Do firms hedge in response to tax incentives? Evidence from Norway

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Preface

In the period from September 2013 to May 2014 I have written this master thesis for the School of Management and Governance at the University of Twente.

I wrote this thesis out of an interest for the subject of risk management obtained through the course Risk Management at the University of Twente, and I feel I have obtained great knowledge from writing the thesis, which has sparked further interest for the subject.

I would like to thank my first supervisor Xiaohong Huang for her kind support in writing this thesis. Further, I would like to thank my second supervisor, for his useful feedback and guidance.

I would also like to thank my parents for their unwavering support and belief in my abilities. Finally, I would like to thank my girlfriend, Karoline Markussen for her encouragement and support throughout the master programme.

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Christopher Bye Hoel

Abstract

This study presents two potential tax incentives for firms to hedge. Firstly firms can hedge in response to tax convexity in order to smooth company earnings. Secondly firms can use derivatives to decrease costs of financial distress and increase debt capacity, thus increasing tax shields of the firm. I empirically test whether Norwegian firms hedge in response to tax incentives arising from tax convexity. A logistic regression is used to compare hedging and no hedging Norwegian nonfinancial firms for the year of 2012 in relation to proxies for tax convexity. The results do not show a significant relationship between proxies for tax convexity and contradicts the theoretical basis for the main hypothesis. The results do not show proof of tax incentives to hedge through tax preference items, such as tax loss carryforwards. Hedging seems to be related to agency cost, profitability leverage and to a certain degree; firm size measured by total assets.

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1: Introduction

Risk-management theory rests on incentives to decrease firm risk, and recent research on risk management and derivatives in a financial management context often take the focus of the relationship between derivative use for hedging purposes and firm value. Studies that describe various factors affecting firm value as an effect of derivative use such as Fauve & Naranjo (2010), Guay (1999) and Fok et al. (1997) show diverged and conflicting results in regards to their empirical results.

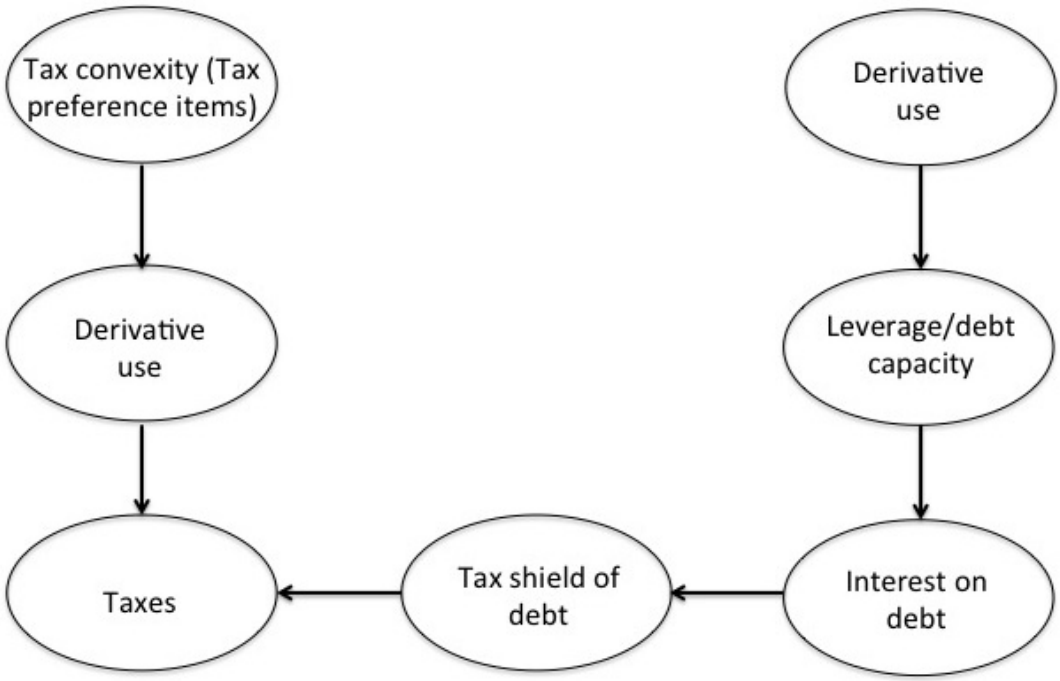
According to Modigliani & Miller (1958), hedging does not affect firm value in the absence of market imperfections. Corporate risk management theory on the other hand, inherently implies that market imperfections exist. If there are no market imperfections, we have no need for risk management, but evidence from empirical studies suggests that firms address imperfections through measures presented in risk management theory. Theory states that derivative use addresses market imperfections such as financial distress costs and decreased expected bankruptcy costs (Smith & Stulz (1985), reduced cash flow volatility (Graham & Smith (1999), Froot et al. (1994)), and decreased taxes (Smith & Stulz 1985).

In a taxation context, studies such as Smith & Stulz (1985) theorise that derivatives can affect taxes through stabilization of income volatility in a situation of tax convexity. It is assumed that for most countries, a company's effective tax rate increases in relation to pre-tax income, and that there are benefits to managing this taxable income so that it falls in an ”optimal” range, neither to high or too low, leading to lower tax payments (Stulz, 1996).

The empirical evidence done on derivative use in relation to taxation does not always correspond with the theory on the subject. For example, studies such as Fok et al. (1997) and Graham & Rogers (2002) do not find significant relationships between reduced expected tax liabilities and derivative use. This is somewhat surprising, considering the reduction of expected tax liability is considered by Smith & Stulz (1985) to be one of the major benefits of derivative use in risk management, and the reduction of costs of debt through tax shields, intuitively suggests increased debt capacity and thus larger tax deductions. The effect of risk management on corporate taxation can potentially affect both profitability and firm value. The effect of derivative use on corporate tax shields, hereunder the effect on expected tax liabilities and the stabilization of income continues to be a subject on which the results of previous research is mixed.

The suggested direct and indirect relationship between derivatives and taxation is presented in figure 1

Figure 1: The Proposed Relationship Between Derivatives, Debt and Taxes



With the proposed relationship presented in figure 1 in mind, I will contribute to the literature by looking at a small and little researched, but potentially important region and see if a relationship can be found. The Norwegian economy holds a unique position in the European economy in terms of regulation, stemming from a conscious choice of taking what the economist calls "the middle way" between socialism and capitalism. Due to the country's attitude towards corporation taxation and regulation, the strong labour movement, as well as the incentives to keep corporations in districts vivid and thriving through different payroll-taxes in different counties, Norway's conditions are quite different in terms of corporate taxation and income from previously researched countries such as the UK or the US. Norway is a constitutional monarchy and a parliamentary democracy, with a population just under 5 million inhabitants. The question is: What is different and why is research on such a small country important?

The tax-structure makes Norway an interesting region for research, as the sheer size of some taxes might be enough to create tax-incentives for hedging. The Norwegian tax system is a dual taxation system, which means private persons and sole proprietorships face a convex tax rate. This makes their tax rate rise on alignment with their profit in the case of firms, and with their income in case of private persons. Limited companies on the other hand, are subject to a flat statutory tax rate of 28 %. The exception is the counties of Finnmark and Nord-Troms, where the statutory rate is 24,5 % (Skatteetaten, 2013). This is fundamentally different from the US, which face a convex tax rate, through statutory rates that increase based on corporate profits. According to KPMG, the corporate tax in Norway is similar to the Netherlands, which has a flat rate of 25

%, while the UK operates with two stages, one for small companies under 1,5 million GBP and one for companies above.

The statutory rate is not the only tax incurred on Norwegian companies. As much of Norway's industry comes from the petroleum Industry and electricity production, there is an addition to the flat statutory rate in form of higher taxes on income from companies operating in the petroleum industry and the power plant industry (Finansdepartementet, Petroleumsskatteloven, 1975). The petroleum tax is currently at 51 % in addition to the ordinary tax on profit, making the marginal tax for companies extracting petroleum 79 % (Finansdepartementet, Regjeringen.no, 2013). For power plants the additional tax is more complicated and not derived directly from income. Power plants face an additional tax of 30 % on resource rent, calculated as a stipulated market price of the power plants' production, after deduction of operating expenses, license fees, property taxes and depreciation (Finansdepartementet, Regjeringen.no, 2013). The Norwegian taxation regime may thus prove to have greater incentives to hedge with derivatives than comparable counterparts, which makes this region an interesting population for research.

This study attempts to shed light on the hedging policies of Norwegian firms, and whether or not Norwegian firms are using derivatives to manage taxes and if increased taxation as a result of industry is an incentive to use derivatives to manage taxation. Using a logistic regression the effects of tax convexity on derivative use is examined through commonly used proxies for tax convexity in order to investigate whether firms hedge in response to tax convexity.

I propose the following criteria for the research question: The firm is a listed Norwegian nonfinancial firm with main office in Norway, with available information through PINavigator and Brønnøysundregistrene or similar databases. I thus propose the following research question to be answered:

Do Norwegian firms hedge in response to tax incentives? (Hedge in response to tax convexity)

In order to give an answer to the main question, it is necessary to divide the question into two subquestions as theory presents two ways derivative use can affect taxation namely through the reduction of income volatility directly and through increased debt capacity.

2: Literature Review:

In this part, derivatives are defined and the benefits of derivative use with focus on tax benefits are discussed.

2.1: What Are Derivatives and How Are They Used?

According to Hull (2011), derivatives are considered to be the use of futures contracts, forward contracts and options used for hedging, speculation and arbitrage. The derivative encompasses an agreement to buy or sell an asset at a certain time for a certain price, in various ways. Such an agreement can be made through an exchange in the case of futures, over-the-counter in the case of forwards or, in the case of options; both. In addition there are other forms of derivatives such as swaps. Smith & Stulz (1985) define hedging as trading in particular futures, forwards, or option markets even though the entity has no significant cash position in the commodity in question. Further, Smith & Stulz (1985) state that firms may hedge by changing actual operating decisions, a so-called operating hedge. It is important to emphasize that the purpose of this paper is the use of derivatives for hedging purposes, and not derivatives that are used for speculation, and studies such as Geczy et al. (1997) find that firms in general use derivatives for hedging rather than speculation.

Graham & Rogers (2002) measure derivative hedging as a "long or short" position in interest rate derivatives or currency derivatives. They state that the long interest position is one that benefits from the rising interest rates, for example interest rate swaps, that pays a fixed rate and receives a floating rate, while a long currency derivative position benefits from a price increase in a currency other than the US dollar. Similarly, a short interest rate position benefits from the decreasing interest rates, while a short currency derivative position benefits from declining foreign currency prices.

In a taxation context, hedging can be used in various ways. A company can for example use hedging in futures to carry a profit of a purchase forward and thus smooth company earnings to minimize taxes. A different example could be tax planning using options in order to receive income from securities and capital gains in different countries the company operates, depending on the tax advantages of the specific country (Hull, 2011). The principle for use in this paper is quite simple: By using derivatives to reduce volatility in taxable income through for example futures and forwards to hedge commodity prices or currency hedging, one reduce the expected tax liability. The expected tax liability can be reduced by controlling the recognition of taxable gains and losses. It is claimed by literature presented in this study that this advantage of hedging is greater when firms face tax convexity, which leads to the hypothesis that firms facing more convex tax schedule hedge more. The advantage can easily be shown by exemplifying a simple futures contract hedge similar to an example made by Hull (2011): Theoretically, if the firm has tax loss carryforwards which can be deducted from income in 2012, then the firm can take a long position in a futures contract in 2011, and close out the position in 2012. If the firm hedges the purchase of a good in 2011, the purchase will be realized in 2012 for accounting

purposes. This is called hedge accounting. Then, if the losses from previous years can be carried forward to 2012, one can offset this amount and reduce tax liability. This way, hedging with derivatives can contribute to smooth company earnings and losses and reduce the expected tax liability.

