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GRA 19703

Master Thesis

Thesis Master of Science

Estimating taxable income responses using the Norwegian tax reform in 2006

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Start:	15.01.2019 09.00
Finish:	01.07.2019 12.00

BI Norwegian Business School

Master thesis: MSc in Business, Major in Economics
Supervisor: Christian Brinch
Date of submission: 28.06.19

Estimating taxable income responses using the Norwegian tax reform in 2006

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Abstract

In this paper, we will examine the Norwegian tax reform from 2006, which included a decrease in overall marginal taxes. By using the approach of Gruber & Saez (2002), we will provide new estimates of the elasticity of taxable income (ETI), regarding this reform. We collected data from Statistics Norway, through Microdata, and discuss how the reform impacted an individuals' labour supply choices. Our results from running 2SLS indicate that the elasticity of taxable income of the tax reform in 2006 is small, compared to other international studies. By using a placebo analysis, we implement a series of fabricated tax reforms to test the robustness of the regression models. The findings of this analysis are that we get a systematic bias when applying a placebo reform.

Acknowledgement

We would like to express our greatest gratitude to our supervisor Christian Brinch, for his support and guidance. The development of this master thesis would not have been possible without his valuable advice and constructive feedback.

We would also extend our gratitude towards SSB and NSD for providing us access to Microdata. And a special thanks to Trond Pedersen from NSD, who helped us with questions regarding Microdata.

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1.0 Introduction

This paper intention is to analyse the impact of the change in the tax schedule on income for individuals, by using the Norwegian tax reform from 2006. This study contains data from the Norwegian population between 2000 and 2015, and we will calculate the elasticity of taxable income (ETI). By using the perspective of Gruber & Saez (2002), allows us to calculate both the income effects of tax changes on taxable income and variation in the elasticity of taxable income. Additionally, we will also include fabricated tax reforms in the years after the real tax reform. Hence, this allows us to test the robustness of the regression models.

In the later years, it has been more common to observe estimates of income responses to tax changes over a tax reform period, particularly on tax reforms in the US. Conversely, several influential articles have also been examining the Norwegian tax reforms from 1992 and 2006, such as Berg & Thoresen (2016), Alstadsæter (2006), Thoresen & Vattø (2013), Thoresen, Bø, Fjærli & Halvorsen (2012) and Aarbu & Thoresen (2001). The motivation for why we have chosen the subject at hand is due to the relatively small literature on the Norwegian tax reform from 2006. Despite the article written by Berg & Thoresen (2016) where they used data from 2001 to 2010 to analyse the tax reform from 2006, we have now expanded the dataset from 2000 to 2015.

The thesis starts with an introduction creating a summary of key aspects. Further, we want to explain the background of the Norwegian tax reform in 2006 and then describe the reform. Section 2 provides a review of the literature on previous work, the labour supply model, the elasticity of taxable income, and the literature from Norwegian studies. Section 3 presents the research question with limitations. Section 4 describes our data where we explain the filtering process, the variables and the limitations for the thesis. Section 5 outlines our methodology approach. In Section 6, we will present the results together with a discussion. At last, we will provide a conclusion in Section 7.

1.1 Background

When explaining the tax reform from 2006, we will start by describing why they implemented the reform and the reasons that led to it. Hence, in this part, we will examine the past and explain the background of the reform.

The previous system in Norway was the "dual income tax" system, introduced in 1992. The reform is also referred to as the "Nordic tax system" because it was first implemented in the Nordic countries Sweden, Denmark, Finland and Norway. This system operated with two different tax rates for income, depending on how the income was generated. Consequently, the system consisted of a combination of a low proportional tax rate on capital income and a progressive tax rate on labour income (Thoresen T. O., Bø, Fjærli, & Halvorsen, 2011). Norway had a flat 28 per cent tax rate imposed on corporate income, capital income and labour income combined with a progressive surtax applicable on labour income. Hence, with the "dual income tax" system, there were incentives for taxpayers to recharacterize labour income as capital income. For example, the owner of a company would instead choose to receive low-tax dividends instead of wages (Thoresen T. O., Bø, Fjærli, & Halvorsen, 2012).

