway approach is also generally supported in the literature (e.g. Ruf and Schindler, 2012) where a prevailing argument is that all thin-capitalisation rules have some loopholes that are possible to exploit, which is again supported by the mere existence of consultancy firms that specialise in tax avoidance. We therefore conclude that the 1994 rule could be seen as a non-specific thin-capitalisation rule with leeway.

Formal implications

The non-specific nature of the 1994 regime implies that the concealment costs are no longer only a function of internal debt but the total debt-to-asset ratio in a company. Additionally, since the rule has leeway, the concealment costs are significant, but not infinitely large when the threshold is exceeded.

We still assume that the difficulty of circumventing the rules increases with leverage, but since the rules restrict total debt, we now denote the concealment costs as C^C. Keeping the previous assumption that concealment costs are zero below the threshold, this formally implies that

$$C^C = C^C(b_i, \alpha_i) \cdot \mathbf{1}_{\bar{b_i}} \text{ with } b_i = b_i^E + b_i^I,$$

$$\text{where } \mathbf{1}_{\bar{b_i}} \begin{cases} 1 \; if \; b_i^E + b_i^I > 80\% \\ 0 \; if \; b_i^E + b_i^I \leq 80\%. \end{cases}$$

We keep the rest of the features of the concealment costs as defined in section 3.2.2 and we also keep the external debt cost function the same as verbally and formally defined in section 3.1.2.

3.3.2 The 2002 regime

As for the 1994 regime, the reduction rule in 2002 had the same upper threshold at 80 per cent debt financing, and the reduction mechanism for net financial costs allocated offshore was unmodified. As seen in figure 2-2, the petroleum tax system continued to contribute to a substantial share of the Norwegian State's petroleum revenues. Thus, petroleum taxation regulations were still an important issue for the authorities. However, the reduction mechanism in 2002 had the same weaknesses as the 1994 rule, implying, among other things, that petroleum companies could still exploit the lack of distinction between interest-bearing and non-interest-bearing debt, and get a net increase in offshore deduction by increasing leverage above 80 per cent. We therefore keep our conclusion from the 1994 rule discussion, implying that the 2002 thin-capitalisation rule had leeway and was possible to circumvent through tax engineering.

After the rule change in 2002, the net financial costs allocated offshore were now eligible for an upward adjustment if the petroleum companies' total debt-to-asset ratio was below 80 per cent. Using the formula for the upwards adjustment in section 2.2.2 together with our assumptions in this section, implies that a company with a debt-to-asset ratio below 80 per cent would always get offshore deduction *as if* it had 80 per cent debt.[111] This meant that the debt tax shield in the borrowing affiliate was constant and independent of the debt-to-asset ratio up to 80 per cent.[112]

Formal implications

We keep the same formal implications as under the 1994 rule regime, but introduce a change in the debt tax shield: If the debt-to-asset ratio is equal to or smaller than 80 per cent, the debt tax shield is constant and set as if the company had 80 per cent. For the total debt tax shield in the borrowing affiliate ($DTS_{i\neq 1}$), this implies that

$$DTS_{i\neq 1} = t_i r \cdot 80\% \cdot K_i + t_i r[(b_i^E + b_i^I) - 80\%] \cdot K_i \cdot \mathbf{1}_{\bar{b_i}},$$

$$\text{where } \mathbf{1}_{\bar{b_i}} \begin{cases} 1 \; if \; b_i^E + b_i^I > 80\% \\ 0 \; if \; b_i^E + b_i^I \leq 80\%. \end{cases}$$

[111] Using the formula for upwards adjustment on a company with total capital of 100, a debt of D and equity of E together with an interest rate of r, we see that the formula becomes: $r \cdot D \cdot \frac{D+(E-20)}{D} = r \cdot 80$.

[112] As stated in section 2.2.2, note that the upwards adjustment was limited to 100 per cent of a company's total interest expenses offshore and onshore.

3.3.3 The 2007 regime

As stated in the discussion of the 2007 rules in chapter two, one of the arguments for the introduction of the new rules was that the old rules had weaknesses that enabled companies to circumvent them. For example, the 2007 rule removed the lack of distinction between interest-bearing and non-interest-bearing debt. Additionally, by using the average interest-bearing debt over the year, it was harder to use equity transactions at the end of the year to increase offshore deductions. One could therefore argue that the 2007 regime was stricter than the previous regimes and therefore also harder to circumvent. However, as previously mentioned, creating perfectly binding thin-capitalisation rules is next to impossible, and thus we assume that there was still leeway under the 2007 regime.

Applying the same assumptions as under the previous regimes, together with the assumption that all assets offshore fall under the definition of specified assets offshore in § 3 d, the deduction formula under the 2007 regime becomes

$$Offshore\ deduction = r(b_i^E + b_i^I)K_i \cdot \frac{50\% \cdot K_i}{(b_i^E + b_i^I)K_i} = r \cdot 50\% \cdot K_i.$$ [113]

In other words, with our assumptions, the offshore deduction is actually independent of the leverage. However, since we still use a leeway approach for leverage over the threshold, the offshore deduction will only be independent of leverage below 50 per cent. This situation is then identical to the 2002 regime, with the only exception being that the threshold is now at 50 per cent instead of 80.

Formal implications

We use the same formal implications as under the 2002 regime, with the only difference being that we change the thin-capitalisation rule threshold and tightness, as well as the leverage at which the debt tax shield is constant.

From the discussion in the previous section, we know that if the debt-to-asset ratio is equal to or smaller than 50 per cent, the debt tax shield is constant and set as if the

[113] The numerator simply becomes total capital because we ignore any onshore activities and assume that all assets offshore fall within the definition of the specified assets offshore in § 3 d. This also implies that the denominator becomes total debt.

company had a debt-to-asset ratio of 50 per cent. Again, for the total debt tax shield in the borrowing affiliate ($DTS_{i\neq 1}$), this implies that

$$DTS_{i\neq 1} = t_i r \cdot 50\% \cdot K_i + t_i r[(b_i^E + b_i^I) - 50\%] \cdot K_i \cdot \mathbf{1}_{\bar{b}_i},$$

$$\text{where } \mathbf{1}_{\bar{b}_i} \begin{cases} 1 \; if \; b_i^E + b_i^I > 50\% \\ 0 \; if \; b_i^E + b_i^I \leq 50\%. \end{cases}$$

We keep the same concealment costs as before, but we now increase the tightness parameter α to reflect the increased difficulty of circumventing the rules. For the same amount of exceeding debt, the implication is that

$$C^C(b_i, \alpha_i^{2007}) > C^C(b_i, \alpha_i^{2002}) = C^C(b_i, \alpha_i^{1994}),$$

meaning that for the same leverage, the concealment costs under the 2007 regime were now higher than under the previous regimes.

3.4 Deriving the optimal capital structures

In this section, we use the same approach as Møen et al. (2011) to derive the optimal capital structure under each rule regime. However, we first provide the reader with a general definition of the profit function that we use to derive the optimal capital structures.

Using the standard framework described in figure 3-1 and defining the costs of debt simply as a function of total debt and thin-capitalisation rule tightness, the general economic profit in affiliate i before tax can be defined as

$$\pi_i^e = F(K_i, L_i) - w \cdot L_i - [r + C^D(b_i, \alpha_i)] \cdot K_i.$$

The first term is the affiliate's product function that equals its revenue with a standardised price of one. The second term represents costs from using labour while the last term represents the affiliate's rental cost of capital as well as general cost per unit of capital from the use of external and internal debt as previously described.

The economic profit in affiliate i after tax can then be defined as

$$\pi_i = (1 - t_i)[F(K_i, L_i) - wL_i] - rK_i + t_i \cdot r \cdot (b_i^E + b_i^I) \cdot K_i - C^D(b_i, \alpha_i) \cdot K_i.$$

From the expression above, we can see that only interest expense on debt is tax deductible, whereas costs of equity are not as the total debt tax shield is added back after subtracting the rental costs of capital. For simplicity, we assume that costs of debt (i.e. the costs of debt excluding the interest expense) are not tax deductible.

The MNC's world-wide profit after tax is then simply the sum of the profit in its all affiliates, or formally:

$$\pi_p = \sum_{i=1}^{n} \pi_i.$$

Having defined the general profit function for the MNC, we can now move on to defining the profit function for each regulation regime and derive the corresponding optimal capital structures.

3.4.1 The 1994 regime

Profit functions

Using the formal implications of the 1994 rule derived in section 3.3.1, we can define the petroleum companies' profit function after tax under this regime as

$$\pi_p = \sum_{i=1}^{n} \{(1-t_i)[F(K_i, L_i) - wL_i] - rK_i + t_i r(b_i^E + b_i^I)K_i - \left[C^E(b_i^E) + C^C(b_i, \alpha_i) \cdot \mathbf{1}_{\bar{b_i}}\right]K_i\}.$$

This leads to the following maximisation problem:

$$\max_{b_i^E, b_i^I} \pi_p = \sum_{i=1}^{n} \{(1-t_i)[F(K_i, L_i) - wL_i] - rK_i + t_i r(b_i^E + b_i^I)K_i - \left[C^E(b_i^E) + C^C(b_i, \alpha_i) \cdot \mathbf{1}_{\bar{b_i}}\right]K_i\},$$

$$s.t. \sum_{i=1}^{n} r \cdot b_i^I \cdot K_i = 0 \text{ and } b_i = b_i^E + b_i^I,$$

which translates into the following Lagrange maximisation problem:

$$\mathcal{L}(b_i^E, b_i^I, \lambda) = \sum_{i=1}^{n} \{(1-t_i)[F(K_i, L_i) - wL_i] - rK_i + t_i r(b_i^E + b_i^I)K_i - [C^E(b_i^E) + C^C(b_i, \alpha_i) \cdot \mathbf{1}_{\bar{b_i}}]K_i\} - \lambda\left(\sum_{i=1}^{n} r b_i^I K_i\right).$$

First-order conditions

Solving the Lagrange problem leads to the following four first-order conditions for external and internal debt ratio, respectively:

$$\frac{\partial \pi_p}{\partial b_i^E} = t_i \cdot r - \frac{\partial C^E(b_i^E)}{\partial b_i^E} - \frac{\partial C^C(b_i, \alpha_i)}{\partial b_i^E} = 0 \; if \; b_i > \bar{b_i},$$

$$\frac{\partial \pi_p}{\partial b_i^E} = t_i \cdot r - \frac{\partial C^E(b_i^E)}{\partial b_i^E} = 0 \; if \; b_i \leq \bar{b_i},$$

$$\frac{\partial \pi_p}{\partial b_i^I} = (t_i - \lambda) \cdot r - \frac{\partial C^C(b_i, \alpha_i)}{\partial b_i^I} = 0 \; if \; b_i > \bar{b_\iota},$$

$$\frac{\partial \pi_p}{\partial b_i^I} = (t_i - \lambda) \cdot r > 0 \; if \; b_i \leq \bar{b_\iota},$$