Information about derivative use has not always been considered public information. With IAS 39, financial instruments are required to be recognized in the firm's financial statements, which means that under IFRS, companies must disclose their derivative position. In this study, hedging will be defined in accordance with the previous studies of Graham & Rogers (2002), Nance et al. (1993) and Fauver & Naranjo (2010), and are defined as users of financial instruments, namely options, forwards, futures and swaps.

2.2: Theory of Tax Incentives to Hedge

Theory argues for two main ways for a company to affect taxes with derivatives. Graham & Rogers (2002) argue that companies hedge to increase debt capacity & interest tax deductions. Secondly, they propose that firms hedge to reduce expected tax liability when the tax function is convex. It is further claimed by Graham & Smith (1999) that if a firm faces a convex tax function, then hedging stabilizes taxable income, which reduces the firms expected tax liability. Literature mostly builds on research by Smith & Stulz (1985) and their theory on derivatives and corporate tax. Smith & Stulz (1985) theorise that if the statutory tax function is convex, there can be tax reducing benefits of hedging through tax credits and decrease in corporate tax liabilities.

(1) Theory: Hedging to Reduce Expected Tax Liability:

Mayers & Smith (1982) state that provisions such as marginal tax rates and zero interest rates in the tax code can lead to increased incentives for corporate insurance. They further claim that hedging can reduce a corporation's expected tax liability and that the carry-back and carry-forward provision has the potential to change the firm's effective marginal tax. In addition they claim that the progressivity in the corporate profits tax, and that by carrying losses forward, one can reduce taxes.

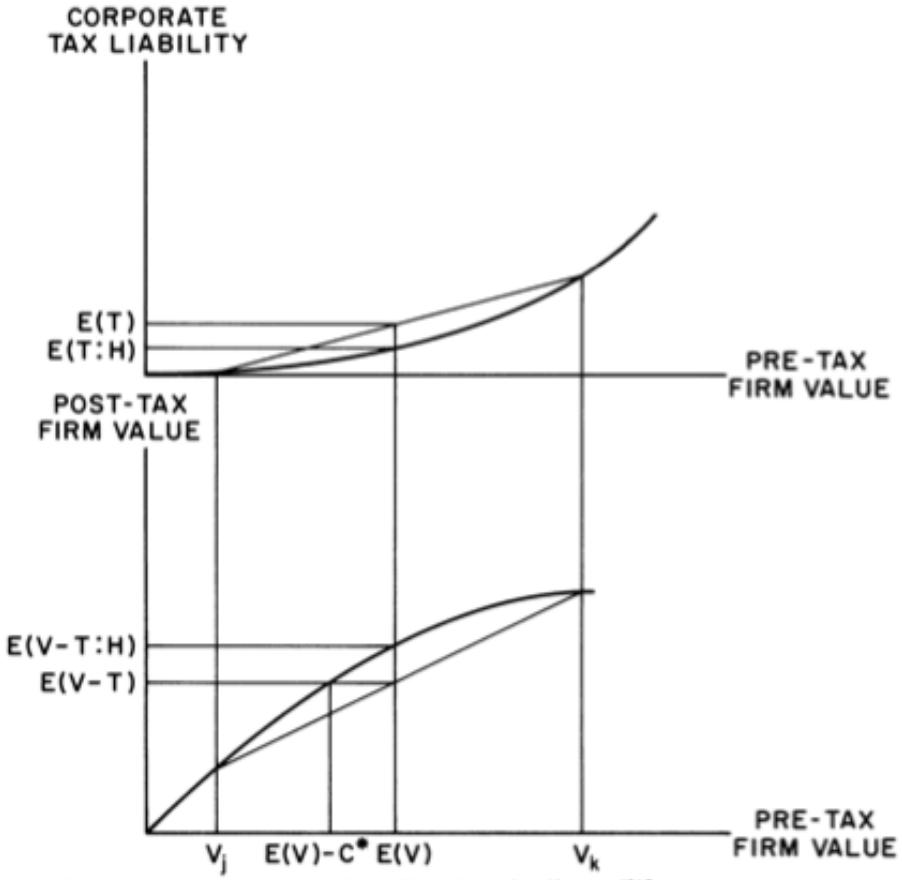
Smith & Stulz (1985) hypothesise that firms hedge in response to certain incentives. The incentives encompass the following three subjects:

(1) Taxes
(2) Contracting costs
(3) Investment decisions

Smith & Stulz (1985) state that "*if costless hedging reduces the variability of pre-tax firm value, then the firm's expected tax liability falls and its expected post-tax value rises*". This means that if we can use derivatives to stabilise income, then the expected tax liability will go down. The main argument is that the tax structure of a firm can make it advantageous to take position in derivatives in order to reduce variability of pre-tax firm value, by controlling the timing of recognition of taxable income and losses.

Their assumption is that the marginal tax rate of firms are an increasing function of the firms pre-tax value, or in other words, that the corporate tax function is convex. If the tax function is convex, firms can reduce the expected corporate tax liability and increase expected post tax value of the firm, as long as the cost of hedging is not too great. The after-tax value will then be a concave function of the pre-tax value of the firm. (Smith & Stulz, 1985). Smith & Stulz' (1985) model is presented in figure 2.

Figure 2: Corporate Tax Liability and Post-Tax Firm Value as a Function of Pre-Tax Firm Value, by Smith & Stulz (1985)



$V_j[V_k]$: pre-tax value of the firm without hedging if state $j[k]$ occurs.
$E(V)$: expected pre-tax value of firm without hedging.
$E(T)$: expected corporate tax liability without hedging.
$E(T:H)$: corporate tax liability with a costless, perfect hedge.
$E(V-T)$: expected post-tax firm value without hedging.
$E(V-T:H)$: post-tax firm value with a costless, perfect hedge.
C^*: maximum cost of hedging where hedging is profitable.

Hedging may in other words decrease the expected tax liability for a firm and increase firm value. Smith & Stulz further theorise that hedging can increase the present value of the tax shield of debt, which will be discussed later.

Smith & Stulz (1985) show that the expected corporate tax liabilities without hedging will be a straighter increasing function than the expected tax liability in a situation where the firm hedges in futures, forwards or options, which will have a more convex tax-curve. The after-tax value of the firm for a nonhedging

firm will similarly have a straighter value-function than the hedging firm, which has a concave after-tax value function.

According to Smith & Stulz (1985), tax preference items such as tax loss carrybacks, carryforwards, and tax credits extend the convex region of the tax function. These offset a part of the corporations tax liability, making the function more convex.

The arguments stated by Smith & Stulz (1985) are supported by Stulz (1996), who states that firms primarily use their derivatives to reduce risks that are associated with short-term contracts. He claims that the tax benefits from risk management derive from the ability of risk management to reduce volatility of income and the progressivity (or convexity) of the tax code. It is stated that if there is convexity in the tax code, there are benefits of managing the taxable income of a firm. By reducing variations in taxable income, hedging can lead to lower tax payments by insuring that the larger portions of the income falls within the optimal range in the business cycle. The main argument of difference is that the income must fall within an optimal range.

Graham & Smith (1999) investigates tax incentives for hedging based on the arguments made by Smith & Stulz (1985). Graham & Smith (1999) state that firms are most likely to face convex tax functions when their expected taxable incomes are near the "kink" in the statutory tax function, meaning that they have a taxable income near zero. Secondly, they are likely to face convex tax functions when their incomes are volatile, and thirdly when the company's income is showing negative serial correlation, meaning that the company is more likely to shift between profits & losses for each period (Graham & Smith, Tax incentives to hedge, 1999).

Graham & Smith (1990)'s simulations make it possible to look at the individual parts of the statutory convexity such as:

- Carrybacks & carryforwards
- Investment tax credits
- Alternative minimum tax
- Uncertainty in taxable income

Because carrybacks and carryforwards gives firms the opportunity to make their income less volatile and thus increasing the tax functions curvative in the most convex parts of the function, managing these can lead to an increased value after taxes. The alternative minimum tax, as well as the investment tax credits was in the empirical results by Graham & Smith (1999) found to only have a minor effect on the convexity. Finally, if the firm faces a linear tax function in total, the firm's expected tax liability is unaffected by the volatility of taxable income. If on the other hand, the firm faces some form of progressivity, then hedging reduces the volatility of the taxable income, and thus reduces the tax liability as presented in figure 3 and 4.

Figure 3: The core tax structure with uncertainty as presented by Graham & Smith (1999).

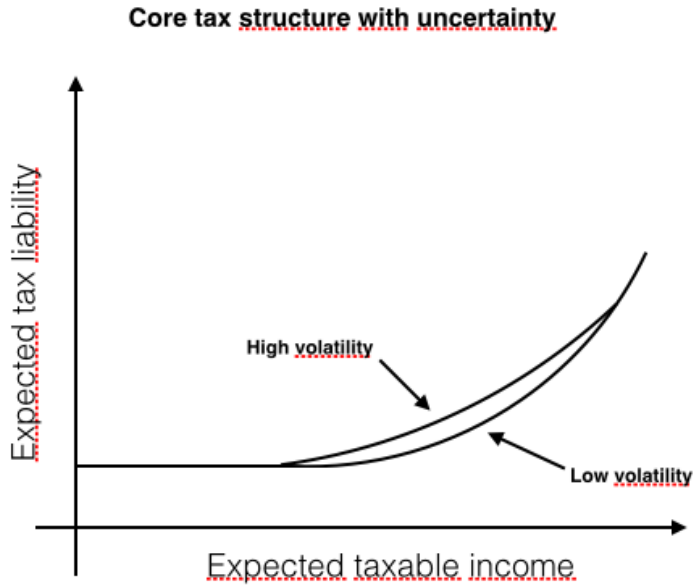
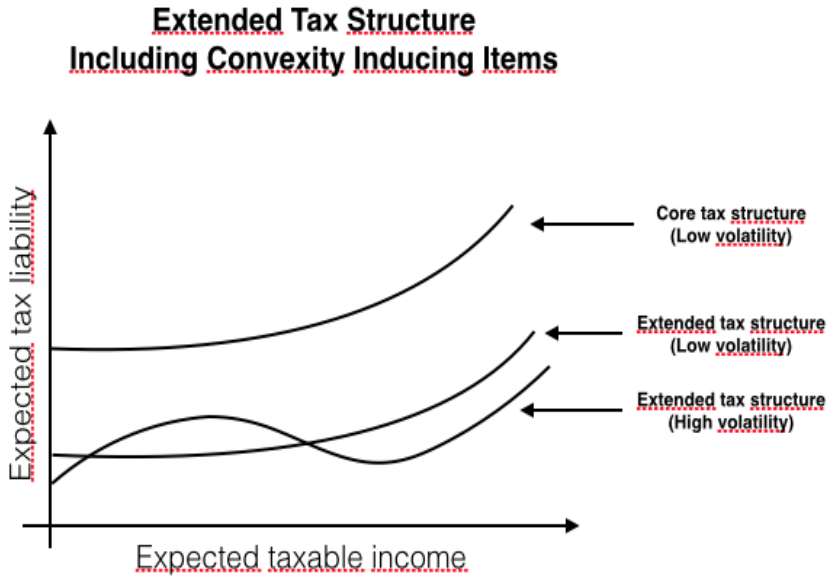


Figure 4: The extended tax structure, including tax preference items as presented by Graham & Smith (1999).



As can be seen from figure 4, the extended tax function is concave in some parts of the curve, while convex in others. Further, it is displayed a difference in benefits from high and low volatility, depending on the amount of expected taxable income. Managing income in order to make sure it falls within the most beneficial range of the tax structure, could help firms utilise their carryforwards and tax credits to their maximised potential. Using the example by Hull (2011) presented in section 2.1, this means that using futures to control the realisation of a purchase from one year to another can help making sure that the purchase falls within the taxable income that is most beneficial, either by increasing or

decreasing the expected taxable income in line with the appropriate tax structure of the firm.