Considering the predictability in the tax policy and knowledge of the tax rules in a population indicates that it is not cost-efficient to change the tax system frequently. However, it must be changed from time to time to adapt to social developments. The tax reform from 2006 can be seen as a result of the EEA-rules, with requirements for equal treatment of dividends whether they are earned in Norway or abroad (Thoresen T. O., Bø, Fjærli, & Halvorsen, 2012). According to Thoresen (2009), the new 2006-reform was implemented due to suspicion of the tax-motivated adjustments to the so-called split model. The split model was a result of the "dual income tax" system, where the model introduced regulations to how companies could classify the dividends distributed to its owners.

Further, the central concept behind the model was how the ownership was distributed. If 2/3 or more were held by active owners (closely held), the income would be treated as labour income regardless of the dividends policy of the company. To classify dividends as capital gains, hence subjected to a low proportional tax rate, more than 1/3 of the shareholders were passive (widely held).

An active owner is characterised as active if he works more than 300 hours annually in the firm (Alstadsæter, 2006). In the period following the tax reform in 1992, there was a significant increase in the number of small corporations with four or fewer employees. The number of widely held corporations also increased, while there was a decrease in the number of self-employed (Alstadsæter, 2006). Thus, these differences lead to an incentive for income shifting from labour income to capital income, and to deter this from happening would be highly costly (Sørensen, 1994). Hence, this was one of the main criticisms of the "dual income tax" system and played a role in the development of the 2006-reform.

The Parliament stated that the 2006-reform was introduced as a solution with the primary objective to ensure "fairer" taxation of income. Besides, the 1992-reform had obvious flaws which lead to an "income-shifting-problem". Thus, the Parliament appointed a committee led by Arne Skauge to develop suggestions to the new tax reform (Finansdepartement, 2004). We will emphasise this further in the next section.

1.2 Tax reform 2006

The tax reform from 2006 introduced significant changes in marginal taxes on wages and capital income. While the effective marginal tax rate on dividends was 28 per cent before the reform, it increased to 48 per cent after the reform. At the same time, the highest marginal tax rate on wages reduced from 55.3 per cent to 47.8 per cent (Thoresen T. O., Bø, Fjærli, & Halvorsen, 2012). The main objective of the 2006-reform was to achieve a more efficient and fair tax system and remove the opportunity for active owners and self-employed to have labour income taxed as capital income at a much lower rate (Ministry of Finance, 2005). The fundamental purpose of the reform was to close the difference in the taxation of capital income and labour income, which had a difference of 33.5 per cent in 2005 (Ministry of Finance, 2005).

The Skauge committee suggested that a more predictable taxation system was necessary. The recommendations from the committee played a significant role in the development of what became known as the shareholder model, which was presented in the reform (Finansdepartement, 2004). The critical elements of the shareholder model were to ensure that it became less attractive with income shifting than before. Hence, by applying double taxation on dividends as well as reducing the existing progressive income tax, it became possible to make the difference as small as possible. Double taxation on dividends was attained by applying a corporate tax on profits, as well as a shareholder tax on dividends (Ministry of Finance, 2016).

However, an increase in dividend tax also has disadvantages. The disadvantages include the motivation to prevent dividend tax and the motivation to emigrate from Norway. Still, the Government did not increase the overall tax level for Norwegian owners. An increase in the tax rate on dividends which follows from the reduced corporate tax rate, will by itself reduce the tax levied to owners on new profits. Thus, this is because parts of the dividend are shielded against dividend tax, while the company's profits are taxed in full (Ministry of Finance, 2016). The goal of the 2006-reform was to decrease the difference between labour income tax and dividend tax. Part of this goal was achieved by an increased tax on dividends, while at the same time lowering the labour income tax. Also, the general population would not experience much of a difference, except for the lower progressive tax-level.