As previously stated, the internal debt tax shield is maximised when the internal bank is in the affiliate located in the country with the lowest corporate tax rate. This can now be seen mathematically from the Lagrange parameter, λ, which represents the shadow costs of using internal debt, which is the tax payment on interest income in the internal bank. This is minimised (and the internal debt tax shield maximised) when $\lambda = min_i \; t_i = t_1$. Letting $\lambda = t_1$ and rearranging the debt tax shields on the left-hand side and the marginal costs on the right-hand side gives us the following:

External debt:

$$t_i \cdot r = \frac{\partial C^E(b_i^E)}{\partial b_i^E} + \frac{\partial C^C(b_i, \alpha_i)}{\partial b_i^E} \; if \; b_i > \bar{b_\iota}, \tag{3.1}$$

$$t_i \cdot r = \frac{\partial C^E(b_i^E)}{\partial b_i^E} \; if \; b_i \leq \bar{b_\iota}. \tag{3.2}$$

Internal debt:

$$(t_i - t_1) \cdot r = \frac{\partial C^C(b_i, \alpha_i)}{\partial b_i^I} \; if \; b_i > \bar{b_\iota}, \tag{3.3}$$

$$(t_i - t_1) \cdot r > 0 \; if \; b_i \leq \bar{b_\iota}. \tag{3.4}$$

From these first-order conditions, the strong incentive to finance a petroleum company with debt becomes mathematically apparent: Due to the marginal tax rate of 78 per cent, the marginal benefit on the left-hand side of the first-order conditions is significantly larger than for a comparable onshore firm facing the normal corporate tax rate of 28 per cent. Thus, a petroleum company will be willing to accept significantly higher

concealment costs than an onshore firm, giving the petroleum companies a much stronger debt-financing incentive.[114]

For leverage below the threshold, we see that the first-order conditions in equations (3.2) and (3.4) are separable. The optimal level of external debt has been reached when the marginal external debt tax shield is equal to the marginal cost of external debt. The first-order condition for internal debt is positive, however, implying that it is optimal to increase leverage at least to the threshold.

For leverage over the threshold, we see from equation (3.1) that the profit-maximising external debt ratio is reached when the marginal tax savings on external interest are equal to the sum of the marginal cost of external debt and marginal concealment costs.[115] Similarly, the profit-maximising internal debt ratio is reached when the marginal net tax savings on internal interest are equal to the marginal concealment costs as shown by equation (3.3). However, as opposed to the first-order conditions when leverage is below the threshold, the first-order conditions in equations (3.1) and (3.3) are interdependent since both external and internal debt drive the concealment costs. How are the optimal levels of the respective debt types then decided? We provide both a mathematical and intuitive answer in the next section.

The optimal mix of external and internal debt

Mathematically, we know that the optimal mix of external and internal debt has been reached when a marginal increase in either type of debt increases the profit by the same amount. Formally, this goal is reached when

$$\frac{\partial \pi_p}{\partial b_i^E} = \frac{\partial \pi_p}{\partial b_i^I}. \tag{3.5}$$

Inserting the respective first-order conditions into equation (3.5) above gives us

$$t_i \cdot r - \frac{\partial C^E(b_i^E)}{\partial b_i^E} - \frac{\partial C^C(b_i, \alpha_i)}{\partial b_i^E} = (t_i - t_1) \cdot r - \frac{\partial C^C(b_i, \alpha_i)}{\partial b_i^I}. \tag{3.6}$$

[114] The high leverage and resulting large interest expenses in petroleum companies reduces their taxable profits significantly, which in turn has a negative impact on the Norwegian State's petroleum tax revenues. Since taxes account for such a large share of the Norwegian State's revenue from the petroleum sector, this illustrates exactly why thin capitalisation in the petroleum sector is such an important issue.

[115] Contrary to the standard model, the first-order condition for external debt now includes the marginal concealment costs since the thin-capitalisation rule in § 3 h was non-specific.

Since the concealment costs are a function of total debt, this implies that

$$\frac{\partial C^C(b_i, \alpha_i)}{\partial b_i^E} = \frac{\partial C^C(b_i, \alpha_i)}{\partial b_i^I},$$

which means that equation (3.6) collapses to

$$t_1 \cdot r = \frac{\partial C^E(b_i^E)}{\partial b_i^E}. \tag{3.7}$$

The optimal trade-off between external and internal debt is therefore achieved when the marginal tax payment in the internal bank is equal to the marginal cost of external debt. This also makes sense intuitively: By substituting one unit of internal debt for external debt, the MNC saves the marginal tax payment in the internal bank, but at the same time incurs the marginal cost of external debt. If the saved marginal tax payment in the internal bank is greater than the marginal external debt cost, it is optimal to increase the external debt and decrease the internal debt. The opposite is true if the saved marginal tax payment in the internal bank is lower than the marginal external debt cost. Thus, under the 1994 thin-capitalisation rule, a petroleum company reached the optimal mix of internal and external debt when the marginal payment in the internal bank was equal to the marginal cost of external debt.[116]

Determining the optimal amount of total debt

We are still left with the question of how the petroleum companies chose their optimal amount of *total* debt under the 1994 thin-capitalisation rule. In order to understand this, we take a closer look at the process that takes place when the petroleum company determines its optimal mix of internal and external debt.

We imagine that a petroleum company is deciding its optimal capital structure and starts off with zero debt. In deciding if the next unit of debt should be external or internal, it looks to the optimality condition in equation (3.7). Since the function for costs of external debt is U-shaped, the marginal cost of external debt is actually *negative*

[116] Note that the debt tax shields in the borrowing affiliate as well as the marginal concealment costs are not part of the solution. This is because substituting a unit of internal debt for a unit of external debt (or vice versa) leaves the MNC with an unchanged debt tax shield (in the borrowing affiliate) and unchanged concealment costs.

for very small amounts of external debt since there is a net benefit from using a marginal unit of external debt. The company compares this to the marginal tax payment in the internal bank, which is positive and constant for all b_i.

Since a marginal unit of internal debt represents a cost while a marginal unit of external debt represents a benefit, the petroleum company chooses its first unit of debt to be external. However, as the use of external debt increases, the net benefit turns into a net cost of external debt. At some point, the marginal cost of external debt will therefore be equal to the marginal tax payment in the internal bank. After this point is reached, the marginal tax payment in the internal bank will be smaller than the marginal cost of external debt. Thus, after this point, it will be optimal to increase the leverage by internal debt.[117] This process is illustrated in figure 3-3 below:[118]

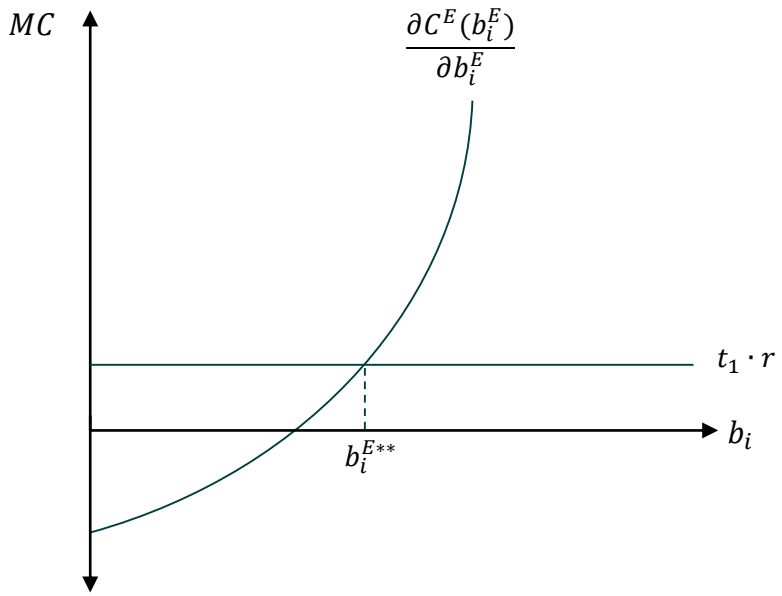

Figure 3-3: Reaching the optimal level of external debt

Source: Own illustration

[117] We know that it will be optimal to continue to increase the leverage by internal debt since the marginal internal debt tax shield, $(t_i - t_1) \cdot r$, is positive.

[118] As stated in section 3.3, we have assumed that the optimal level of external debt is below the defined threshold of $\overline{b_i}$. We know that for each unit of external debt, a petroleum company would gain the external debt tax shield, but at the same time incur a marginal unit of external debt costs. If the optimal level of external debt was above the threshold, the company would then need to compare this marginal net gain against the marginal concealment costs.
This optimality condition is naturally exactly what is stated for the first-order condition for external debt in equation (3.1) when leverage is over the threshold. If the first-order condition was zero for $b_i < b_i^{E**}$, this would imply that it was optimal to use less external debt than $b_i^{E**}$and then also zero internal debt. If the first-order condition was positive for $b_i < b_i^{E**}$, it would be optimal to increase the external leverage to b_i^{E**} where the optimal mix condition was satisfied, and then increase leverage by internal debt until the first-order condition in equation (3.3) was satisfied.

From figure 3-3, we can see that as long as the leverage is below b_i^{E**}, it is optimal to increase the leverage by using external debt since the marginal cost of external debt ($\frac{\partial C^E(b_i^E)}{\partial b_i^E}$) is smaller than the marginal tax payment in the internal bank ($t_1 \cdot r$). After b_i^{E**} is reached, it is optimal to increase the leverage by using internal debt.