Graham & Rogers (2002) continue the research on derivative use and tax convexity, and argue that firm's can hedge to decrease income volatility in accordance with the studies of Smith & Stulz (1985) and Graham & Smith (1999). They investigate the tax benefits of hedging and the general motives for increasing debt and measure the tax convexity explicitly, similar to Graham & Smith (1999).

According to theory mentioned in this section, not only direct convexity stemming from progressive tax rates can cause tax convexity. Tax preference items such as tax loss carryforwards and tax credits can make the extended tax schedule convex, since large or profitable firms tend to have less loss carryforwards and thus higher expected taxes. The items cause convexity in the tax liability indirectly. In a country such as Norway, it may thus be beneficial to examine the direct derivative-tax liability relationship even though the statutory rate for limited companies is a flat rate, as opposed to the US.

As will be seen from the empirical evidence later, investment tax credits and tax loss carry forwards are often seen as a proxy for tax incentives for hedging. First however, we have to define what the definition of tax credits in Norway is. According to Skaar & Kildal (2010) a postponed taxation, or, more correctly, a deferred tax, whereas the payment is postponed to a later point in time where, in the meantime, the firm can invest the amount, causing a tax credit. The return on this investment makes the actual taxation less than the nominal taxation (Skaar & Kildal, 2010). This makes up the investment tax credit.

According to Skaar & Kildal, losses that are not covered by the current years profit can be carried forward to profits for later years. This is called a tax loss carryforward (Skaar & Kildal, 2010). Tax loss carryforwards are a form of tax preference items, and are thus assumed by to contribute to tax function convexity similar to tax credits (Smith & Stulz, 1985).

Empirical Evidence for Tax Incentives

The existing empirical evidence of derivatives and tax incentives do not show a clear tendency. Nance et al. (1993) argue that hedging can increase the value of the firm by reducing expected taxes, and use the theory of Mayers & Smith (1982) and Smith & Stulz (1985) to theorise that if the tax schedule is convex, expected taxes will be reduced by hedging. Nance et al. (1993) provide evidence on the hypothesis of tax reducing incentives through their empirical study and find that the greater tax loss carry forwards and investment tax credits a firm has, the greater the benefit of hedging is. Nance et al. (1993) do not find a significant relationship between tax loss carry forwards and hedging, although they find a significant relationship between tax credits and derivatives. Finally, they conclude that firms using hedging instruments not only use these derivatives, but also have significantly higher amounts of tax credits than firms that do not hedge.

Graham & Rogers (2002) investigate the relationship between derivatives and tax incentives further, under the assumption that firms hedge in response to a convex tax function. They find that the coefficient of tax convexity is negative and statistically insignificant, and conclude that firms do not hedge in response to tax convexity and by definition not to reduce expected tax liability directly. They do in other words not find any support to the claim that firms hedge in response to tax convexity. Shezad L. Mian (1996) finds support for the predictions that hedging is positively related to tax convexity, carryforwards, and tax credits. However, the only variable that is statistically significant is foreign tax credits.

Other studies, such as Geczy et al. (1997) measure tax preference items as net operating loss carryforwards, and use this as the only proxy for tax incentives. They do not find statistically significant results in regard to the relationship between currency derivatives and preference tax items. Neither do Fok et al. (1997), who find no support for the relationship between derivatives and tax convexity in their results. Fok et al. (1997) use two proxies to measure a firm's convexity of the statutory tax function. The first is the magnitude of investment tax credits, and the second is the amount of tax loss carry forwards. They find that hedged firms had larger investment tax credits, but no significant difference in carryforwards between hedged and nonhedged firms.

Shanker (2000) continues the research on derivatives and tax incentives, and measures corporate hedging activity, finding empirical evidence for the tax incentives to hedge. The research shows that the higher the tax incentive to hedge is, the greater the hedging activity of the firm is, and that the magnitude of tax losses carried forward determines the tax incentives to hedge, which again contradicts the results found by Geczy et al. (1997) and Fok et al. (1997).

Fauver & Naranjo (2010) test the hypothesis that agency costs and monitoring problems affect derivative usage and firm value, in U.S. non-financial firms, as well as the effect of derivatives on tax loss carry forwards to total assets. They find that the greater tax loss carry forwards-to-total assets, the more likely it is that the firm uses derivatives. Tax loss carry forwards are in the case of Fauver & Naranjo used to represent the entirety of tax-effects from derivative use. This may in my opinion be a proxy that is too simple to measure the entire effect of derivatives on taxes, since derivatives may affect taxes in other ways than through tax loss carry forwards directly.

It is thus not clear what to expect with regards to the relationship between derivatives and tax preference items. It seems, that while studies find a relationship between investment tax credits and derivatives, they do not find the same relationship for carryforwards. From the empirical results alone, one might expect that there is not a positive relationship between tax credits or tax loss carryforwards and derivative use for this study.

(2) Hedging to Increase Debt Capacity & Interest Tax Deductions

In addition to the direct effect from derivatives on taxation, the tax shields generated by increased leverage can affect taxation. The tax shield of debt is based on the model created by Modigliani & Miller (1958). As mentioned, risk management theory rests on the assumption that markets are not effective, and can be improved. Hedging may thus improve debt capacity and lead to a leverage ratio closer to optimal leverage. These theories will be examined in this section.

Trade-off theory is essential to the theory that increased leverage leads to increased tax deductions. According to the trade-off theory, *the total value of a levered firm equals the value of the firm without leverage plus the present value of the tax savings from debt, less the present value of financial distress costs* (Berk & DeMarzo, 2011).

Berk & DeMarzo, Equation 16.1:

$$V^L = V^U + PV(Interest\ tax\ shield) - PV(Financial\ distress\ costs)$$

where V^L represents the value of a levered firm and V^U represents the value of the firm without leverage.

Under the assumption that the trade-off theory holds for Norwegian firms, thus suggesting that financing with debt leads to greater interest payments and smaller taxable income, the question is whether Norwegian firms derivative use actually is correlated with increased debt. A theory could be that since one of the commonly used arguments for hedging with derivatives is to reduce the cost of financial distress, this causes the companies to be able to increase the amount of leverage, and thus increasing tax deductions through the tax shields of debt.

Smith & Stulz (1985) show that a firm can decrease costs of bankruptcy by hedging. They theorise that companies can decrease expected bankruptcy costs, and increase the after-tax firm value net of bankruptcy costs. They further show an extension of this analysis through issuance of a tax shield. They show that The firm can reduce bankruptcy costs by holding a hedge portfolio that pays positive amounts when the firm would be bankrupt without hedging and thus, hedging can decrease the present value of bankruptcy costs and increase the present value of the tax shield of debt (Smith & Stulz, 1985). Furthermore, Stulz (1996) claims that risk management can be used as a direct substitute for financing with equity. He claims that if the firm hedges its financial exposures, it increases the debt capacity of the firm, under the assumption that equity capital is more expensive than debt.

Leland (1998) further compares the model of Modigliani & Miller (1958) with the model of Jensen & Mackling (1976), and argues that while M-M show that the optimal amount of debt balances the tax deductions provided by interest payments against costs of potential default, J-M assumes that equity holders potentially can extract value from debt holders by increasing investment risk after debt is in place. They find that optimal capital structure reflects both tax advantages of debt less default costs, and the agency costs resulting from asset substitution. Equity holders thus hold control of the firm's choice of capital structure and investment risk.

Ross (1997) introduces the theory that risk management is making firms able to increase their optimal debt ratio, and thus increase the associated tax benefits. He argues that risk management enables the firm to shift from equity to debt as a result of increased optimal leverage. He further states that he believes the strongest motivation for derivative hedging is this increased debt capacity, and that this benefit is far greater than the benefits of reduced bankruptcy costs. Ross (1997), using the capital structure of Leland (1994) proposes three impacts of derivatives:

- Increase in tax benefits.
- Reduction of bankruptcy costs.
- Reduction in potential cost of underinvestment.

It is concluded that firm's should be hedging the market value of assets, and that the hedging of the firm's assets results in an enhanced optimal capital structure, meaning greater debt capacity.

It is claimed that the improved effect on debt capacity is caused by derivative-users ability to use financial instruments to reduce the volatility of income. Graham & Rogers (2002) hypothesise that by reducing the volatility of income and reducing probability of financial distress, hedging increases debt capacity. If firms add leverage in response to this greater debt capacity, they will increase their interest deductions, reduce tax liabilities and increase firm value.
Using data from 10-K forms they investigate the tax benefits of hedging and the general motives for increasing debt. They measure the tax convexity explicitly, similar to Graham & Smith (1999). Graham & Rogers (2002) state that Stulz (1996), Ross (1997) and Leland (1998) and others all show that by reducing the volatility of income and reducing the probability of financial distress, hedging increases debt capacity. The associated increase in interest deductions reduces tax liabilities and increases firm value. It is further proposed two different channels similar to Leland (1998):

- Lower expected default rates and distress costs
- Lower average volatility of income

The following argument is based upon the results of Graham & Rogers (2002), Graham & Smith (1999), Leland (1998), and Modigliani & Miller (1958). If we can assume that increased leverage leads to tax deductions, and that the trade-off theory holds, implicating that increased leverage leads to increased interest payments, then this should in turn cause the debt tax shield to grow, and thus decrease taxes. Thus, derivative users should be able to indirectly affect taxes through their ability or tendency of having more leverage.

Empirical Evidence for Debt Capacity Incentives

Graham & Rogers (2002) use two regressions to measure the relationship between debt and hedging with derivatives:

- Regression with hedging as dependent variable and debt as independent variable, which show a significant positive relationship, meaning that leverage leads to increased hedging due to higher expected costs of distress.
- Regression with debt as dependent variable and derivatives as independent variable, giving a significant positive relationship, indicating that hedging increases debt capacity and tax deductions.

Using simulations, Graham & Rogers (2002) find that the general motive is increasing tax deductions through increased debt capacity. Specifically, hedging increases the average firms debt by 3 %, thus increasing the tax deductions by 1.1%. Graham & Rogers (2002) further claim to be the first study to show that not only can leverage have an effect on hedging, but that derivatives affects leverage as well.

The arguments made by Graham & Rogers (2002) is supported by Bartram, Brown & Fehle (2009), who based on previous literature from Myers (1993), Myers (1984) on capital structure, and Leland (1998), hypothesise that if derivatives lower the chance of financial distress, and thus increases the optimal leverage-ratio, then this should lead to an increase in the associated tax shield of debt. Their results show that hedging is an important factor determining leverage, and thus supports the hypothesis that firms hedge to increase debt capacity.

Next, Guay (1999) does not explicitly examine the effect of leverage in a taxation context, but uses leverage as proxy for financial distress costs. In his empirical results, he finds a significant results showing difference in leverage for hedging and nonhedging firms. Further, Hentschel & Kothari (2001), conducts an empirical study on corporate use of derivatives in relation to the stock return risk, find that firms using derivatives have significantly more leverage than non-derivative users, further strengthening the predictions for this theory.

Fauver & Naranjo (2010) also investigates the relationship between leverage and derivatives as part of their analysis, and find that the relationship between leverage and derivatives is positive and statistically significant.

Considering the information from previous empirical studies, we might expect that there is a significant positive relationship between derivative use and leverage for Norwegian firms

2.3: Main Hypothesis

Literature holds two main theories for the effect of derivatives on corporate taxation. Firstly, companies using derivatives are assumed to increase company debt, and thus leading to an increase in interests deductible on taxes. Secondly, firms using derivatives are assumed to be able to manage their pre-tax income volatility, thus decreasing their expected tax liability. In addition, companies that hedge is assumed to have a higher amount tax preference items than

nonhedging companies, something which is assumed to represent tax convexity. The literature is summarized in table 1.