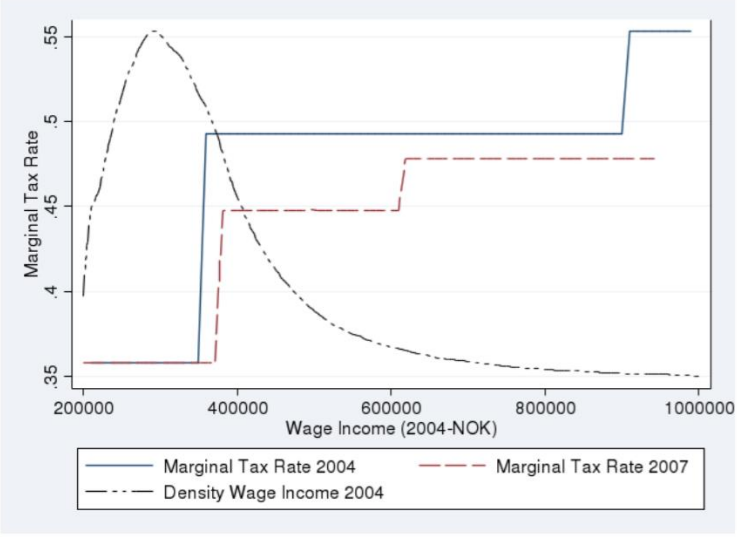

Figure 1: Reductions in marginal tax rates as a result of the tax reform (Thoresen & Vattø, 2013)

The reform was gradually implemented in the years before 2006. Figure 1 compare the schedules for 2004 (pre-reform) and 2007 (post-reform). The figure also shows the key features of the Norwegian labour income tax system. In 2004, incomes above 354 300 NOK (first surtax bracket) had a rate of 15.5 per cent, and income excess of 906 900 NOK (second surtax bracket) had a rate of 19.5 per cent. In contrast to 2007, where incomes above 400 000 NOK (first surtax bracket) had a rate of 9 per cent, and income excess of 650 000 NOK (second surtax bracket) had a rate of 12 per cent. This led to the decrease in the marginal tax rate from 55.3 per cent to 47.8 per cent (Thoresen & Vattø, 2013).

2.0 Literature Review

To be able to conduct a thorough analysis of the subject, it is considered necessary to examine the existing literature. The literature review includes current knowledge on evaluations of other tax reforms where they use different theoretical and methodological approaches. Further, we will supplement with the theory on labour supply models. The ETI literature is enormous, with a lot of different types of articles and review articles. Such as Saez, Slemrod & Giertz (2012) that wrote a critical review on the elasticity of taxable income with respect to marginal tax rates. Additionally, McClelland & Mok (2012) reviewed all the different ETI estimates of the Tax Reform Act of 1986. However, to cover the whole literature on the field would be beyond the scope of this thesis. Thus, we will cover the aspects which we consider relevant. This paper will mainly focus on the article written by Gruber and Saez (2002), where they exploit tax returns to study a series of tax reforms throughout the 1980s in the US.

2.1 Previous work

There is much research on the behavioural elasticities of labour supply and savings which determine the responsiveness of real behaviour to taxation. Gruber & Saez (2002) wrote a paper about the elasticity of taxable incomes where they emphasised evidence and implications of tax reforms in the US. During the 1980s, one of the essential features of economic policymaking was a series of tax reforms which dramatically lowered marginal income tax rates in the US. The income tax schedule reduced from 15 brackets to four, which resulted in a dramatic decrease in the top marginal income tax rate (Gruber & Saez, 2002). During the 1980s the top marginal

tax rate at the federal level was 70 per cent, and by 1988 it was decreased to 28 per cent. Several prominent articles have covered this subject and expressed logical arguments behind this dramatic reduction in marginal tax rates. Boskin (1978) argued that behaviours such as savings and labour supply were extremely elastic regarding their prices, and as a result, lower tax rates could generate substantial increases in economic activity. On the other hand, a large group of subsequent literature suggested that these behavioural elasticities were rather modest (Gruber & Saez, 2002). However, at the start of 2000, new research emerged where they argued that these standard behavioural responses are only one component of what drives taxable income. Other responses, such as the form of unmeasured effort, compensation, and compliance, also determine taxable income, and these may be more elastic to taxation.