As the internal leverage is increased, the total leverage approaches the defined threshold ($\overline{b_i}$) of 80 per cent defined in the 1994 rule. Concealment costs and the debt tax shield in the borrowing affiliate are now relevant since the optimal level of external debt has already been decided. From the first-order condition for the internal debt, it is optimal for the petroleum company to increase the internal debt until the internal debt tax shield equals the marginal concealment costs. When this point is reached, the petroleum company has reached its optimal total leverage. This process is illustrated in figure 3-4 below:[119]

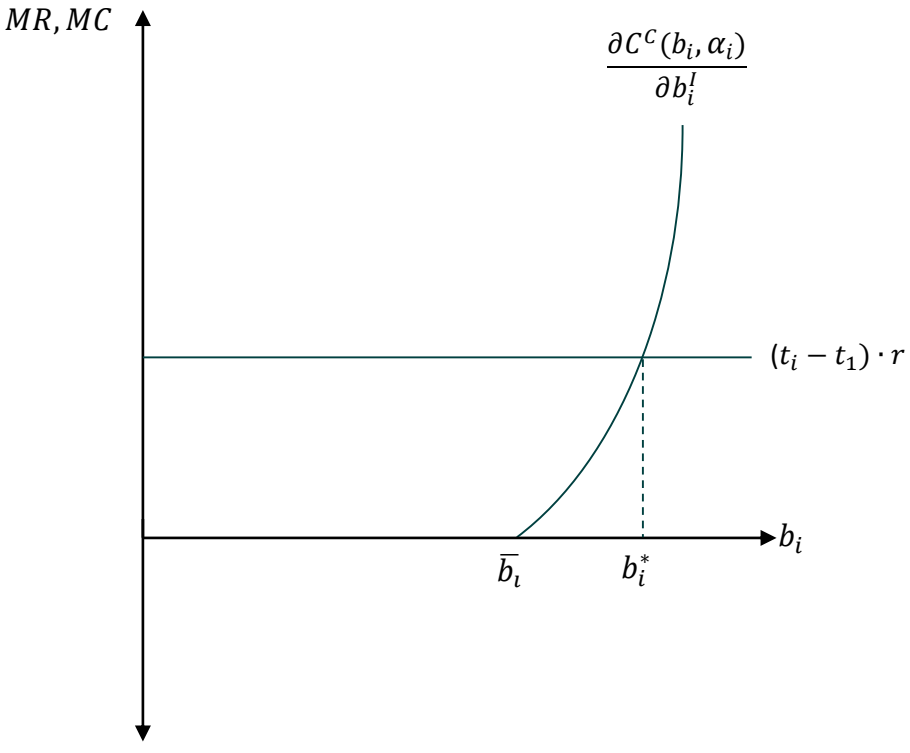

Figure 3-4: Reaching the optimal total leverage

Source: Own illustration

[119] Note that in this graph we have MR and MC on the same axis in order to make the trade-off between the marginal concealment costs and marginal internal debt tax shield evident.

From figure 3-4 on the previous page, we see that it is optimal to increase the internal leverage until total leverage reaches b_i^*. The optimal *internal* leverage will then be $b_i^{I*} = b_i^* - b_i^{E**}$.[120]

Summary

Under the 1994 regime, the derived optimal capital structure shows that petroleum companies had incentive to have a leverage *at least* at the threshold of $\overline{b_\iota}$ or 80 per cent. With the possibility of partially circumventing the thin-capitalisation rule in § 3 h, the 1994 regime also meant that petroleum companies always had incentives to exceed the threshold to some extent.

Within the optimal total leverage, the optimal mix of external and internal debt depended on the marginal cost of external debt and the marginal tax payment in the internal bank. A petroleum company would increase the external leverage until these two were equal, and then increase the leverage over the threshold by internal debt, until the marginal internal debt tax shield was equal to the marginal concealment costs.

[120] Following our assumption that the optimal external debt level is below the threshold, an interesting implication of our results is that the external leverage is in fact independent of the tax rate in the borrowing affiliate. This can be seen explicitly from the optimal mix condition in equation (3.7) where the optimal external leverage is only dependent on the marginal cost of external debt and the marginal tax payment in the internal bank.

3.4.2 The 2002 regime

Profit functions

Using the formal implications of the 2002 rule derived in section 3.3.2, we can define the petroleum companies' profit function after tax under this regime as

$$\pi_p = \sum_{i=1}^{n}\{(1-t_i)[F(K_i,L_i)-wL_i]-rK_i+t_i r\cdot 80\%\cdot K_i+t_i r[(b_i^E+b_i^I)-80\%]\cdot K_i\cdot \mathbf{1}_{\bar{b_i}} - \left[C^E(b_i^E)+C^C(b_i,\alpha_i)\cdot \mathbf{1}_{\bar{b_i}}\right]K_i\}.$$

This leads to the following maximisation problem:

$$\max_{b_i^E,b_i^I}\pi_p = \sum_{i=1}^{n}\{(1-t_i)[F(K_i,L_i)-wL_i]-rK_i+t_i r\cdot 80\%\cdot K_i+t_i r[(b_i^E+b_i^I)-80\%]\cdot K_i \cdot \mathbf{1}_{\bar{b_i}} - \left[C^E(b_i^E)+C^C(b_i,\alpha_i)\cdot \mathbf{1}_{\bar{b_i}}\right]K_i\},$$

$$s.t.\sum_{i=1}^{n} r\cdot b_i^I\cdot K_i = 0 \text{ and } b_i = b_i^E + b_i^I,$$

which translates into the following Lagrange maximisation problem:

$$\mathcal{L}(b_i^E,b_i^I,\lambda) = \sum_{i=1}^{n}\{(1-t_i)[F(K_i,L_i)-wL_i]-rK_i+t_i r\cdot 80\%\cdot K_i+t_i r[(b_i^E+b_i^I)-80\%] \cdot K_i\cdot \mathbf{1}_{\bar{b_i}} - [C^E(b_i^E)+C^C(b_i,\alpha_i)\cdot \mathbf{1}_{\bar{b_i}}]K_i\} - \lambda\left(\sum_{i=1}^{n} r b_i^I K_i\right).$$

First-order conditions

Solving the Lagrange problem leads to the four following first-order conditions for external and internal debt ratio, respectively:

$$\frac{\partial \pi_p}{\partial b_i^E} = t_i\cdot r - \frac{\partial C^E(b_i^E)}{\partial b_i^E} - \frac{\partial C^C(b_i,\alpha_i)}{\partial b_i^E} = 0 \; if \; b_i > \bar{b_i},$$

$$\frac{\partial \pi_p}{\partial b_i^E} = -\frac{\partial C^E(b_i^E)}{\partial b_i^E} = 0 \; if \; b_i \le \bar{b_i},$$

$$\frac{\partial \pi_p}{\partial b_i^I} = (t_i - \lambda) \cdot r - \frac{\partial C^C(b_i, \alpha_i)}{\partial b_i^I} = 0 \; if \; b_i > \bar{b_\iota},$$

$$\frac{\partial \pi_p}{\partial b_i^I} = -\lambda \cdot r < 0 \; if \; b_i \leq \bar{b_\iota}.$$

Again, letting $\lambda = min_i \; t_i = t_1$ and rearranging the debt tax shields on the left-hand side and the marginal costs on the right-hand side gives us the following:

External debt:

$$t_i \cdot r = \frac{\partial C^E(b_i^E)}{\partial b_i^E} + \frac{\partial C^C(b_i, \alpha_i)}{\partial b_i^E} if \; b_i > \bar{b_\iota}, \tag{3.8}$$

$$\frac{\partial C^E(b_i^E)}{\partial b_i^E} = 0 \; if \; b_i \leq \bar{b_\iota}. \tag{3.9}$$

Internal debt:

$$(t_i - t_1) \cdot r = \frac{\partial C^C(b_i, \alpha_i)}{\partial b_i^I} \; if \; b_i > \bar{b_\iota}, \tag{3.10}$$

$$-t_1 \cdot r < 0 \; if \; b_i \leq \bar{b_\iota}. \tag{3.11}$$

For $b_i > \bar{b_\iota}$, the interpretation of the first-order conditions remains the same as under the 1994 rule regime. However, the interpretation of the first-order conditions changes when $b_i \leq \bar{b_\iota}$: There are still no concealment costs under the threshold, but now the debt tax shield in the borrowing affiliate is constant. Therefore, when leverage is below the threshold, the marginal external debt tax shield becomes zero while the marginal internal debt tax shield becomes negative.

As long as $b_i \leq \bar{b_\iota}$, we see from equations (3.9) and (3.11) that the first-order conditions are independent and separable. From equation (3.9), we see that the optimal level of external debt has been reached when the marginal cost of external debt is zero[121, 122]. For internal debt, the first-order condition in equation (3.11) is always negative. Since internal leverage in the borrowing affiliate is limited to zero, it will therefore be optimal to use no internal debt at all. The optimal level of external debt will then also be the

[121] This is actually identical to the situation described in figure 3-2 when there is an absence of taxation.

[122] Assuming that the optimal level of external debt is below the threshold, which is also what we assume for the remainder of the 2002 regime discussion.

optimal level of total debt. Denoting the optimal level of external debt as b_i^{E*}, we illustrate this optimal adaption in figure 3-5 below:

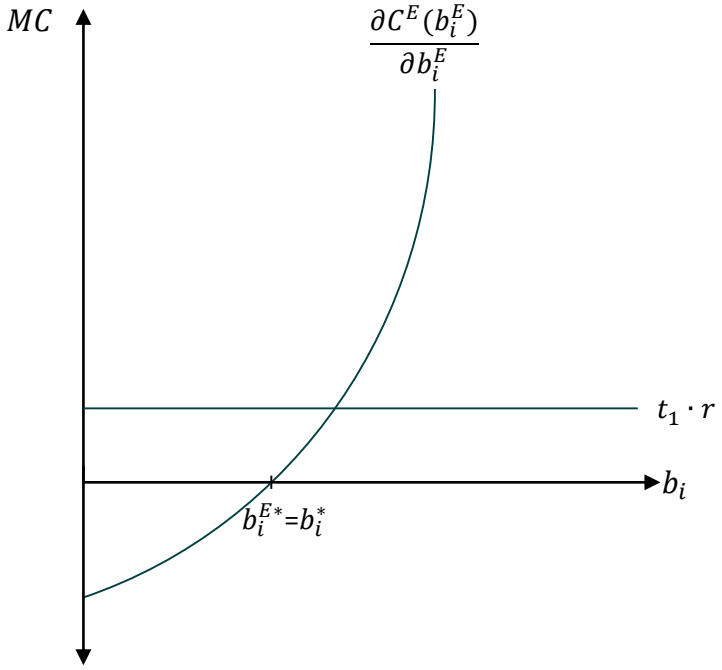

Figure 3-5: Optimal external and total debt-to-asset ratio

Source: Own illustration

Following this result, it seems like the 2002 regime implied that petroleum companies had weak incentives to use external debt and no incentives to use internal debt. Looking at the first-order conditions for $b_i > \overline{b_i}$ in equations (3.8) and (3.10), however, we know that the debt tax shield for both internal and external debt turns positive when leverage is increased beyond the threshold. Are there then situations where a petroleum company would willingly increase its leverage beyond the threshold in order to reap the benefits of the increased debt tax shield?

Intuitively, the only situation where this would be profitable is when the gain of exceeding the threshold is greater than the total cost of reaching it. Otherwise, a petroleum company should stick to the optimal leverage of b_i^{E*}.