Table 1: Summary of literature on derivatives, taxes, leverage and tax shield of debt.

Derivatives and tax convexity		
Theory	**Empirical evidence**	**Relationship (Tax incentives/Derivatives)**
Smith & Stulz (1985)	Geczy et al. (1997)	No relationship
Mayers & Smith (1982)	Fok et al. (1997)	Nonsignificant positive relationship
Smith (1982)	Fauver & Naranjo (2010)	+
Graham & Smith (1999)	Nance et al. (1993)	+
Graham & Rogers (2002)	Shanker (2000)	+
Stulz (1996)	Mian (1996)	Mixed

Derivatives, leverage and tax shield of debt		
Theory	**Empirical evidence**	**Relationship (Derivatives/leverage)**
Modigliani & Miller (1958)	Guay (1999)	+
Graham & Smith (1999)	Bartram et al. (2009)	+
Graham & Rogers (2002)	Leland (1999)	+
Ross (1998)	Graham & Rogers (2002)	+
Leland (1998)	Hentschel & Kothari (2001)	+
Stulz (1996)	Fauver & Naranjo (2010)	+

Unfortunately, most theories are based on the assumptions of convex tax schedules in the US, while the Norwegian tax system is based on a flat statutory tax for limited corporations. Still, if tax preference items can contribute to making a tax schedule convex, a relationship between derivatives and tax liabilities may still be found.

Mainly, the hypothesis that increased leverage increases the tax shield of debt holds in most studies and will not be examined further in this paper, we expect to find a positive relationship between derivatives and leverage. The direct relationship between derivative use and taxes will be empirically tested, but we keep the expectancy of a positive relationship low due to the inconsistency of previous empirical results.

This leads to the following main hypothesis, which will make up the basis for the research in this thesis:

Hypothesis: Norwegian hedging firms report significantly higher tax convexity through tax preference items than no hedging firms (Firms are hedging in response to tax convexity in order to decrease tax liabilities).

3. Research Method

The study is a quantitative study based on financial information and the dataset consists of listed nonfinancial firms based in Norway. The data is made from cross-sectional data from 2012, with the final goal of investigating the relationship between derivative use and secondary variables. The variables chosen are based on the empirical studies reviewed in the previous chapter, the research method largely based on the method used by Fauver & Naranjo (2010) and their logistic regression measuring incentives for hedging, and I use supporting arguments from other studies.

3.1: Regression Analysis

The regression is constructed from the most prominent variables assumed and tested to be incentives for hedging in accordance with previous studies on derivatives, and especially with derivative use as dependent variable.
In this case, the dependent variable is a dummy variable with the variables 0 or 1. This means that an OLS regression is incompatible with the equation because the values can only be between 0 and 1, while OLS regressions models can predict values less than 0 and greater than 1 (Stock & Watson, 2012). We must thus use a logistic (logit) regression, which is capable of handling a dependent dummy variable, creating a logistic curve rather than a linear curve. The tests will then have to be an Odds Ratio Test and an Effect Likelihood Ratio Test.

This leads the following regression, and the following function:

$$Y_i = \frac{1}{1 + e^{-(REG)}} + \mu_i$$

Where

$$\text{REG} = \beta_0 + \beta_1 \times (Carryforwards)_{t-1} + \beta_2 \times (Tax\ credits)_t + \beta_3 \times (Tax\ liabilities)_t + \beta_4 \times (Leverage)_t + \beta_5 \times (Sales)_t + \beta_6 \times (Assets)_t + \beta_7 \times (Geographical\ Dummy)_t + \beta_8 \times (Petroleum\ dummy) + \beta_9 \times (Electricity\ dummy) + \beta_{10} \times (Growth\ opportunities)_t + \beta_{11} \times (Agency\ Costs)_t + \beta_{12} \times (Profit\ Ratio)_t$$

and

Y_i represents the hedging dummy, which can produce a predicted value between 0 and 1. Explanations for the independent variables can be found in table 2.

The betas represents the increase or decrease in likelihood that Y = 1 for each variable. In other words, an increase in the variable Y of 1 is more (or less) likely for each change in the independent variable in question.

Since this is a logistic regression, the calculation of the betas in the equation represents a more complicated estimation than through an OLS-regression, and

is not easily estimated. In the logistic regression the parameter estimates gives the estimates of the beta of each variable, where $\log\left(\frac{Prob(Odds_{r_2})}{Prob(Odds_{r_1})}\right) = b_1$ represents the estimate of b_1 based on the change in difference between two fitted variables.

The betas in the equations represent the following:

β_1 = The marginal impact on hedging dummy resulting from change in tax loss carryforwards, keeping all other factors constant.
β_2 = The marginal impact on hedging dummy resulting from change in interest tax Credits, keeping all other factors constant.
β_3 = The marginal impact on hedging dummy resulting from change in tax liability, keeping all other factors constant.
β_4= The marginal impact on hedging dummy resulting from change in leverage, keeping all other factors constant.
β_5 = The marginal impact on hedging dummy resulting from change in total sales, keeping all other factors constant.
β_6 = The marginal impact on hedging dummy resulting from change in total assets, keeping all other factors constant.
β_7 = The marginal impact on hedging dummy resulting from change in geographical location, keeping all other factors constant.
β_8 = The marginal impact on hedging dummy resulting change in petroleum dummy, keeping all other factors constant.
β_9 = The marginal impact on hedging dummy resulting from change in electricity dummy keeping all other factors constant.
β_{10} = The marginal impact on hedging dummy resulting from change in growth, keeping all other factors constant.
β_{11} = The marginal impact on hedging dummy resulting from change in agency costs, keeping all other factors constant.
β_{12} = The marginal impact on hedging dummy resulting from change in profit ratio, keeping all other factors constant.

The main hypothesis test is in this case represented by the Effect Likelihood Ratio Chi-Square Test, which tests the effect of the variables on the dependent hedging variable. The ELR test shows whether the variables have a statistically significant effect on the hedging likelihood. This part will be the main result of the study. Further, Odds Ratios are used to measure how much the odds of the dependent variable reaching a value of 1 increases from a one unit change in independent variable in question. The unit odds ratios gives an indication of how many times more likely it is that a company uses derivatives from a one unit increase in the parameter. The unit odds ratio is represented as:

$$e^{b_1} = \frac{Prob(Odds_{r_2})}{Prob(Odds_{r_1})}$$

Table 2: Explanations for variables in the logistic regression

Variable	Explanation	Equation
Carryforwards	Tax loss Carryforwards to total assets for 2011	$\frac{Tax\ loss\ carryforwards}{BV\ of\ assets}$
Tax Credits	Tax credits to total assets for 2012	$\frac{Tax\ credits}{BV\ of\ assets}$
Tax liabilities	Net tax liabilities to total assets for 2012	$\frac{Net\ tax\ liabilities}{BV\ of\ assets}$
Leverage	Debt to total assets for 2012	$\frac{Current\ debt + Noncurrent\ debt}{BV\ of Assets}$
Sales	Total sales for 2012	Log of total sales
Assets	Total assets for 2012	Log of total assets
Agency Costs	Total sales to total assets for 2012	$\frac{Total\ Sales}{BV\ of assets}$
Profit Ratio	Return on Equity and Operating profit to total sales for 2012	$\frac{Net\ profit}{BV\ of\ equity}$ and $\frac{Operating\ profit}{Total\ sales}$
Growth opportunities	Quick ratio and current ratio for 2012	$\frac{Cash\ + Short\ term\ investments}{Current\ liabilities}$ and $\frac{Current\ assets}{Current\ liabilities}$
Geographical dummy	Dummy variable of 1 if firm is located in a low tax region	
Petroleum dummy	Dummy variable of 1 if firm is a petroleum-producer	
Electricity dummy	Dummy variable of 1 if firm is a electricity producer	

3.2: Main Variables

1. Measurement of derivative use (Hedging): Literature presents two main methods for measurement of derivative use:

- Dummy variable separating hedging firms from nonhedging firms used by studies such as Fauver & Naranjo (2010), Nance et al. (1993) and Fok et al. (1997) used in a logistic regression, where 0 represents nonhedging firms, and 1 represents hedging firms. This variable has the obvious disadvantage that one is not able to see the extent of hedging activities or changes over time. The advantage of the method is that it gives an easily available, comparable method of measuring derivative use.
- Numerical value of individual derivatives used by for example Guay, (1999) and Hentschel & Kothari (2001). Using these variables one is able to determine the increase and decrease in derivatives over time, as well as differences between types of derivatives. Unfortunately, this method is less reliable as reporting of derivatives across databases and reports are less uniform.

For data availability, I choose to use the dummy variable of hedging vs. Nonhedging as measurement for derivative use, for this introductory empirical study in Norway, meaning I measure hedging firms with the value ”1” and nonhedging firms with the value ”0”. The variable will be set to ”1” if the firm reports values of derivative use as defined in this paper (insert definition: options, futures, swaps etc.) and serves as the dependent variable.

2. Measurement of tax convexity: As stated in literature, tax preference items such as tax credits and tax loss carryforwards are frequently used methods for measuring tax convexity and thus tax incentives to hedge. Fok et al. (1997) uses both values to measure tax convexity, while Fauver & Naranjo (2010) use only carryforwards as a proxy for the entirety of tax incentives. Geczy et al. (1997) and Fauver & Naranjo (2010) scale the carryforwards by assets.

In this study, losses carried forward will be used as measure for tax convexity in accordance with Fauver & Naranjo (2010), Fok et al. (1997) Geczy et al (1997) and others. In addition, where available, interest tax credits will also be used, as both variables have the potential to measure tax convexity as explained by Smith & Stulz (1985). I will use the tax loss carryforwards of 2011 in comparison with data from 2012 to see the effect of the carryforwards of 2011 on the results of 2012.

3.3: Control Variables

1. Leverage: As stated in the literature review, leverage can potentially lead to derivative use as well as being an effect of it (Graham & Rogers, 2002). Further, empirical studies such as Shanker (2000) use leverage to proxy for costs of financial distress. It is claimed that if hedging reduces bankruptcy costs, then leverage ratios should be positively related to the likelihood that a firm hedges (Leland), as well as that firms with higher leverage is more likely to hedge

because the underinvestment problem is more prominent with firms with high leverage (Nance et al. 1993).

Values used to measure leverage are EBIT to interest, debt to value (Nance et al. 1993), Book value of debt to total assets (Fauver & Naranjo, 2010), and debt to assets (Graham & Rogers, 2002). I choose the commonly used book value of debt to assets ratio for this study.

2. Size (Sales & Assets): Smith & Stulz (1985) suggest that large firms are more likely to hedge. It is thus important to control for this issue by adding a variable for size.
Fok et al. (1997) has found that larger firms have a stronger tendency to hedge. Further, expected bankruptcy costs are related to firm size, so large firms should have less bankruptcy costs. Nance et al (1993) imply that small firms are more likely to hedge because large firms are less likely to face costs of financial distress, while Graham & Rogers (2002) find that hedging increases with firm size.

The book value of assets is a potent measure for firm size used by amongst others Fauver & Naranjo (2010), Graham & Rogers (2002) and Fok et al. (1997). The measure is thus chosen to measure firm size. I use the natural log of the variables in the regression.

3. Geographical location: Due to the different tax-regions in Norway it is reasonable to assume that this may have an effect on the incentives to hedge in a taxation context. It is necessary to divide into two regions, one for low tax areas and one for high tax areas. The variable for tax area will take on a value of 0 if the company is located in the county of Nord-Troms or the county of Finnmark, which, has a statutory rate of only 24,5 %. Otherwise the variable will take on a value of two.