If it was profitable to increase leverage beyond b_i^{E*}, the best way to further increase the leverage would be by using the cheapest debt instrument. Following the discussion of the optimal mix of external and internal debt under the 1994 regime, we know that external debt is cheapest up to the point where

$$t_1 \cdot r = \frac{\partial C^E(b_i^E)}{\partial b_i^E}.$$

If it was profitable to exceed the threshold, a petroleum company would therefore (all else equal) choose the same level of external debt as under the 1994 regime (i.e. b_i^{E**}), and increase the leverage further by internal debt. The costs of reaching the threshold would therefore consist of additional costs of external debt from exceeding b_i^{E*} as well as additional tax payments in the internal bank. Identical to under the 1994 regime, the optimal amount of internal debt is found from the first-order condition for internal debt when $b_i > \overline{b_\iota}$ in equation (3.10).

The two optimal adaptations together with the trade-off between the total cost of reaching the threshold and the net gain of exceeding it are illustrated graphically in figure 3-6 below:[123]

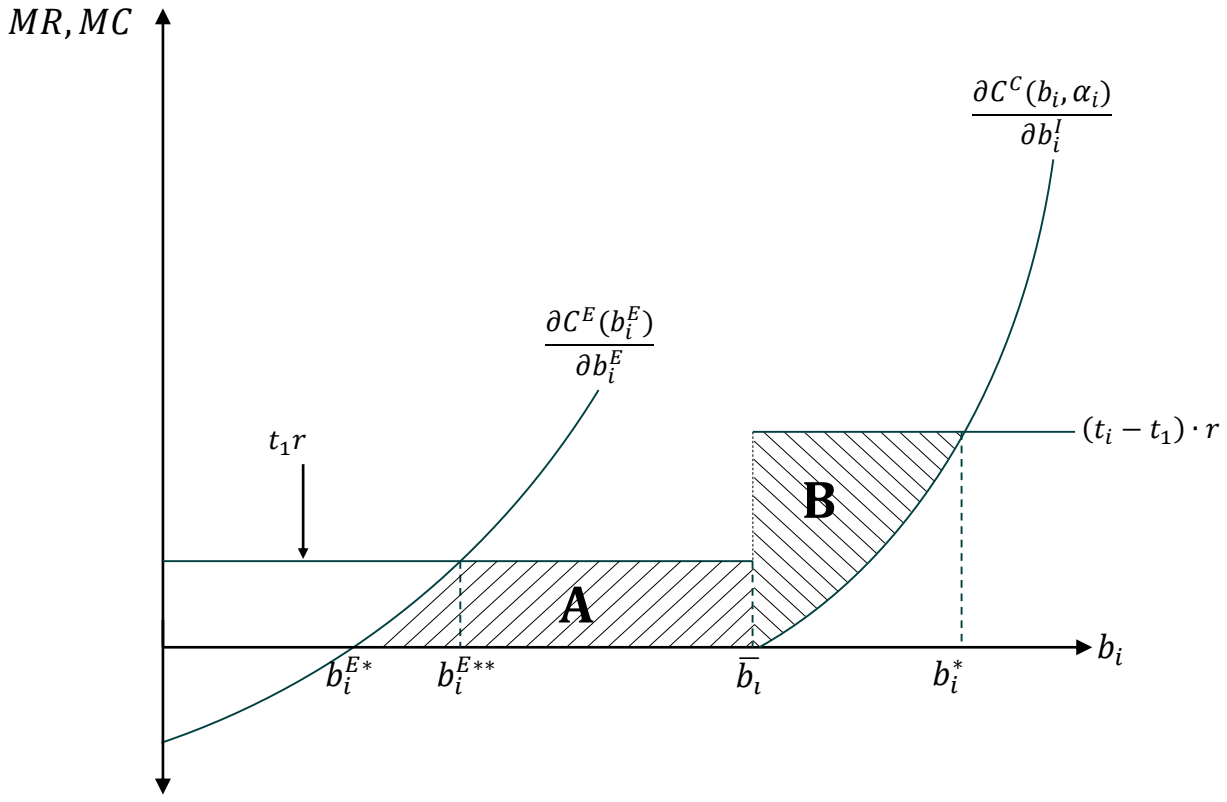

Figure 3-6: Determining whether it is profitable to increase leverage beyond b_i^{E*} and the corresponding optimal adaptations

Source: Own illustration

[123] Note that in this graph, we have MR and MC on the same axis in order to make areas A and B easily comparable. Additionally, note that this implies that area A is the sum of costs from reaching the threshold, while area B is the sum of net benefits gained from exceeding the threshold.

The interpretation of figure 3-6 is as follows: b_i^{E*} is the same as in figure 3-5 and is the optimal level of external (and total) debt if a petroleum company did not find it optimal to increase its leverage above the threshold.

If it was profitable to increase leverage above the threshold, it was optimal to increase external leverage to b_i^{E**} and from that point increase leverage to b_i^* by internal debt. By increasing leverage further than b_i^{E*}, a company would incur additional costs of external debt up to b_i^{E**}. After this point, a company would incur the negative marginal internal debt tax shield ($-t_1 r$) for each unit of debt up to the threshold. When the threshold was reached, a company would for each additional unit of internal debt gain the positive marginal internal debt tax shield, $(t_i - t_1)r$, but at the same time incur an additional unit of concealment cost up to b_i^*. Only if the sum of this net gain (denoted as area **B** in figure 3-6) was larger than the sum of additional debt costs (denoted as area **A**), would it be optimal to increase leverage to b_i^*.

More mathematically, the same condition can be shown as

$$\int_{b_i^{E*}}^{b_i^{E**}} \left[\frac{\partial C^E(b_i^E)}{\partial b_i}\right] db_i + \int_{b_i^{E**}}^{\bar{b}_\iota} (t_1 r)\, db_i < \int_{\bar{b}_\iota}^{b_i^*} \left[(t_i - t_1)r - \frac{\partial C^C(b_i, \alpha_i)}{\partial b_i}\right] db_i.$$

If this inequality held, a petroleum company would have a leverage above the threshold at b_i^*. Conversely, if it did not hold, leverage would be limited to b_i^{E*} below the threshold and there would be no internal debt.

Optimal capital structure if upwards adjustment was limited

Until now, we have assumed that the upwards adjustment was unlimited. However, as stated in the discussion of the 2002 regime in chapter two, the upwards adjustment would be limited if adjusted offshore deductions reached 100 per cent of total interest expenses. This would imply a positive debt tax shield in the borrowing affiliate up to the point where total interest expenses were large enough for the upwards adjustment to take effect. We define this point as $\widetilde{b_\iota}$. From $\widetilde{b_\iota}$, the debt tax shield in the borrowing affiliate would make a jump as if the leverage was at the threshold ($\bar{b}_\iota$), stay constant up to the threshold and then finally increase when exceeding the threshold. Both the total

and marginal debt tax shield in the borrowing affiliate in this situation are shown in figure 3-7 below:

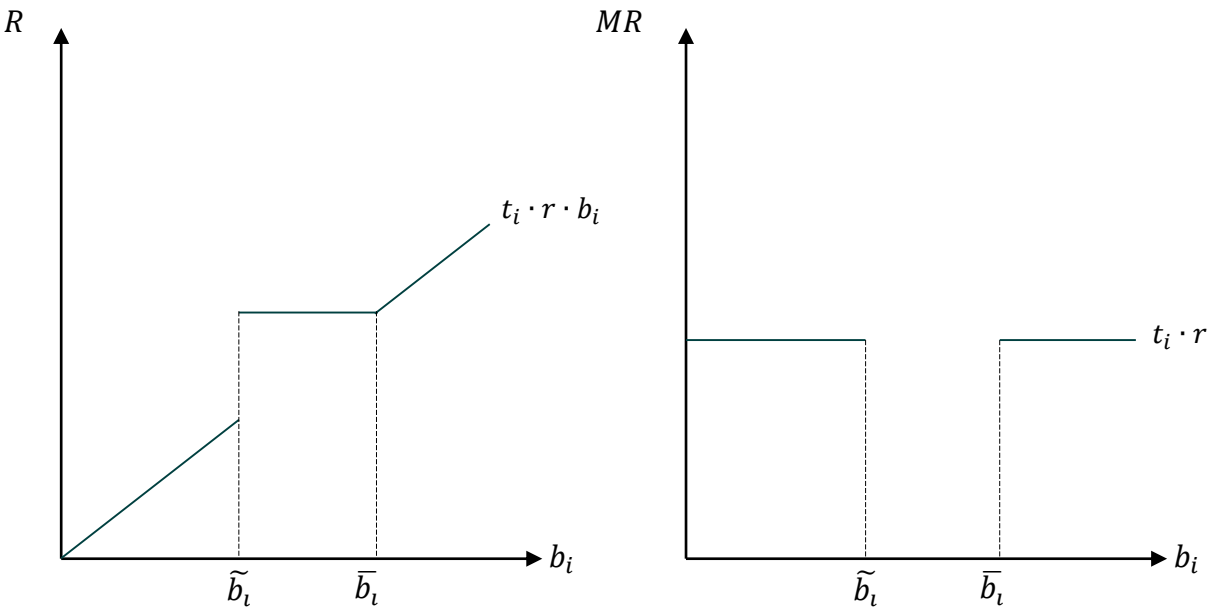

Figure 3-7: The effect of a limited upwards adjustment on the total and marginal debt tax shield in the borrowing affiliate.

Source: Own illustration

As long as the leverage is below $\widetilde{b_\iota}$, both the external and internal debt tax shields are positive and it is optimal to increase leverage either by external or internal debt depending on which is cheapest. When $\widetilde{b_\iota}$ is reached, the marginal debt tax shield in the borrowing affiliate changes to zero. The petroleum company now faces the same type of trade-off as without the limitation: It is only profitable to increase leverage beyond $\widetilde{b_\iota}$ if the gain of exceeding the threshold is larger than the cost of reaching it. The cost is now the sum of debt costs between leverage $\widetilde{b_\iota}$ and $\overline{b_\iota}$ while the benefit is the (positive) marginal internal debt tax shield less the concealment costs up to b_i^*.

If the net gain of exceeding the threshold was larger than the cost, the optimal leverage would be above the threshold at b_i^*. Otherwise, the optimal leverage would be limited to $\widetilde{b_\iota}$.

Summary

With the introduction of the upwards adjustment rule in 2002, the optimal capital structure derived in 1994 was no longer necessarily optimal. Since a petroleum company could get an interest deduction *as if* its leverage was at the threshold of 80 per cent, it was in some cases optimal to use no internal debt at all, and use external debt up to the point where the marginal cost of external debt was zero. Only if the net gain of exceeding the threshold at 80 per cent was larger than the debt costs incurred by reaching the threshold was it optimal to exceed the threshold. In such a situation, a petroleum company would end up with the same optimal total leverage as under the 1994 regime.

If the upwards adjustment was limited because of insufficient total interest expenses, it was always optimal to increase leverage up to the point where the upwards adjustment would take effect. Additionally, if the net gain of exceeding the threshold at 80 per cent was larger than the debt costs incurred by reaching the threshold, it was optimal to exceed the threshold. Then, a petroleum company would also end up with the same optimal total leverage as under the 1994 regime. Otherwise, leverage would be limited to the point where the upwards adjustment would take effect.

3.4.3 The 2007 regime

Profit functions

Using the formal implications of the 2007 rule derived in section 3.3.3, we can define the petroleum companies' profit function after tax under this regime as

$$\pi_p = \sum_{i=1}^{n}\{(1-t_i)[F(K_i,L_i)-wL_i]-rK_i+t_i r\cdot 50\%\cdot K_i+t_i r[(b_i^E+b_i^I)-50\%]\cdot K_i\cdot \mathbf{1}_{\bar{b_i}} - \left[C^E(b_i^E)+C^C(b_i,\alpha_i^{2007})\cdot \mathbf{1}_{\bar{b_i}}\right]K_i\}.$$

This leads to the following maximisation problem:

$$\max_{b_i^E,b_i^I}\pi_p = \sum_{i=1}^{n}\{(1-t_i)[F(K_i,L_i)-wL_i]-rK_i+t_i r\cdot 50\%\cdot K_i+t_i r[(b_i^E+b_i^I)-50\%]\cdot K_i \cdot \mathbf{1}_{\bar{b_i}} - \left[C^E(b_i^E)+C^C(b_i,\alpha_i^{2007})\cdot \mathbf{1}_{\bar{b_i}}\right]K_i\},$$

$$s.t.\sum_{i=1}^{n} r\cdot b_i^I\cdot K_i = 0 \text{ and } b_i = b_i^E + b_i^I,$$

which translates into the following Lagrange maximisation problem:

$$\mathcal{L}(b_i^E,b_i^I,\lambda) = \sum_{i=1}^{n}\{(1-t_i)[F(K_i,L_i)-wL_i]-rK_i+t_i r\cdot 50\%\cdot K_i+t_i r[(b_i^E+b_i^I)-50\%] \cdot K_i\cdot \mathbf{1}_{\bar{b_i}} - [C^E(b_i^E)+C^C(b_i,\alpha_i^{2007})\cdot \mathbf{1}_{\bar{b_i}}]K_i\} - \lambda\left(\sum_{i=1}^{n} r b_i^I K_i\right).$$

First-order conditions

Solving the Lagrange problem leads to the four following first-order conditions for external and internal debt ratio, respectively:

$$\frac{\partial \pi_p}{\partial b_i^E} = t_i r - \frac{\partial C^E(b_i^E)}{\partial b_i^E} - \frac{\partial C^C(b_i,\alpha_i^{2007})}{\partial b_i^E} = 0 \; if \; b_i > \bar{b_i},$$

$$\frac{\partial \pi_p}{\partial b_i^E} = -\frac{\partial C^E(b_i^E)}{\partial b_i^E} = 0 \; if \; b_i \le \bar{b_i},$$

$$\frac{\partial \pi_p}{\partial b_i^I} = (t_i - \lambda)r - \frac{\partial C^C(b_i, \alpha_i^{2007})}{\partial b_i^I} = 0 \; if \; b_i > \overline{b_\iota},$$

$$\frac{\partial \pi_p}{\partial b_i^I} = -\lambda r < 0 \; if \; b_i \leq \overline{b_\iota}.$$

Again, letting $\lambda = min_i \; t_i = t_1$ and rearranging the debt tax shields on the left-hand side and the marginal costs on the right-hand side gives us the following:

External debt:

$$t_i \cdot r = \frac{\partial C^E(b_i^E)}{\partial b_i^E} + \frac{\partial C^C(b_i, \alpha_i^{2007})}{\partial b_i^E} if \; b_i > \overline{b_\iota}, \tag{3.12}$$

$$\frac{\partial C^E(b_i^E)}{\partial b_i^E} = 0 \; if \; b_i \leq \overline{b_\iota}. \tag{3.13}$$

Internal debt:

$$(t_i - t_1) \cdot r = \frac{\partial C^C(b_i, \alpha_i^{2007})}{\partial b_i^I} \; if \; b_i > \overline{b_\iota}, \tag{3.14}$$

$$-t_1 \cdot r < 0 \; if \; b_i \leq \overline{b_\iota}. \tag{3.15}$$

Not surprisingly, we end up with a result similar to the 2002 regime. However, as opposed to the 2002 regime, the threshold $\overline{b_\iota}$ is now at 50 per cent instead of 80, and the tightness of the concealment costs has increased.[124] What is then the implication of these differences on the optimal capital structure compared to what it was under the 2002 regime?

Implication of stricter rules and reduced threshold

We know that

$$\frac{\partial C^C(b_i, \alpha_i^{2007})}{\partial \alpha_i^{2007}} > 0,$$

implying that an increase in the tightness of the rules increases the concealment costs. Additionally, we know that

[124] The interpretation of the first-order conditions is still identical to what it was under the 2002 regime.

$$\frac{\partial^2 C^C(b_i, \alpha_i^{2007})}{\partial b_i \partial \alpha_i^{2007}} > 0,$$

implying that an increase in the tightness of the rules also increases the marginal concealment costs. In other words, the 2007 rules were more costly to circumvent, and the net gain of exceeding the threshold was reduced compared to the previous regimes. Intuitively, one could therefore expect that this implied a reduction in the amount of debt exceeding the threshold. Indeed, this can be seen mathematically by using comparative statics to differentiate the first-order condition for internal debt in equation (3.14) with respect to the tightness parameter:

$$\frac{db_i}{d\alpha_i^{2007}} = -\frac{\dfrac{\partial^2 C^C(b_i, \alpha_i^{2007})}{\partial b_i \partial \alpha_i^{2007}}}{\dfrac{\partial^2 C^C\left(b_i, \alpha_i^{2007}\right)}{(\partial b_i)^2}} < 0.^{125} \tag{3.16}$$

Since the concealment cost function is convex, we know that the denominator in the fraction above is positive, implying that equation (3.16) is negative. This meant that an increase in the tightness parameter implied a decrease in the optimal total and internal debt-to-asset ratio. Additionally, since the marginal concealment costs increased while the debt tax shields were unchanged, we can see from the first-order conditions in equations (3.12) and (3.14) that the amount of leverage exceeding the threshold would be reduced.

There would also be a further leverage reduction compared to before. This is because the reduction of the threshold from 80 per cent to 50 per cent implied that the concealment costs now started to occur at an earlier point of leverage than before.

Comparing this to figure 3-6 describing the 2002 regime, the 2007 regime meant that the marginal concealment cost function became steeper and the threshold $\overline{b_i}$ moved to the left. This meant that both area A and B in figure 3-6 became smaller. Apart from these differences, however, the qualitative intuition of the results under this regime remained exactly the same as under the 2002 regime: If the upwards adjustment was not limited by the total interest expenses, a petroleum company would either have an

[125] We do this by defining $H(x, y) \equiv 0$ and use the fact that $\frac{dx}{dy} = -\frac{\partial H/\partial y}{\partial H/\partial x}$.

optimal debt-to-asset ratio of b_i^{E*} or b_i^*. However, as discussed in the two previous paragraphs, b_i^* under the 2007 regime would be lower than under the 2002 regime due to the increased tightness of the thin-capitalisation rules and the reduced threshold.

Optimal capital structure if upwards adjustment was limited

Parallel to the 2002 regime, the upwards adjustment under the 2007 regime would be limited if adjusted offshore deductions reached 100 per cent of total interest expenses. If this was the case under the 2007 regime, we end up with the same result as under the 2002 regime as will be explained below.

Using the same notation as under the 2002 regime, both the external and internal debt tax shields are positive as long as the leverage is below $\widetilde{b_\iota}$. Up to this point, it is optimal to increase leverage either by external or internal debt depending on which is cheapest. When $\widetilde{b_\iota}$ is reached, the marginal debt tax shield in the borrowing affiliate changes to zero. Again, the petroleum company now faces the trade-off between the additional debt costs incurred in order to reach the threshold of $\overline{b_\iota}$, and the net gain of exceeding the threshold. If the net gain of exceeding the threshold was larger than the cost, the optimal leverage would be above the threshold at b_i^*. Otherwise, the optimal leverage would be limited to $\widetilde{b_\iota}$.

Summary

Following our assumptions, the rule for offshore deduction in 2007 was almost identical to what it was under the 2002 regime. However, the two regimes differed because the 2007 rule was harder to circumvent and the threshold was reduced.

The increased difficulty of circumventing the rules implied an increase in the marginal concealment costs. This reduced the amount of leverage exceeding the threshold, which also implied a reduction in the optimal total and internal leverage. Since the threshold in the 2007 regime was reduced, the concealment costs would now occur at a lower level of leverage, also reducing the total optimal leverage. If it was optimal to exceed the threshold, the amount of exceeding debt would therefore now be lower than under the 2002 regime. If it was not optimal to exceed the threshold, the leverage was restricted either to b_i^{E*} or $\widetilde{b_\iota}$, depending on if the upwards adjustment was limited or not. b_i^{E*} and $\widetilde{b_\iota}$ would then be the same as under the 2002 regime.

3.5 Empirical predictions

In this section we summarise our findings from the previous section and use these to make predictions for what we expect to see empirically.[126]

3.5.1 The 1994 regime

Following the optimal capital structures derived under the 1994 regime, we know that it would be optimal to have a debt-to-asset ratio of at least 80 per cent. We should therefore expect that all petroleum companies operating on the Norwegian continental shelf had at least 80 per cent debt and maximum 20 per cent equity. We should also expect that most companies exceeded the threshold at 80 per cent due to the ability to conceal the exceeding leverage.

We predict that very few companies (if any at all) would find that their optimal level of external debt was above the defined threshold of 80 per cent. Thus, from the discussion of the optimal mix of external and internal debt, we expect that most petroleum companies used both external and internal debt.

From the optimality condition stated in equation (3.7), we know that the lower the marginal tax payment in the internal bank is, the higher will the internal debt's share of total leverage be. We therefore expect that petroleum companies with the internal bank in countries facing a relatively low corporate tax rate, should (all else equal) have a higher internal leverage than companies with the internal bank in countries facing a relatively high corporate tax rate.

3.5.2 The 2002 regime

Following the optimal capital structures under the 2002 regime, we know that petroleum companies could end up with different adaptations. We primarily expect to see a bifurcation with respect to the chosen capital structures: One group of petroleum companies is expected to have leverage below the threshold with a dominating share being external debt. The other group of petroleum companies is expected to have more

[126] Note that following our models' strict assumptions, it is clear that the empirical results will not necessarily coincide with our theoretical predictions. Additionally, if they do coincide, this is not necessarily due to the effects predicted in the theory.

or less the same level of total debt and the same mix of external and internal debt as under the 1994 regime.