4. Industry dummies: As mentioned in section two, the petroleum industry and the electricity industry operates with a heavier tax burden than other industries, making it reasonable to distinguish between these industries. I will apply a dummy variable similar to the one for geographical location for each industry:

Petroleum dummy: This dummy variable takes on a variable of 1 if the company is a petroleum producer. Otherwise the value is 0.

Electricity Dummy: This dummy variable takes on a variable of 1 if the company is an electricity producer. Otherwise, the value is 0.

5. Growth opportunities: According to previous research, amongst others Geczy et al. (1997), Fauver & Naranjo (2010), Fok et al. (1997), Panaretos et al. (2013), firms with more growth opportunities, also called investment opportunities, tend to hedge more and is thus an important control variable. In accordance with Fauver & Naranjo (2010) the quick ratio is used to measure growth opportunities. The quick ratio represents whether the company is able to handle its current short-term obligations. If the current ratio is high, this means the

company has more cash at hand than is required to pay off its current obligations, and can be used to invest in new projects. Further, Mian (1996) argue that firms with better liquidity have more growth options. The quick ratio is a more conservative ratio than what for example the current ratio represents, since it does not call for sales of assets in order to generate cash. The variables are expected to be positively related to hedging.

6. Agency Costs: Some studies, such as Nance et al. (1993), Fauver & Naranjo (2010) and Jensen-Meckling (1976) claim that agency costs affect derivative usage.

Sales to assets, which is expected to be negatively related to agency costs is chosen for this study, since an increased amount of sales compared to assets could mean that the firm is better at utilizing the assets to create income rather than satisfying ulterior motives of managers or other agents in the firm.
I thus include the variable sales to assets, used by Fauver & Naranjo (2010) to proxy for agency costs, where a higher value indicates less agency costs.

7. Profitability: In accordance with Graham & Smith (1999) and Graham & Rogers (2002), firms may be more inclined to hedge in response to tax incentives if the firm has income near zero or alternates between positive and negative income. It can from this be inferred that profitable firms may have fewer tax incentives to hedge, as they may have no loss carryforwards to offset. I will use ROE as measure for profitability. This claim is not without controversy, since some studies find a positive relationship between profitability and derivative use and thus assume that profitable firms hedge more (Fauver & Naranjo, 2010).

As for the variable, we have several measures that can represent profitability. Fauver & Naranjo, 2010 uses operating profit to sales as measure for profitability. Another widely used method is the return on equity, measured as net profit to book value of equity. In this study, both are chosen to measure profitability separately.

4: Data

The study is conducted on quantitative, observational data of a cross-section of firms for the year of 2012, consisting of multiple entities observed at a single time period. Data is collected through the use of the ORBIS financial database, for all available variables.

The sample is made up from firms listed on Oslo Børs, which is Norway's only public exchange. The sample is made up of a total population of 225 public listed nonfinancial firms. The final sample consists of 62 firms for the year 2012 and 2011 as time and data availability puts limits on the size of the sample. The sample consists of companies that operate and pay taxes in Norway, and must be a registered Norwegian company registered in Brønnøysundregisteret, where all Norwegian firms must be registered. Further, their headquarter must be in Norway. Further, I am only including nonfinancial firms, as financial firms treat derivatives differently than nonfinancial firms. The firm must have available consolidated financial reports for 2012 through PI Navigator and have available financial information from ORBIS on items such as total assets, total sales, net profit etc. The remaining information, such as information on derivative use and tax loss carry forwards are collected from the annual reports extracted from PI Navigator. The data will be collected from consolidated annual reports from 2012, the firm must thus have available financial statements from 2012 and follow IFRS. The firm must also have available information on tax loss carryforwards from the end of 2011, and finally the firm must be listed, meaning it is a public limited company, or "allmennaskjeselskap" (ASA).

Since data on derivative use is not available through ORBIS or other available databases for nonfinancial firms these data in the sample will be collected manually from annual reports for Norwegian firms downloaded through PI Navigator, which is a database containing consolidated annual reports and other financial documents for over 50 000 companies. Information on tax loss carryforwards and tax credits is not available through Orbis and must be collected manually from annual reports as well. Firms are only kept in the sample if they display values in Orbis, and have annual reports downloadable from PI Navigator. Firms not reporting values in Orbis, or not having available annual reports in PI Navigator are excluded from the sample.

As tax credits are not available through annual reports, notes or available databases, I have, in order to have a representation of incentives arising from deferred tax liabilities due to the argument by Fok et al. (1997), that the effect on this variable shows and indication of the tax convexity, implemented net deferred taxes (deferred tax liability net of deferred tax assets) as additional proxy for tax incentives. Further, all firms operate within a high tax region, which may indicate that there are benefits to operating in more urban areas outweighing the tax benefits of operating in a low-tax region. The variable for tax region will thus be excluded. Unfortunately, the sample contains only five observations for petroleum firms, and only two observations for hedging electricity companies. This is not enough to create reliable results in the

regression, and a larger sample of firms would have to be collected for these variables to be included in the final regression.

Table 3 summarises the mean values of the main variables differences between hedging and nonhedging firms. Table 4 summarises pairwise correlations for all continuous variables.

The derivative usage dummy variable takes a value of 1 if the firm uses derivatives and 0 if the firm does not use derivatives. A firm can have the value of 1 if the firm's annual reports state that the firm is using financial derivatives for risk management. This measure has a certain level of interpretation to it. The firm must use derivatives in forms of options, forwards, futures or swaps, and I search the annual reports for proof of derivative usage. However, some companies report only "derivatives" or "financial instruments" as value without specifying further in the notes, for which some level of interpretation of the term is required in each case. It is worth noting that the amount of hedging firms is nearly twice as large as the amount of nonhedging firms.

T-tests are used as test for differences in each respective mean value, while a Wilcoxon's Range Sum Test is conducted for the medians. An F-Test for differences in variance is conducted for difference in standard deviations. Detailed results of each t-test, Wilcoxon's Range Sum Test and F-Test can be found in appendix A. The table further presents mean values, standard deviation, minimum values, and maximum values for each variable of hedging and no hedging firms. Of the mean values, only carryforwards display a significant value on the five percent level, while assets and sales displays a significant value on the ten percent level. For the medians, total sales, deferred taxes and carryforwards display significant values on the five percent level while total assets and profit ratio displays a significant value on the ten percent level.

Not surprisingly, there is a significant difference in mean and median values for sales and assets, indicating firm size for hedging and nonhedging firms, which supports the argument that more large firms tend to hedge than small firms such as amongst others Stulz (1996) and the empirical results of Fauver & Naranjo (2010) and Fok et al. (1997) who find the same correlation in their study.

Table 3: Summary Statistics

This table presents summary statistics for Norwegian nonfinancial companies for the sample of firms consisting of hedging and nonhedging firms. Profit is proxied by return on equity (ROE) and operating income to sales. Deferred taxes are defined as deferred taxes divided by total assets. Growth opportunities are proxied by the quick ratio, defined as cash and short-term investments divided by total liabilities, as well as the current ratio. Agency costs are represented through sales divided by assets. Carryforwards represents tax loss carryforwards scaled by total assets. Total sales and total assets are both used as measure for firm size. Leverage is defined as current and noncurrent debt scaled by the book value of assets. Electricity and Petroleum represents the dummy variables for producers of electricity and petroleum companies. T-tests are conducted on differences in mean values for hedging and nonhedging firms, Wilcoxon's Range Sum Test is conducted on difference in medians, while an F-Test for difference in variance is conducted on the difference in standard deviation of the variables for hedging and nonhedging firms.

Variable	Statistics	Hedging	Nonhedging	Difference	Sign.
Total Assets (in millions)	Median	5 159	230	4 929	0.01**
	Mean	15 062	702	14 360	0.01**
	Std Dev	29 772	1 082	28 690	0.01**
	Min	12	25	- 13	
	Max	169 364	3 775	165 589	
Total Sales (in millions)	Median	1 760	218	1 542	0.01**
	Mean	8 795	502	8 293	0.01**
	Std Dev	18 999	796	18 203	0.01**
	Min	1 574	126	1 448	
	Max	101 879	3 469	98 410	
Debt to Assets	Median	0.61	0.49	0.12	0.19
	Mean	0.63	0.53	0.10	0.11
	Std Dev	0.33	0.30	0.03	0.63
	Min	0.13	0.05	0.08	
	Max	1.97	1.22	0.75	
Carryforwards to Assets	Median	0.02	0.07	-0.05	0.37
	Mean	0.18	1.04	-0.86	0.93
	Std Dev	0.53	2.54	-2.01	0.01**
	Min	0.00	0.00	0.00	
	Max	3.17	11.32	-8.15	
Deferred Tax to Assets	Median	0.02	0.00	0.02	0.02**
	Mean	0.04	0.02	0.02	0.20
	Std Dev	0.05	0.08	-0.03	0.01***
	Min	-0.01	0.00	-0.01	
	Max	0.16	0.36	-0.20	
ROE	Median	0.05	-0.04	0.09	0.16
	Mean	-0.01	-0.18	0.17	0.30
	Std Dev	0.26	1.42	-1.16	0.01***
	Min	-0.95	-3.03	2.08	
	Max	0.38	4.79	-4.41	
Sales to Assets	Median	0.47	0.80	-0.34	0.21
	Mean	0.61	0.86	-0.25	0.91
	Std Dev	0.56	0.75	-0.19	0.12
	Min	0.00	0.00	0.00	
	Max	2.14	2.51	-0.38	
Quick Ratio	Median	0.51	0.27	0.24	0.55
	Mean	0.74	0.95	-0.21	0.70
	Std Dev	1.15	1.62	-0.47	0.06*
	Min	0.01	0.01	0.00	
	Max	7.07	6.99	0.08	
Operating income to sales	Median	0.12	0.06	0.06	0.04**
	Mean	0.21	-16.68	16.89	0.14
	Std Dev	2.44	69.90	-67.46	0.01***
	Min	-4.73	-321.30	316.57	
	Max	12.96	0.84	12.12	
Current Ratio	Median	1.50	1.26	0.24	0.61
	Mean	1.98	1.78	0.19	0.35
	Std Dev	2.14	1.64	0.50	0.20
	Min	0.07	0.34	-0.27	
	Max	12.82	7.41	5.42	
Electricity	N	2	0	2	
Petroleum	N	5	0	5	
Number of Observations		41	21	20	

Further, the difference in mean and median values for carryforwards indicate that nonhedging firms have more tax loss carryforwards than nonhedging firms. This is contrary to the hypothesis that hedging firms have higher tax incentives to hedge. The difference is however, not statistically significant. Looking to the profit ratio, one could seek an explanation to this by claiming that profitable firms with low carryforwards hedge more, but the difference from the sample is in this case also insignificant in terms of ROE. It is however interesting to note the higher standard deviation for carryforwards for nonhedging firms, compared to their hedging counterparts. The value is statistically significant, and indicates that nonhedging firms have more varying amounts of tax loss carry forwards than hedging firms. The operating income to sales variable does however show more promising results in terms of median and standard deviation, having higher values for medians and lower values for standard deviation for hedging firms.

The industry-dummies show that the sample is characterised by relatively low amounts of electricity-producers and petroleum-firms. There are two electricity producers and five petroleum-companies in the sample. These firms are all derivative users, giving some indication that petroleum and electricity firms have larger incentives to hedge.

Lastly, I do not find a significant mean difference in deferred taxes for hedging and nonhedging firms, although the median value is significantly lower for nonhedging firms. It can also be seen a statistically significant difference in standard deviation, indicating that nonhedging firms have more fluctuating values of net deferred taxes than hedging firms.

Table 4: Pairwise Correlations

This table presents pairwise correlations between each independent variable as well as significance for each level.