We expect that companies adapting below the threshold will typically be small or newly established. One could argue that these companies face higher risks than larger, more established companies and will thus also face higher marginal costs of external debt, making area A in figure 3-6 larger. In addition, they may have a less developed intra-group infrastructure, making profit shifting to an internal bank more difficult as well as insufficient funds or expertise for tax engineering, making area B in figure 3-6 smaller and area A even larger. Hence, we expect that these companies would typically be adapted below the threshold.

3.5.3 The 2007 regime

In our theoretical models, we have assumed that all debt is interest bearing and theoretically we could therefore compare the threshold of 50 per cent under the 2007 regime with the threshold of 80 per cent under the previous regimes. However, as stated in footnote 68 in chapter two, the thresholds cannot be directly compared empirically.

Following the 2007 models' results, we expect to see the same bifurcation with respect to the chosen capital structures as under the 2002 regime, but the bifurcation from 2007 should be above and below 50 per cent interest-bearing debt. In addition, as under the 2002 regime, we expect that small, newly established firms will typically adapt below the threshold, while larger, more established firms will adapt above. Finally, we also expect that for companies exceeding the threshold, the amount of exceeding debt relative to the threshold should be lower than before because the 2007 rules were harder to circumvent.

Chapter 4: Empirical observations

In this chapter, we provide some descriptive analyses based on empirical observations of debt from the Norwegian Petroleum Sector. In section 4.1 we provide a description of the data used while the empirical observations are presented and discussed in sections 4.2 and 4.3.

4.1 About the data

For consistency purposes, we would have liked to use the same database for all our descriptive analyses. We have access to the accounting database created by the Centre for Applied Research at NHH (SNF) that contains accounting figures for all Norwegian corporations from 1992 to 2011. However, after proof checking variables such as internal debt with the companies' annual reports we have found the database to be too unreliable with respect to some of the figures we require. This can be partially rectified by using figures in the annual reports, but a problem with this approach is that not all annual reports are available and not all the available annual reports explicitly show the figures we need. Thus, relying solely on this database is not possible.

However, the SNF database seemed to be consistently correct with respect to the debt-to-asset ratio for most of the largest petroleum companies. We have therefore chosen to use the database to provide an overview of the debt-to-asset ratio for the largest companies operating on the Norwegian continental shelf from 1992 to 2011. For groups that have several subsidiaries in Norway, we have chosen the subsidiary with the consistently highest revenue in the database.

With respect to the analysis of internal and external interest-bearing debt, we have chosen to use the Petroleum Tax Office's 2013 report *"Petroleumssektoren og petroleumsskatten i tall og trender"*.[127] This gives a quantitative aggregate overview over the total long-term interest-bearing debt for all petroleum companies operating on the Norwegian continental shelf as well as the share of this which is internal debt from 2005 to 2011.

Our data sources therefore limit our empirical observations to the following:

[127] Petroleum Tax Office (2013), pp. 27-28.

I) Total debt-to-asset ratio for selected companies from 1992 to 2011

II) Total long-term interest-bearing debt for companies operating on the Norwegian continental shelf from 2005 to 2011

III) Internal debt as a share of total long-term interest-bearing debt for companies operating on the Norwegian continental shelf from 2005 to 2011

4.2 Total debt-to-asset ratio

4.2.1 Company selection

Our initial selection consists of the nine companies that Norwegian Petroleum Directorate categorises as "Large Norwegian companies" and "Integrated international petroleum companies". These are shown in table 4-1 below.

NPD selection

Large Norwegian companies	*Integrated international petroleum companies*
Statoil Petoro	BP Chevron ConocoPhillips Eni ExxonMobil Shell Total

Table 4-1: Petroleum companies in our initial selection from the Norwegian Petroleum Directorate
Source: Norwegian Petroleum Directorate (2013b)

As mentioned in chapter two, Petoro manages SDFI and is not an operating entity. We therefore exclude this company from our final selection. Additionally, we remove Chevron as the recorded revenue for the chosen Norwegian subsidiary is mistakenly low. The final selection of companies, the corresponding Norwegian subsidiary we have chosen for each company together with observation years are shown in table 4-2 below.

Our selection

Group name	*Chosen Norwegian subsidiary*	*Observation years*
BP	BP Norge AS	2011-1999
ConocoPhillips	ConocoPhillips Skandinavia AS	2011-1992
Eni	Eni Norge AS	2011-1992
ExxonMobil	ExxonMobil Exploration and Production AS	2011-1992
Shell	A/S Norske Shell	2011-1992
Statoil	Statoil Petroleum AS	2011-2007
Total	Total E&P Norge AS	2011-1992

Table 4-2: Final selection of petroleum companies with Norwegian subsidiaries and observation years

4.2.2 Observations and comparison to theory

The debt-to-asset ratios for these subsidiaries in the years 1992 to 2011 are shown in figure 4-1 below:

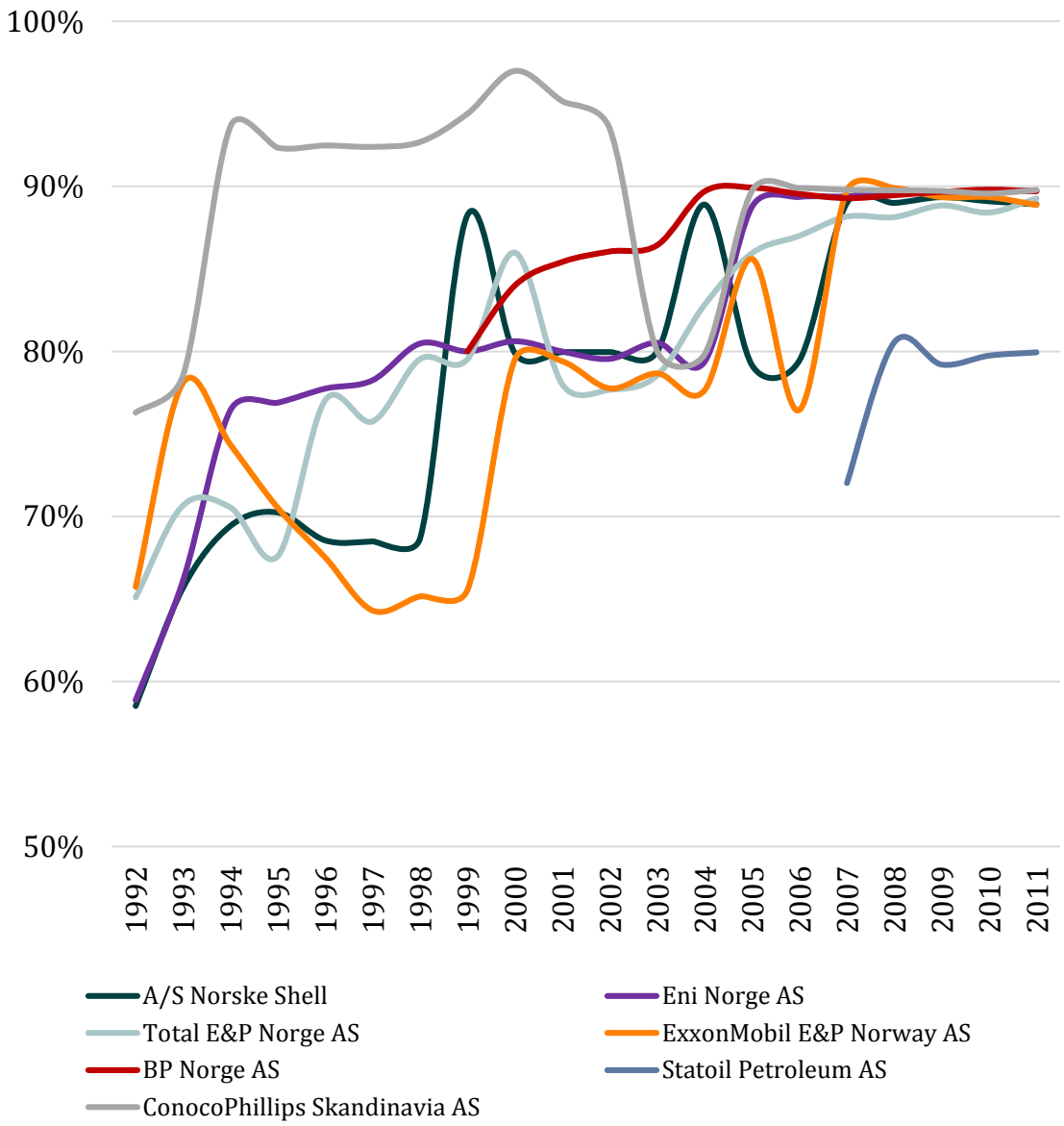

Figure 4-1: Debt-to-asset ratio for selected subsidiaries of petroleum companies operating on the Norwegian continental shelf, 1992-2011

Source: Figures from SNF database, own illustration

In order to provide a clearer view of the overall trend over the years of observation, the average debt-to-asset ratio for the same subsidiaries is shown in figure 4-2 on the next page.