Pairwise Correlations

	Total Assets	Total Sales	Carryforwards to Assets	Debt to Assets	Deferred Tax to Assets	ROE	Sales to Assets	Quick Ratio	Operating Income to Sales	Current Ratio
Total Assets	1									
Total Sales	0.8968***	1								
Carryforwards to Assets	-0.1201	-0.1101	1							
Debt to Assets	0.0067	0.041	0.215*	1						
Deferred Tax to Assets	0.0198	0.0052	0.0391	-0.1524	1					
ROE	0.0862	0.0784	-0.0968	0.1434	0.0208	1				
Sales to Assets	-0.0709	0.0937	-0.1576	0.1389	-0.2256	0.1218	1			
Quick Ratio	-0.1111	-0.1233	0.2675**	-0.3444***	0.3194**	-0.1742	-0.2847**	1		
Operating Income to Sales	0.0621	0.0538	0.0031	0.0425	0.0458	0.4466***	0.1505	-0.16	1	
Current Ratio	-0.0792	-0.0751	0.1194	-0.256**	0.1988	-0.1081	-0.1894	0.6526***	-0.0755	1

It can be seen from table 4 that sales and assets have a high correlation, which is to be expected since it is reasonable that firms with high assets have an appropriate amount of sales, and is in accordance with the results of Fauver & Naranjo (2010). Otherwise, the table is characterised by somewhat low correlations. Carryforwards and profitability through ROE seems to be somewhat negatively correlated, as well as growth opportunities and leverage, and growth opportunities and agency costs.

The statistically significant correlation between operating income to sales and quick ratio, as well as quick ratio and current ratio are to be expected, as they measure similar effects.
There is a significant negative correlation between profitability and tax loss carryforwards. This means that the higher the return on equity is, the less likely it is that the company has tax loss carryforwards. This is a reasonable inference, as profitable firms logically would have a harder time to present losses to carry forward.

Further, the quick ratio is significantly negatively correlated with leverage. This could indicate that firms with higher leverage have less investment opportunities than lower leveraged firms, meaning that high leveraged firms have less cash on hand, which again is a logical inference as a company financing with more equity could reasonably have more of this equity available as cash. However, it could also mean that leveraged firms have lower liquidity, as some studies such as Geczy et al. (1997) use the quick ratio as a liquidity measure. This however, does not eliminate the variables potential as a proxy for growth options as studies such as Mian (1996) claim that firms with better liquidity has more growth options. The results of this study corresponds with this argument, as firms with high growth opportunities are expected to have higher liquidity and lower leverage, according to Mian (1996).

Lastly, there is a significant positive relationship between deferred taxes and quick ratio. A reason for this could be that the company originally keeps cash on hand to use for these tax payments, and has an increased amount of available cash due to the postponed tax payment the deferred taxes represent. The reasoning holds for the current ratio as well.

Note that the industry dummies are excluded from this display, since it is not compatible with the method in Table 3.

The purpose of the summary statistics in this section is to get a general impression of the data. To further investigate the hypothesis I will proceed with the logistic regression.

In light of the information provided by the summary statistics I have chosen to omit the variable for geographical location as all companies are situated in high-tax regions. In order to avoid mulitcolinearity, size will be measured using the log of total assets. Assets is mainly chosen since it is the variable widely used for scaling other variables, and because it is a frequently used variable for size in previous studies and is the main size variable used by Fauver & Naranjo (2010). The geographical variable, the petroleum variable and the electricity variable will be excluded entirely as they return unstable results in the regression results. The log of assets is applied in order to make the variable fit for the regression. I have chosen to revise the regression accordingly. This leads to the following revised equation:

$$Y_i = \frac{1}{1 + e^{-(REG)}} + \mu_i$$

Where

$$\text{REG} = \beta_0 + \beta_1 \times (CFOR)_{t-1} + \beta_2 \times (TAXCR)_t + \beta_3 \times (TAX)_t + \beta_4 \times (LEV)_t + +\beta_5 \times (SIZE)_t + +\beta_6 \times (GROWTH)_t + \beta_7 \times (AGENCY)_t + \beta_8 \times (PROFIT)_t$$

and

Y_i represents the hedging dummy, which can produce a predicted value between 0 and 1.

5: Empirical Results

In this chapter the hypothesis that firms hedge in response to tax incentives, the theory that firms with more tax incentives have a higher probability of being designated with a hedging variable of "1" than firms with low tax incentives is tested. First, the regression is revised in accordance with the discoveries from the summary statistics. Secondly, the results of the logit regression will be presented, before finally I will present a discussion of the results.

5.1: Results

The results of the logistic regression are presented in table 4.

Model 1 shows significant results for carryforwards to assets at the ten percent level as well as significant parameterstimates for the variable. The explanatory power of the model is somewhat low, and the panel is not including control variables and may thus prove to be insufficient to test the hypothesis as it is suspected that other variables to be related to hedging. Nonetheless, the results assuming no other effects affecting derivative use proclaim weak support for the main hypothesis in this study as the results for carryforwards are negative and statistically insignificant at the five percent level. It is however not reliable enough to conclude as the result is prone to estimation bias due to missing variables. Further, the variable for net deferred tax is nonsignificant.

Model 2 includes all the control variables and is the main test of the hypothesis in this study. The results show that half of the control variables, namely Log Assets, Leverage and Agency Costs display significant results at the five percent level. Further, tax loss carryforwards display significant results at the ten percent level, but not at the five percent level. I do not find a significant result for net deferred taxes. The results are similar to several previous studies such as Nance et al. (1993), Fok et al. (1997), Geczy et al. (1993) and more in regards to size, leverage and agency costs, but displays some differences in regards to tax-variables in comparison with some studies.

The nonsignificant results for tax loss carryforwards indicates that carryforwards do not have an impact on the hedging decision, as the main hypothesis suggests. The results from model 2 suggests that the null hypothesis that firms do not hedge in response to tax convexity cannot be rejected. This is contrary to Fauver & Naranjo (2010) who find statistically significant results for all models in their study, as well as Nance et al. (1993) and Shanker (2000), who find positive relationships between these variables in their studies. Further, the results are contrary to the suggested relationship between derivative use and tax incentives argued for in theoretical papers such as Smith & Stulz (1985).

The whole model test gives a measure of fit for the model. The test for the whole model versus the reduced model gives a significant result, meaning that the model is a good fit for the regression.

The results show that rather than tax incentives, there are other incentives that cause Norwegian firms to hedge. Only size and agency costs have statistically significant results. Log Assets, shows an indication that the probability of derivative use goes up with an increase in assets, giving support to arguments by most studies on the matter, such as Fok et al. (1997), Fauver & Naranjo (2010), and Geczy et al. (1993). The effect may, according to these previous studies be a result of hedging companies taking advantage of economies of scale due to fixed costs. Further, the variable for sales to assets indicates a negative effect, meaning that with a decrease in agency costs, the indicated probability of derivative use goes up, which is in line with results from Fok et al. (1997), indicating that derivatives have this effect. Leverage, while not statistically significant at the five percent level, but significant at the tenth percent level, shows an indication that an increase in leverage could increase the probability of derivative use.

The unit odds ratio for leverage shows that the more heavily leveraged the firm is, the more likely it is that the firm is a derivative user. Further, the more assets in the company, the more likely it is that the firm uses derivatives. Agency costs has the lowest of the values, and indicates a decrease in likelihood of hedging as agency costs represented by sales to assets increases. As for tax loss carryforwards and net deferred taxes, these variables seem to have opposite effects, as carryforwards decrease the likelihood and net deferred taxes increase the likelihood of the firm being a hedging firm. The results are different from the study of Fauver & Naranjo (2010), who show significant results for both the quick ratio and tax-loss carryforwards to assets in addition to leverage and sales.

Model 3 shows results using operating income to sales as proxy for profitability and the current ratio as proxy for growth opportunities, similar to Fauver & Naranjo (2010).

The Chi-Square Test for the whole model test has now decreased, improving the fit of the model.

It is interesting to see how replacing these two variables affect the general outlook of the results. In this new equation, the log of assets no longer predict significant results. The variable for tax loss carry forwards is now not statistically significant at any level. The variable for leverage and agency costs represented by debt to assets and sales to assets, are still significant and their significance has improved. The fact that the explanatory power and improvement of statistical significance in the whole model indicates that this model is a better fit for the test of the hypothesis as a whole. The breakthrough from introducing model 3 is represented through the new proxy for profitability, which now shows a significant result.

Table 5: Logistic Regression Results

Variables	(1) ParameterEst	Odds Ratio	ELR ChiSq	(2) ParameterEst	Odds Ratio	ELR ChiSq	(3) ParameterEst	Odds Ratio	ELR ChiSq
Intercept	0.74 (0.03**)			-4.93 (0.04**)			-4.45 (0.08*)		
Carryforwards to Assets	-0.83 (0.08*)	0.44	(0.01***)	-4.93 (0.30)	0.49	(0.08*)	-0.37 (0.49)	0.67	(0.38)
Deferred Tax to Assets	7.31 (0.20)	1506.78	(0.15)	-0.70 (0.72)	10.74	(0.72)	10.87 (0.2012)	174764.90	(0.18)
Debt to Assets				2.37 (0.07*)	13.24	(0.04**)	3.55 (0.06*)	33.57	(0.02**)
ROE				0.16 (0.70)	1.17	(0.70)			
Sales to Assets				-1.80 (0.01***)	0.17	(0.01***)	-1.87 (0.01***)	0.14	(0.02**)
Quick Ratio				0.31 (0.31)	1.36	(0.29)			
Log Assets				0.98 (0.03**)	2.67	(0.02**)	0.68 (0.16)	1.99	(0.16)
Operating income to Sales							0.43 (0.06*)	1.59	(0.03**)
Current Ratio							053 (0.11)	1.56	(0.08*)
Rsq		0.091			0.312			0.373	
Whole Model ChiSq		0.03**			<0.01***			<0.01***	

This table presents the results of the logistic regression testing the hypothesis whether firms with high amounts of tax preference items have a higher probability of being a hedging firm. The effect likelihood ratio represents the hypothesis test and represents the significance level of the full versus the reduced model. Model 1 tests the hypothesis without taking into account any control variables. Model 2 includes all control variables discussed in theory. Model 3 represents a robustness test including alternative variables for profitability, represented by operating income to sales, and growth opportunities represented by the current ratio. The ChiSq-test for the Effect Likelihood Ratio Test is presented in brackets at the 2 % level (***), 5 % level (**) and 10 % level (*). Odds ratios are included for interpretation purposes. The ChiSq-test for parameter estimates is found under the appropriate estimate. Detailed examples of the regression are presented in Appendix B.

5.2: Discussion

The results paint a picture of the main hypothesis in the following ways:
Firstly, odds ratio and parameter estimates for tax loss carryforwards in model 1 and 2 indicate a negative impact on the hedging variable, meaning that companies that have more carryforwards are less likely to hedge. The results of the Effect Ratio Tests are however insignificant on the five-percent level, but significant on the ten percent level in panel 2. This means that the results may be due to happenstance. Further, in panel 3, the variable is insignificant at all levels. Looking to the summary statistics, there is no significance for either means nor medians, giving no further reason to expect a significant relation. There is a significant result for difference in standard deviation for carryforwards between hedging and nonhedging firms indicating that the amount of carryforwards on

book for nonhedging firms varies more than in their nonhedging counterparts. The results are not sufficient to reject the null hypothesis that firms do not hedge in response to tax incentives. However, the results for the variable presents an interesting revelation: It may be the case that tax loss carryforwards in fact are negatively related to hedging, which is surprising, although the variables are statistically insignificant. The main theories for the hypothesis, namely Smith & Stulz (1985), Graham & Smith (1999) and Graham & Rogers (2002) suggest that firms hedge in response to tax incentives through tax preference items, such as tax loss carry forwards. The results do not support this theory, but is in accordance with the empirical results of Geczy et al. (1997) and Fok et al. (1997) who find no relationship between derivative use and tax loss carryforwards. Nance et al. (1993) find results that contradict the results of this study, however, Nance et al. (1993) also include investment tax credits, foreign tax credits and progressive tax rates in the US represented by income in the convex part of the schedule, which may lead to a different result. Fauver & Naranjo (2010) measure tax convexity through tax loss carry forwards similarly to this study, which presents no obvious explanation to the difference in the results, as Fauver & Naranjo (2010) find a significant positive relationship. This study is also the most interesting study in comparison, considering the method is modelled after Fauver & Naranjo (2010). Depending on which control variables is deemed relevant and included in the model, the results can change.

The variable for deferred tax to assets is nonsignificant for the main hypothesis, meaning I cannot find proof that a company's net deferred tax liability has an effect on hedging activity in the firm. The summary statistics do however show significant results for difference in median and standard deviation, showing a higher median for hedging firms and a higher standard deviation for nonhedging firms. This variable is arguably a poor proxy for tax incentives, since the variable includes far more elements than the tax credit variables that are stated by the theory of Smith & Stulz (1985) and empirical studies such as Fok et al. (1997) and Shezad L. Mian (1996) to serve as a proxy for tax incentives. It may very well be that tax credits have an effect that is not shown here as a result of the poor fit of the proxy, although that is not possible to determine from this study. Several studies, such as Fauver & Naranjo, Shanker (2000) and Geczy et al (1997) do not include the tax credit variable for tax incentives and Graham & Smith (1999) argue that tax credits have little impact on the convexity of the tax function.

In model 2, I find that of the control variables, hedging is more likely in firms with more assets, which gives support to the arguments of Smith & Stulz (1985), Graham & Rogers (2002) and the results of Fok et al. (1997), Geczy et al. (1997) and Fauver & Naranjo (2010) that larger firms hedge more. The Effect Ratio Test is significant on the five percent level, indicating a clear increase in probability of hedging as size increases. Further, the summary statistics show significant values for mean, median and standard deviation, supporting the results. Studies such as Nance et al. (1993) claim that smaller firms should be more likely to hedge, since they are more likely to face higher expected costs of financial distress, but find no clear results showing a relationship with firm size. The argument provided by Nance et al. (1993) does not seem to apply for this study. There is almost no correlation between leverage and assets, and assuming that

leverage can be used as proxy for costs of financial distress, this does not at a superficial glance give any reason to believe there is a connection between size and financial distress costs. It may be that larger firms have more free capital and capacity to attend to issues of effective hedging than smaller firms, and that these firms are more focused on the day-to-day operations than larger firms who might have more opportunities to pursue derivative-hedging. Model 3 on the other hand, does not show a significant relationship between assets and hedging, but rather a significant relationship between operating income to sales and hedging, indicating a positive relationship between hedging and profitability instead.

I find a statistically significant result for leverage at the five percent level in model 2, and the significance is strengthened in model 3. According to the odds ratio, an increase in leverage increases the likelihood of a firm using derivatives. Even though the parameter estimates are not statistically significant at the five percent level, leverage is still having a large impact on the equation, and increase in leverage seems to have an impact on whether a firm is hedging or not judging from model 2 and 3. The explanation provided by previous studies such as Shanker (2000), is that leverage increases the expected bankruptcy costs, and hedging helps decrease these bankruptcy costs. In all cases the results are in accordance with the theory of Graham & Rogers (2002) and Smith & Stulz (1985) that highly leveraged firms hedge more.

Finally, the variable for agency costs, which is statistically significant at the one-percent level in both model 2 and 3, indicates a clear relationship between agency costs and derivative use. This is in accordance with the hypothesis and the findings of earlier studies such as Fauver & Naranjo (2010) and Nance et al. (1993). The results here indicate that hedging is less likely in companies with high amounts of sales in relation to assets. A higher sales/assets ratio indicates lower agency costs, as it is assumed that firms with higher sales to assets are investing more productively, purchasing assets that are more productive and that they consume less perquisites, which is assumed to result in higher sales compared to the asset base (Fauver & Naranjo (2010). This means that the lower agency costs, the less likely it is that the firm is a hedging firm, implying that there could be a relation between derivative use and agency problems in a firm. This could imply that derivatives are being used to promote other interests than the ones of the company, and interests of the managers rather than the true goals of the company. An alternative method in order to further investigate the agency problem could be to use free cash flows to measure agency costs. This variable is used by Fauver & Naranjo (2010) in addition to the sales/assets ratio in accordance with the free cash flow theory. Nance et al. (1993) on the other hand claim that agency costs are more likely in more leveraged firms and in firms with more investment opportunities, and that firms hedge in response to these. By these measures, the results from this study could imply that firms hedge in response to leverage in order to mitigate agency costs.

Return on equity and the quick ratio are not found to have an impact on the hedging decision in model 2. They both have low odds ratios and insignificant values for parameter estimates, as well as insignificant values for the Effect

Likelihood Test, indicating no relationship between hedging activity and return on equity or quick ratio. This implies that there is no relation between the ability to handle short-term liabilities and hedging activity in the sample and no relation between the firm's profitability and hedging activities. These results counter the findings of Fauver & Naranjo (2010) who found a positive relationship between return on equity and hedging activity, as well as a positive relation between hedging activity and growth opportunities. When introducing the operating income to sales as additional proxy for profitability as done in model 3, I find a positive relationship between the variable and the probability of hedging. Firms with higher operating income in relation to total sales are thus more inclined to be a hedging firm. The current ratio reports insignificant results and cannot shed more light on the likelihood of hedging as proxy for growth opportunities.

The summary statistics show that all firms with an industry variable with a result of 1 are hedging firms. While not included in the regression, this may give an indication that petroleum and electricity firms are more likely to hedge. This hypothesis was not tested in the regression due to the low amount of firms causing instability problems. The indication is however clear. According to the results of this study, petroleum and electricity companies show a clear tendency to hedge. Whether this rises from incentives arising from tax convexity, or because the firms in the sample with these values are exceptionally large, and is a result of economies of scale or other factors such as agency costs, is not possible to determine without a larger sample of firms from these two industries.

6: Conclusion, limitations & recommendations

This chapter presents the conclusion of the findings, before presenting the limitations of the study, and finally recommendations for future study is presented.

6.1: Conclusion

Smith & Stulz (1985), Graham & Rogers (2002), Graham & Smith (1999) and others claim that firms may have tax incentives for hedging through stabilizing and reducing tax-based income, and that the tax incentives for hedging stems from convexity in the tax structure. Empirical studies have tested the relationship between hedging and tax convexity through tax preference items in US firms, and the results of some studies, such as Nance et al. (1993), Fauver & Naranjo (2010) and Shanker (2000) have found a relationship between derivative use and tax preference items, mainly tax loss carryforwards, indicating a tax incentive to hedge arising from tax convexity. This study attempts to find a similar relationship in publicly listed Norwegian firms and to answer the research question: *"Do Norwegian firms hedge in response to tax incentives? (Hedge in response to tax convexity)"*. The results do not show proof of tax incentives to hedge through tax preference items, such as tax loss carryforwards. Hedging seems to be related to agency cost, profitability leverage and to a certain degree; firm size measured by total assets.

Firstly, the results show no significant relationship between the proxies used for tax preference items and derivative usage. There was no positive relation between tax loss carryforwards and derivative use. There was however a barely statistical insignificant negative result in model 2, indicating that there might be a slight negative relationship between tax preference items and hedging. The relation was not present in model 3, indicating that this may have been a coincidence. Further, the summary statistics showed lower mean, median and standard deviations for tax loss carryforwards in hedging firms than nonhedging firms. The study further cannot show a relationship between derivative use and net deferred tax liabilities wich indicates no relationship between this variable and the likelihood of hedging, although I question the accuracy of this variable to proxy for tax incentives.

The answer to the main hypothesis is that there is no significant hedging response arising from tax incentives in listed Norwegian firms.

Theory presents other incentives that may cause firms to hedge. The results from this study shows that the main variable affecting the likelihood of the firm being a hedging firm is caused by increased agency costs. The lower the agency costs are, the less likely it is that the firm is a hedging firm, which is in accordance with previous empirical studies such as Fauver & Naranjo (2010) and Nance et al. (1993). One reasoning for this could be that firms use derivatives to decrease their agency costs. A different reasoning could be that the derivative use is a direct result of the agency problem. Further, the results show a consistent significant relationship between derivative use and leverage. I find

that highly leveraged firms are more likely to be users of derivatives, in accordance with previous research.

Growth opportunities are not found to affect the likelihood of hedging, which contradicts previous studies such as Geczy et al. (1997), Fauver & Naranjo (2010) and Fok et al. (1997).

Finally, no relationship is found between return on equity and hedging, which is used to proxy for profitability. However, by proxying profitability through operating income to sales, I find a statistically significant result, indicating a positive relationship, meaning that profitability in this case increases the likelihood of a firm being a hedging firm.

6.2: Limitations

The limitations of the study are mainly concerning issues with data availability and collection of data.

Firstly, firms do not readily report tax credits in their financial statements, and the amounts are not given in the available database. This means that tax credits cannot be accurately measured for the purpose in this study. The proxy used, net deferred tax liability, is arguably a poor proxy for tax credits and tax incentives, and may not reflect the true tax incentives of the firm. In this case, this may represent an error-in-variable bias, since the variable may be measured imprecisely.

Secondly, the lack of consistent detailed information about derivative use presents a challenge when it comes to measuring the effect of derivative use. In this study, the simple derivative use dummy variable gives an indication of whether the firm is engaged in hedging or not, but it does not give information about the extent to which the firm hedges. For an accurate measurement of the effect of hedging on tax incentives, a variable including the extent of hedging, through the amount of derivative contracts in the firm is desirable.

Thirdly, the number of firms in the petroleum industry and the electricity industry in the sample is low. The firms in said industries are characterized as large firms, some of them national firms, which gives a poor foundation for a quantitative study. In a study such as this, a larger number of firms in each category is desirable to make a proper analysis of the effects. This may be done by introducing a larger sample, since simply including companies by industry may introduce a sample-selection bias as the sample should be randomly selected.

Finally, I since all firms were located in high tax and mainly urban regions, I was not able to look at the difference in hedging activity for firms operating in low versus high tax regions. The reason for this is most likely that listed firms tend to draw to urban areas as their location of operations, since this may prove to be beneficial for large firms, especially in terms of for example employment issues. It may be that smaller, nonlisted firms could have a larger proportion of firms in

low-tax regions, and including nonlisted firms could increase the number of firms operating in low-tax regions in the sample.

It is also worth mentioning that parts of the key observations on tax incentives and derivative use had to be manually collected, since they are not available through ORBIS, which makes it a more reliable, however more time consuming process. As a result the sample size is quite small. A larger sample could be beneficial in order to see trends more clearly.

This study found no relation between growth opportunities and derivative use. This counters the results of previous empirical studies and is somewhat surprising. It may be that introducing other proxies for growth opportunities, such as R&D investment, may give better insights as to the effects of these variables when it comes to if a firms is a hedging firm or not, and may give better security to the question whether growth opportunity is part of what causes a firm to hedge. This may, if this is the case represent an omitted variable bias.

Finally, this study does not take into account the theory that firms may use hedging with derivatives as a mean for increasing their debt capacity and increasing the tax shields.

6.3: Recommendations for Future Research

The hypothesis that firms may use derivatives to increase their debt capacity as opposed to derivative use being a result of high leverage remains untested for Norwegian firms. Comparing hedging activity to leverage in order to test this hypothesis can show whether firms use derivatives to increase leverage, as opposed to leverage leading to an increase in derivative use.