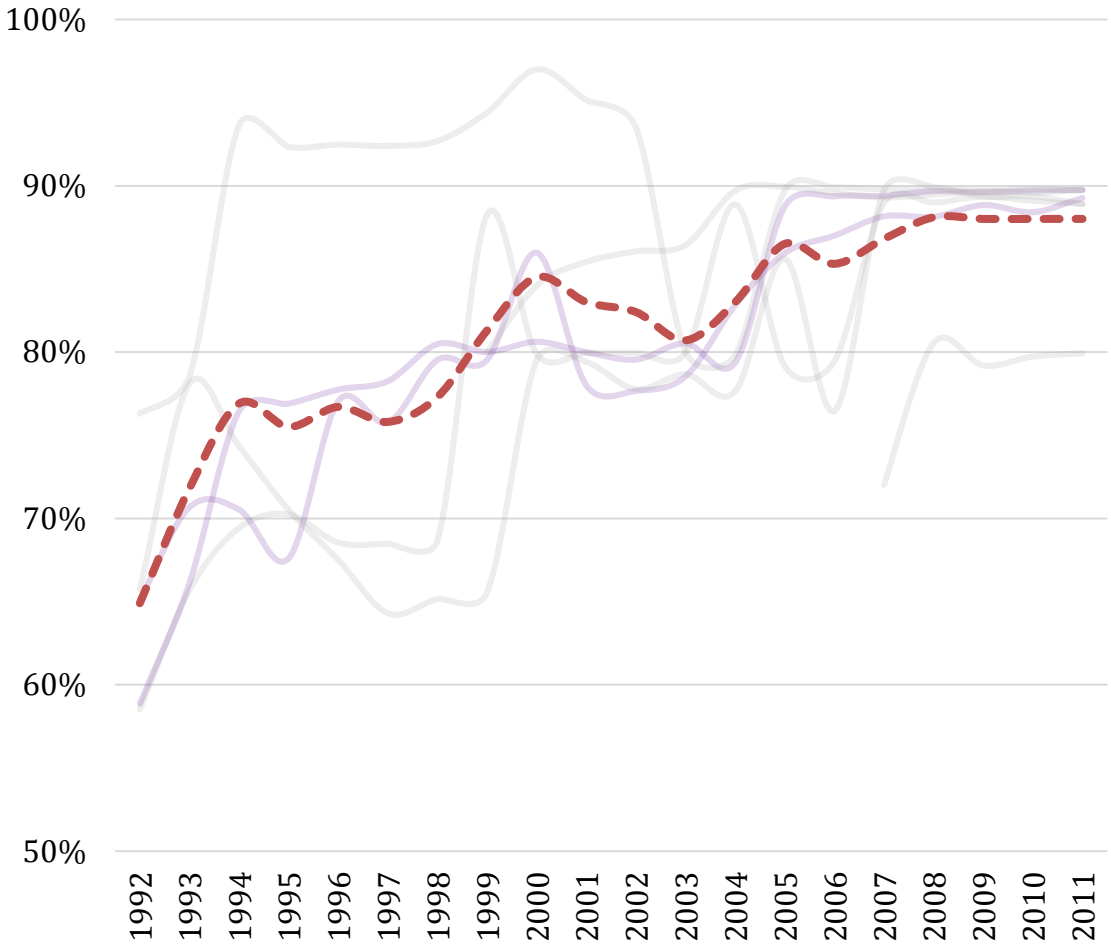

Figure 4-2: Average debt-to-asset ratio for selected subsidiaries of petroleum companies operating on the Norwegian continental shelf, 1992-2011

Source: Figures from SNF database, own illustration

We see from the figures above that the overall trend over the last 20 years has been that the petroleum companies have increased their debt-to-asset ratio from an average of around 65 per cent to around 88 per cent in 2011.

As mentioned in chapter two, an unintended effect of the tax and accounting reforms in 1992 was that they gave petroleum companies stronger incentives to be thinly capitalised. This can explain the sharp increase in leverage from 1992 to 1994.

In 1994, the same year that the first thin-capitalisation rule was introduced, we see that the sharp increase levels out on average just below 80 per cent. In the following years, however, leverage continues to increase and exceeds 80 per cent in 1999. Although petroleum companies did not increase leverage to at least 80 per cent in 1994 (contrary to what we predicted), we see that by widening the time horizon, the predictions from

our theoretical model coincide quite well with what we see as most companies either come close or exceed the threshold by 1999.

Our theoretical model for the 2002 regime predicts that leverage should either be unchanged from the 1994 regime or be reduced to under the threshold. From figure 4-2, we see that the average leverage is in fact reduced from 2002 to 2003, but the average is still over the threshold. By looking at figure 4-1, we see that the average reduction is primarily due to ConocoPhillips Skandinavia AS' significant reduction in leverage from the mid-90s to around 80 per cent. Figure 4-1 also shows that by 2003, most of the companies had leverage at around 80 per cent, which is more or less the same as the case before 2002. Thus, it looks like leverage was largely unchanged compared to what it was under the 1994 regime, which coincides with one alternative of the 2002 models' prediction.

However, from the discussion of the 2002 model in chapter three and especially figure 3-6, we know that by having leverage at 80 per cent meant that companies only incurred the cost of additional debt (area A) without gaining the benefit of the tax shield from debt exceeding the threshold (area B). Since most companies kept their leverage at around 80 per cent, other mechanisms that affected the capital structure choice were obviously in play.

From 2003, there was more or less a steady increase in leverage up to 2007 where perhaps the most striking feature of the figures incurred, namely that the leverage for all petroleum companies except for Statoil Petroleum AS converged to 90 per cent. As stated in our empirical predictions for the 2007 rule, the threshold of 50 per cent in the 2007 model cannot be directly compared to the previous threshold of 80 per cent as the 2007 rule targeted interest-bearing debt and not total debt. As our empirical observations are based on the total-debt-to-asset ratio, we can therefore not compare the observations directly to the threshold in the theoretical model. Nevertheless, since almost all the companies' leverage converged to 90 per cent in 2007, it seems as if the 2007 rule did not contribute to a significant reduction in thin capitalisation.[128]

[128] A 10 per cent equity-to-asset ratio is also the limit for being allowed to pay out dividends as stated in § 8-1 in the Norwegian act relating to limited liability companies (Aksjeloven).

However, since the problem of thin capitalisation is tied to interest deductibility and that non-interest-bearing debt makes up a large share of many petroleum companies' total debt, looking at the total debt-to-asset ratio does not give a correct picture of the current regime's ability to limit thin capitalisation.[129] We therefore provide an overview of the development in interest-bearing debt in the sector from 2005 in the next section.[130]

[129] See e.g. annual reports for A/S Norske Shell and Total E&P Norge AS where non-interest-bearing debt such as deferred tax and provisions make up a significant share of total debt.

[130] While the empirical observations so far are based on seven companies from 1992 to 2011, the empirical observations in the next section are based on all petroleum companies operating on the Norwegian continental shelf from 2005 to 2011. For consistency, we would preferably have used the same seven companies with the same time horizon in the next section. However, as mentioned in section 4.1, this was unfortunately not possible with the available data.

4.3 Long-term interest-bearing debt and internal debt share

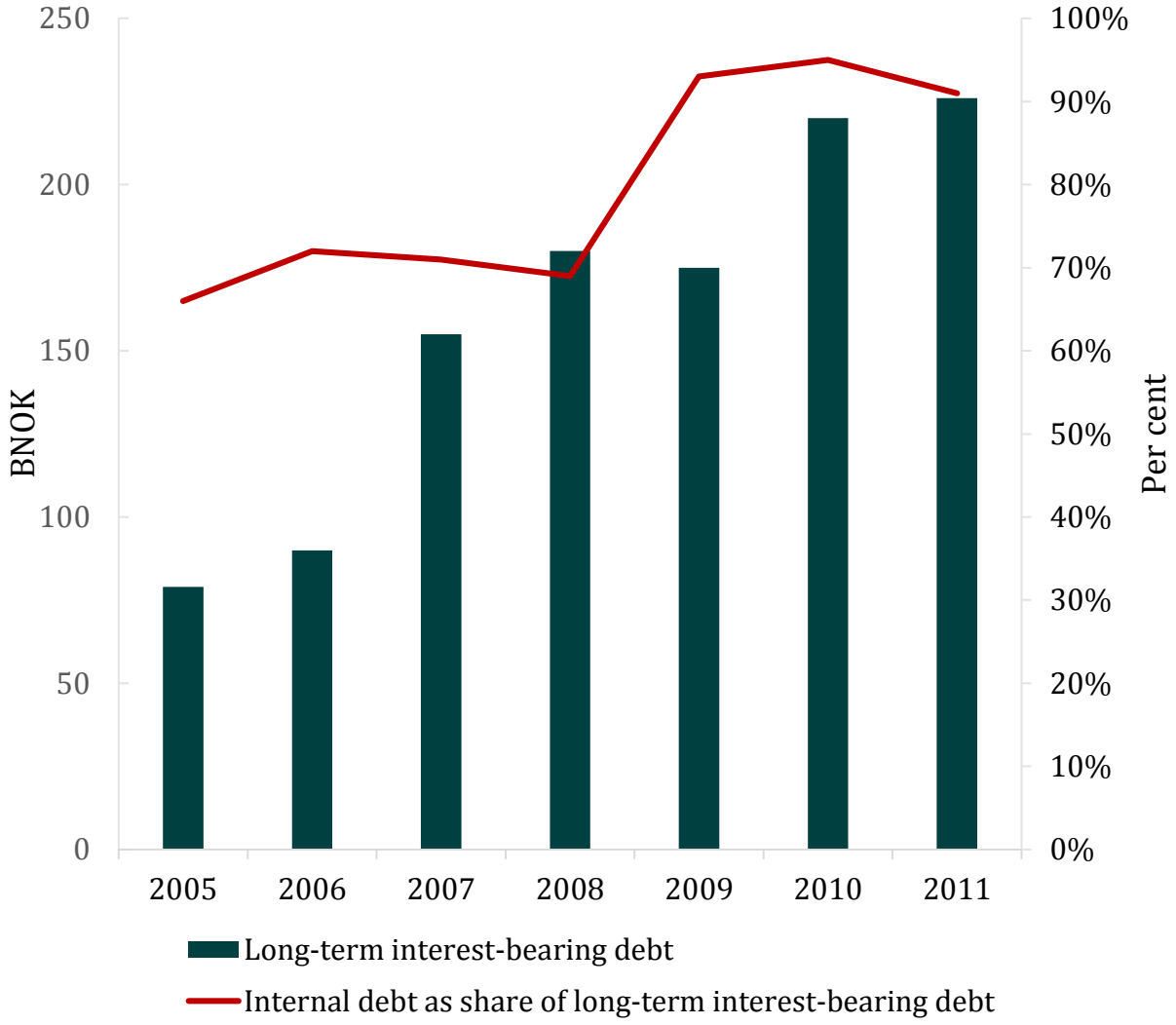

Figure 4-3: Development of long-term interest-bearing debt in the Norwegian petroleum sector and the share of internal debt, 2005-2011

Source: Approximate figures from the Petroleum Tax Office (2013), own illustration

As seen above, there was a large increase in interest-bearing debt from around 80 BNOK in 2006 to some 150 BNOK in 2007. In reference to the previous section, it indeed seems as if the 2007 regime did not contribute to a reduction in thin capitalisation but rather an increase. This is also in contrast with our theory that predicted the current regime to be stricter than before. Unfortunately, we are unable to compare the empirical observations to the threshold defined in the 2007 rule as we do not have figures for long-term interest-bearing debt in relation to total capital.

Comparing the observations of internal debt to our theory, it is indeed evident that the high tax rate in the petroleum sector is driving the internal leverage up significantly. Moreover, comparing the observations to the 2007 model, the optimal external leverage (b_i^{E**}) is substantially lower than the optimal level of internal debt. If we look to our optimal mix condition stated in equation (3.7), it therefore seems as if the marginal cost of external debt was equal to the marginal tax payment in the internal bank at a low point of leverage.

There was no significant change in the use of internal debt from 2007 (when the current regime was introduced) to 2008, but then a sharp increase followed in 2009. A reason for this could be the financial crisis in 2008 where interest rates rose sharply. To see why, we can use the optimal mix condition in equation (3.7) again. Since the rise in interest rates made external debt more expensive, the marginal cost of external debt increased. With the likely assumption that the marginal tax payment to the internal bank was unchanged, the point where the (increased) marginal cost of external debt was equal to the (unchanged) marginal tax payment was lower than before the crisis. This can also be seen by looking at figure 3-3 in chapter three. The increased marginal external debt cost function in the figure was now steeper than before, and the point where the optimal mix condition was satisfied (b_i^{E*}) moved to the left. Thus, the internal debt's share of total interest-bearing debt increased.