Based on the results of this research and the limitations of the study, I would recommend that further studies investigate the impact of the actual degree a firm is using financial derivatives for hedging. Further, a study including the exact values of investment tax credits in addition to the tax loss carryforwards may prove to give more accurate results in order to retest the hypothesis in this study. Further, a study including nonlisted firms may give an indication to the hedging incentives in low versus high tax regions, as it is more likely that one is able to include companies from low tax regions. It would also be beneficial to include a larger sample including petroleum and electricity companies.

Finally, as opposed to a quantitative study investigating the hedging incentives in petroleum companies, a case study may be valuable in order to look at the hedging incentives of a single large oil-producer, such as DNO (Det Norske Oljeselskap). In this fashion, one can have a look at the hedging incentives of a firm representing a large amount of the total turnover in the industry. Alternatively, a future study could investigate these industries specifically with a larger sample, focusing on the hedging decisions of petroleum and electricity producers.

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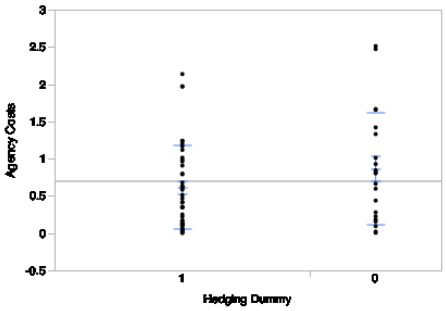
Appendix A: Excerpt of univariate tests

Oneway ANOVA, Wilcoxon Rank Sums, Tests of Equal Variances for Summary Statistics

Oneway Analysis of Agency Costs By Hedging Dummy



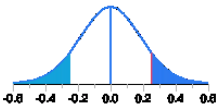
Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
1	41	0.610726	0.559491	0.06738	0.43413	0.7873
0	21	0.862326	0.747542	0.16313	0.52205	1.2026

t Test

0-1
Assuming unequal variances

Difference	0.25160	t Ratio	1.359593
Std Err Dif	0.18505	DF	31.81349
Upper CL Dif	0.62883	Prob > |t|	0.1835
Lower CL Dif	-0.12543	Prob > t	0.0918
Confidence	0.95	Prob < t	0.9082



Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Expected Score	Score Mean	(Mean-Mean0)/Std0
1	41	1207.00	1291.50	29.4390	-1.249
0	21	746.000	661.500	35.5238	1.249

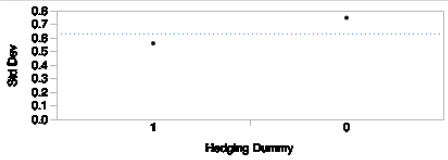
2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
746	1.24939	0.2115

1-way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
1.5796	1	0.2088

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
1	41	0.5594915	0.4409431	0.4318593
0	21	0.7475422	0.5798627	0.5721141

Test	F Ratio	DFNum	DFDen	p-Value
O'Brien[.5]	2.0942	1	60	0.1531
Brown-Forsythe	1.6229	1	60	0.2076
Levene	1.8558	1	60	0.1782
Bartlett	2.3135	1	.	0.1283
F Test 2-sided	1.7852	20	40	0.1175

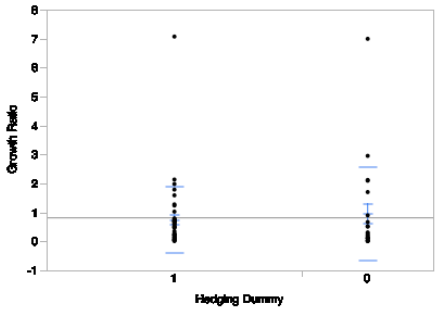
Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.8485	1	31.813	0.1835

t Test
1.3596

Oneway Analysis of Growth Ratio By Hedging Dummy



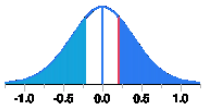
Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
1	41	0.740243	1.14880	0.17941	0.37764	1.1028
0	21	0.952766	1.61898	0.35329	0.21582	1.6897

t Test

0-1
Assuming unequal variances

Difference	0.2125	t Ratio	0.536359
Std Err Dif	0.3962	DF	30.62744
Upper CL Dif	1.0211	Prob > |t|	0.5956
Lower CL Dif	-0.5960	Prob > t	0.2978
Confidence	0.95	Prob < t	0.7022



Wilcoxon / Kruskal-Wallis Tests (Rank Sums)

Level	Count	Score Sum	Expected Score	Score Mean	(Mean-Mean0)/Std0
1	41	1332.00	1291.50	32.4878	0.595
0	21	621.000	661.500	29.5714	-0.595

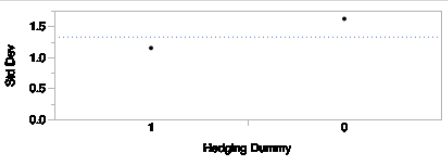
2-Sample Test, Normal Approximation

S	Z	Prob>|Z|
621	-0.59495	0.5519

1-way Test, ChiSquare Approximation

ChiSquare	DF	Prob>ChiSq
0.3629	1	0.5469

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
1	41	1.148801	0.598876	0.5519637
0	21	1.618961	1.056967	0.8466497

Test	F Ratio	DFNum	DFDen	p-Value
O'Brien[.5]	0.4565	1	60	0.5018
Brown-Forsythe	0.8255	1	60	0.3672
Levene	2.6079	1	60	0.1116
Bartlett	3.2650	1	.	0.0706
F Test 2-sided	1.9861	20	40	0.0641

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
0.2677	1	30.627	0.5956

t Test
0.5364

This table contains a t-test for differences in mean values for hedging and nonhedging firms, a Wilcoxon's Range Sum Test for difference in medians, and an F-Test for difference in variance is conducted on the difference in standard deviation of the variables for hedging and nonhedging firms. The table accompanies Table 2: Summary statistics.

Appendix B: Excerpts of logistic regression

Logistic regression, Whole Model Test, Parameter Estimates, Odds Ratio and Effect likelihood Ratio Tests for Panel 1, 2 and 3.

Nominal Logistic Fit for Hedging Dummy

Converged in Gradient, 5 iterations

Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	3.586565	2	7.193129	0.0274*
Full	36.094341			
Reduced	39.680906			

RSquare (U)	0.0906
AICc	78.6025
BIC	84.5701
Observations (or Sum Wgts)	62

Measure	Training	Definition
Entropy RSquare	0.0906	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.1517	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.5822	Σ -Log(p[i])/n
RMSE	0.4467	√Σ(y[i]-p[i])²/n
Mean Abs Dev	0.3983	Σ |y[i]-p[i]|/n
Misclassification Rate	0.3065	Σ (p[i]≠pMax)/n
N	62	n

Lack Of Fit

Source	DF	-LogLikelihood	ChiSquare
Lack Of Fit	55	36.094341	72.18868
Saturated	57	0.000000	Prob>ChiSq
Fitted	2	36.094341	0.0599

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	0.73600427	0.336248	4.79	0.0286*
Carryforwards to Assets	-0.8320751	0.4683766	3.16	0.0756
Deferred Tax to Assets	7.31773504	5.6806942	1.66	0.1977

For log odds of 1/0

Effect Likelihood Ratio Tests

Source	Nparm	DF	L-R ChiSquare	Prob>ChiSq
Carryforwards to Assets	1	1	5.99445106	0.0144*
Deferred Tax to Assets	1	1	2.04643294	0.1526

Odds Ratios

For Hedging Dummy odds of 1 versus 0

Tests and confidence intervals on odds ratios are likelihood ratio based.

Unit Odds Ratios

Per unit change in regressor

Term	Odds Ratio	Lower 95%	Upper 95%	Reciprocal
Carryforwards to Assets	0.435145	0.140339	0.868464	2.2980825
Deferred Tax to Assets	1506.787	0.080464	1.447e+9	0.0006637

Range Odds Ratios

Per change in regressor over entire range

Term	Odds Ratio	Lower 95%	Upper 95%	Reciprocal
Carryforwards to Assets	0.000081	2.21e-10	0.297516	12346.698
Deferred Tax to Assets	15.17687	0.361967	2539.945	0.0658906

Nominal Logistic Fit for Hedging Dummy

Converged in Gradient, 6 iterations

Whole Model Test

Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	12.377245	7	24.75449	0.0008*
Full	27.313661			
Reduced	39.690906			

RSquare (U)	0.3118
AICc	73.3443
BIC	87.6444
Observations (or Sum Wgts)	62

Measure	Training	Definition
Entropy RSquare	0.3118	1-Loglike(model)/Loglike(0)
Generalized RSquare	0.4559	(1-(L(0)/L(model))^(2/n))/(1-L(0)^(2/n))
Mean -Log p	0.4405	Σ -Log(p[i])/n
RMSE	0.3791	√Σ(y[i]-p[i])²/n
Mean Abs Dev	0.2867	Σ |y[i]-p[i]|/n
Misclassification Rate	0.2097	Σ (p[i]≠pMax)/n
N	62	n

Lack Of Fit

Source	DF	-LogLikelihood	ChiSquare
Lack Of Fit	54	27.313661	54.62732
Saturated	61	0.000000	Prob>ChiSq
Fitted	7	27.313661	0.4505

Parameter Estimates

Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	-4.9321331	2.4411426	4.08	0.0433*
Carryforwards to Assets	-0.7048238	0.6838766	1.06	0.3027
Leverage	2.58300099	1.448602	3.18	0.0746
Deferred Tax to Assets	2.37371426	6.6339688	0.13	0.7205
ROE	0.15548954	0.4079156	0.15	0.7031
Agency Costs	-1.8017019	0.6726621	7.17	0.0074*
Growth Ratio	0.30689077	0.3011998	1.04	0.3083
Log Assets	0.98387502	0.4544605	4.69	0.0304*

For log odds of 1/0

Effect Likelihood Ratio Tests

Source	Nparm	DF	L-R ChiSquare	Prob>ChiSq
Carryforwards to Assets	1	1	3.03329299	0.0816
Leverage	1	1	4.35417584	0.0369*
Deferred Tax to Assets	1	1	0.1305209	0.7179
ROE	1	1	0.14838779	0.7001
Agency Costs	1	1	9.46383716	0.0021*
Growth Ratio	1	1	1.12069032	0.2896
Log Assets	1	1	5.4188749	0.0199*

Odds Ratios

For Hedging Dummy odds of 1 versus 0

Tests and confidence intervals on odds ratios are likelihood ratio based.

Unit Odds Ratios

Per unit change in regressor

Term	Odds Ratio	Lower 95%	Upper 95%	Reciprocal
Carryforwards to Assets	0.494196	0.098885	1.05382	2.0234901
Leverage	13.2368	1.15084	399.34	0.0755469
Deferred Tax to Assets	10.7372	0.000032	16671678	0.0931342
ROE	1.16823	0.517253	2.791947	0.855996
Agency Costs	0.165018	0.036838	0.542486	6.0589522
Growth Ratio	1.359192	0.76769	2.73092	0.735731
Log Assets	2.674801	1.160175	6.974728	0.3738596

Range Odds Ratios

Per change in regressor over entire range

Term	Odds Ratio	Lower 95%	Upper 95%	Reciprocal
Carryforwards to Assets	0.000342	4.19e-12	1.810395	2922.9406
Leverage	142.4682	1.309614	98703.78	0.0070191
Deferred Tax to Assets	2.416284	0.021366	483.2478	0.4138587
ROE	3.375956	0.005751	3084.223	0.2962124
Agency Costs	0.010846	0.000251	0.215308	92.204134
Growth Ratio	8.732157	0.154624	1204.642	0.1145192
Log Assets	334.4383	2.405393	98231.64	0.0029901