Summarising, the empirical observations of interest-bearing debt in 2007 do not seem to be in line with our theoretical predictions for the regime as interest-bearing debt rose sharply. However, the significant increase in internal debt in 2009 can be explained by our optimal mix condition for external and internal debt.

Chapter 5: Conclusions and suggestions for further research

5.1 Conclusions

In this thesis we have looked at the thin-capitalisation rules in the Norwegian petroleum sector, theoretically modelled some of their features and derived the petroleum companies' optimal capital structures under each rule regime. The question we have sought to answer is:

"From a theoretical perspective, how have the thin-capitalisation rules in the Norwegian petroleum sector restricted the use of internal and external debt?"

There have been three different rule regimes; 1994, 2002 and 2007. The 1994 regime introduced the first thin-capitalisation rule which reduced the net financial costs allocated offshore if total debt exceeded 80 per cent. The regime in 2002 further introduced an upwards adjustment rule that increased net financial costs allocated offshore if total debt was below 80 per cent. However, this upwards adjustment would only take effect as long as the increased net financial costs offshore were below 100 per cent of the companies' total net financial costs. The 2007 regime combined the reduction and increase mechanisms of the previous regimes, but had a threshold defined over interest-bearing debt at 50 per cent.

Due to the complexity of the rules, we have imposed some strict assumptions in our theoretical models. We ignore all financial income and let all financial costs be interest expense on interest-bearing debt. Moreover, we assume that all debt is interest bearing. Additionally, we ignore any activities onshore and thereby also the allocation of net financial costs offshore and onshore. Finally, we assume that the optimal level of external debt is always below the defined threshold, and that the reduction mechanism under each rule regime is to a certain extent possible to circumvent through tax engineering.

We find that under the 1994 regime, all petroleum companies would have a leverage of at least 80 per cent, consisting of both external and internal debt. Furthermore, we find that the optimal mix of external and internal debt is reached when the marginal cost of external debt is equal to the marginal tax payment in the internal bank.

With the introduction of the upwards adjustment in 2002, we find that petroleum companies had several optimal adaptations. Since the upwards adjustment mechanism implied that companies would get interest deduction *as if* they had 80 per cent leverage, it was sometimes optimal to have leverage below the threshold of 80 per cent without any internal debt. Only if the additional debt costs incurred by increasing leverage to the threshold were larger than the net gain of exceeding it, would companies exceed the threshold. They would then have the same capital structure as they did under the 1994 regime.

In cases where the upwards adjustment was limited, it would always be optimal to increase leverage up to the point where the upwards adjustment started to take effect. From this point, it was only optimal to increase leverage further if the additional debt costs incurred by reaching the threshold were larger than the net gain of exceeding it. If this was the case, leverage would exceed the threshold and again be the same as it was under the 1994 regime.

Under our strict assumptions, the current 2007 regime turns out to be largely similar to the 2002 regime, with differences being that the reduction mechanism under the 2007 regime was harder to circumvent and that the threshold was reduced. We find that in the cases where it was not optimal to increase leverage beyond the threshold, the optimal capital structures would be identical to under the 2002 regime. It could still be optimal to exceed the threshold, but the increased difficulty of circumventing the reduction rule and the reduced threshold implied that the optimal leverage would be lower than under the 2002 regime.

When looking at the total debt-to-asset ratio for selected petroleum companies between 1992 and 2011, the observations coincide largely with what our model predicts under the 1994 regime. Observations also coincide with one of the alternatives under the 2002 regime stating that leverage should be unchanged compared to the previous regime. However, since most companies do not exceed the threshold of 80 per cent, they are (according to our model) only incurring the additional debt costs from reaching the threshold and not gaining the benefits of exceeding it. Other mechanisms must therefore be in play that alter our theoretical predictions.

In 2007, under the current regime, the companies' total leverage converges to 90 per cent while the interest-bearing debt for the sector in total increases from around 80 BNOK in 2006 to some 150 BNOK in 2007. Thus, the 2007 regime did not seem to contribute to a reduction in thin capitalisation, but rather an increase that contradicts what our theory predicted. Up to 2009, internal debt made up around 70 per cent of total interest-bearing debt in the sector, while this figure rose to over 90 per cent in 2009. We believe this is largely due to the increase in interest rates following the financial crisis in 2008, which is supported by our optimal mix condition for external and internal debt.

5.2 Suggestions for further research

During our work with this thesis, we have discovered several interesting areas that have been outside the boundaries of the thesis, but highly relevant to the subject we are writing about. In the following, we will present some of these areas which we believe should be subject for further research.

5.2.1 Consistent database with more companies and variables

Following our discussions in chapter four, it would be highly preferable to create a database that has consistent and correct data for more petroleum companies and variables for the years we are looking at. As the SNF database already contains a lot of data on the Norwegian petroleum sector, this would be a natural place to start. Such a database could also be used for econometric analyses of the variables we have described in our models in order to pinpoint the rules' exact impact on the petroleum companies' total leverage and mix of external and internal debt over the years.

5.2.2 Offshore and onshore shifting

Due to the differing corporate tax rates offshore and onshore, petroleum companies can use onshore affiliates as internal banks and shift internal debt to offshore affiliates. Thus, petroleum companies do not necessarily need to utilise cross-country tax differentials to profit from internal debt shifting, but rather the cross-district tax differential offshore and onshore. An interesting subject to study would therefore be if and how petroleum companies shift internal debt between its affiliates onshore and offshore.

5.2.3 The thin-capitalisation rules' effect on real investment

As noted in Ruf and Schindler (2012), tightening of binding thin-capitalisation rules (i.e. thin-capitalisation rules that restrict leverage) has a negative effect on real investment by MNCs due to higher capital costs. As we state in chapter two, it is important for the Norwegian State to stimulate to activity on the Norwegian continental shelf to be able to reap the benefits of the petroleum resources. Thus, ensuring that the thin-capitalisation rules do not have an overly adverse effect on real investment on the Norwegian continental shelf is crucial. Investigating the thin-capitalisation rules' impact on real investment in petroleum companies would therefore be a highly interesting subject.

Chapter 6: Appendix

6.1 Petroleum companies operating on the Norwegian continental shelf

Table 2-1 - Petroleum companies operating on the Norwegian continental shelf

Company	Category
Statoil	Large Norwegian companies
Petoro	Large Norwegian companies
BP Norge	Integrated international petroleum companies
Chevron	Integrated international petroleum companies
ConocoPhillips	Integrated international petroleum companies
Eni	Integrated international petroleum companies
ExxonMobil	Integrated international petroleum companies
Shell	Integrated international petroleum companies
Total	Integrated international petroleum companies
Bayerngas	European gas/power companies
Centrica	European gas/power companies
Dong	European gas/power companies
E.ON	European gas/power companies
Edison	European gas/power companies
GDF Suez	European gas/power companies
PGNiG	European gas/power companies
RWE Dea	European gas/power companies
VNG	European gas/power companies
BG	Medium-sized companies
Cairn	Medium-sized companies
Det norske	Medium-sized companies
Idemitsu	Medium-sized companies
Lotos	Medium-sized companies
Lundin	Medium-sized companies
Maersk	Medium-sized companies
Marathon	Medium-sized companies
OMV	Medium-sized companies
Premier	Medium-sized companies
Repsol	Medium-sized companies
Suncor	Medium-sized companies
Talisman	Medium-sized companies
Wintershall	Medium-sized companies
Bridge	Small companies
Concedo	Small companies
Core	Small companies
Dana	Small companies
Emergy	Small companies
Explora	Small companies

Company	Category
Fortis	Small companies
Noreco	Small companies
Norske AEDC	Small companies
North	Small companies
Petrolia	Small companies
Rocksource	Small companies
Skagen44	Small companies
Skeie	Small companies
Spring	Small companies
Svenska	Small companies
Valiant	Small companies

Source: Norwegian Petroleum Directorate (2013b)

6.2 Notation overview

Below, the notations used in chapter three are presented in the same order as they appear in the text.

Notation	Description
$\boldsymbol{i}$	countries with affiliate of a multinational company
$\boldsymbol{D_i}$	total debt in affiliate i
$\boldsymbol{E_i}$	equity in affiliate i
$\boldsymbol{D_i^E}$	external debt in affiliate i
$\boldsymbol{D_i^E}$	internal debt in affiliate i
$\boldsymbol{X_i}$	produced good in affiliate i
$\boldsymbol{K_i}$	real capital in affiliate i
$\boldsymbol{L_i}$	labour in affiliate i
$\boldsymbol{p}$	the country in which the parent of the MNC is domiciled
$\boldsymbol{t_i}$	country-specific corporate tax rate in affiliate i
$\boldsymbol{r}$	cost of capital
$\boldsymbol{t_i \cdot r \cdot D_i^E}$	external debt tax shield
$\boldsymbol{C_i^E}$	net costs of external debt
$\boldsymbol{b_i^E}$	external debt-to asset-ratio
$\boldsymbol{b_i^{E*}}$	optimal external debt-to-asset ratio in absence of taxation
$\boldsymbol{b_i^{E**}}$	optimal external debt debt-to-asset ratio taking taxation into account
$\boldsymbol{(t_i - t_1) \cdot r \cdot D_i^I}$	internal debt tax shield
$\boldsymbol{t_1}$	corporate tax rate in the internal bank
$\boldsymbol{b_i^I}$	internal debt-to-asset ratio
$\boldsymbol{\overline{b}_i^I}$	threshold for internal debt
$\boldsymbol{C^I}$	concealment costs for internal debt
$\boldsymbol{\alpha_i}$	a measure of tightness in thin-capitalisation rules

Notation	Description
C^I	concealment costs for total debt
$DTS_{i\neq 1}$	debt tax shield in the borrowing affiliate
π_i^e	general economic profit in affiliate i before tax
$F(K_i, L_i)$	product function in affiliate i
w	cost of labour
C^D	general debt cost function
π_i	economic profit in affiliate i after tax
π_p	MNC's world-wide profit after tax
λ	Lagrange parameter representing the corporate tax rate in the internal bank
b_i	total debt-to-asset ratio
$\bar{b_i}$	threshold for total debt-to-asset ratio
b_i^*	optimal total debt-to-asset ratio
b_i^{I*}	optimal internal debt-to-asset ratio
$\widetilde{b_i}$	the point where the total interest expense becomes large enough for the upwards adjustment under the 2002 and 2007 regimes to take effect

Chapter 7: Bibliography

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