Furthermore, Gruber & Saez (2002) provided a new estimate of the elasticity of taxable income, which is different from previous work. The elasticity they found was 0.4, which is significantly lower than in earlier studies. An important reason behind the different results is the size of the tax changes that they studied. Most previous work has only focused on the Tax Reform Act of 1986. Conversely, the variations in Gruber and Saez comes from bracket creep, state tax changes and changes through the Economic Reform Tax Act of 1981 and the Tax Reform Act of 1986.

Feldstein (1995) showed a strong response of taxable income to changes in marginal tax rates. He indicated that it is the overall elasticity of taxable income, which is relevant for assessing the implications of tax changes for income raising. He estimated a relatively high elasticity for the Tax Reform Act of 1986, where other papers calculated this elasticity close to zero. Hence, this has generated a wide range of estimated elasticities, which reflects a variety of differences between the approaches used in these papers. See McClelland & Mok (2012) for the variety of ETI results, where different definitions of income, the sample used[1], and the source of identification can explain some of these differences (Gruber & Saez, 2002).

[1] Ranging from just focusing on high income taxpayers to using a full range of incomes.

Due to the dramatic fall in the marginal tax rates, the Tax Reform Act of 1986 has been a particularly useful natural experiment for studying the responsiveness of taxpayers to changes in marginal tax rates (Feldstein, 1995). Therefore, it consists a wide range of literature where different people have examined the reform. A change in individuals' marginal income tax rate can bring them to adjust their taxable income in a wide variety of ways[2]. For understanding the effect of tax rates on income requires not only assessing the effect on labour supply, but also assessing the response of overall taxable income (Feldstein, 1995).

Kleven & Schultz (2014) estimated taxable income responses by using Danish tax reforms and rich administrative data from 1980. Unlike the studies from the US, the dataset Kleven & Schultz (2014) used combines tax return information with a more detailed labour market, education, and sociodemographic information. Furthermore, the Danish income distribution has been much more stable than most other countries, making them overcome identification problems as well as eliminating bias from nontax changes in inequality. Additionally, the Danish tax reforms created significant and compelling variations that are not strongly correlated with income levels (Kleven & Schultz, 2014). However, they emphasised concerns about the external validity of a single-country study and especially a small-country study. They found relatively low-income elasticities, despite the presence of very high marginal tax rates. Thus, this indicates that the Danish system offers small opportunities for avoidance and evasion. The main reason could be that the tax bases are broad and provide limited opportunities for dedications and negative capital income to count against the income tax base. Hence, their overall conclusion was that the Danish tax system had modest behavioural responses (Kleven & Schultz, 2014).

[2] Including changes in labour supply, portfolio investments, how employee compensation is taken, other expenditures that reduce taxable income and in taxpayer compliance

2.2 Labour supply model

In a traditional labour supply model is hours of work and participation in work, the primary measures of the effort supplied by individuals. There are different ways to adjust for effort, whether people work or not they can change how many hours they work per week or year, and the amount of effort they put into working. Besides, some people can also choose between the way of how they earn income[3], and how they consume to change tax liabilities (Meghir & Phillips, 2010). According to Meghir and Phillips, hours worked is for many people an appropriate approximation to effort, and the incentive effects of taxation is a study of how hours worked are affected by taxes and transfers. Conversely, evaluating hours worked on higher-skilled individuals is not a good measure of effort, because of the design concerning the taxation system. Taxation might provide an incentive to shift earnings from tax-favoured forms or over-consume items that are tax-deductible (Meghir & Phillips, 2010).

Meghir and Phillips examined the tax system in the UK thirty years ago, with a focus on the empirical consensus on how taxes and benefits affect incentives. They discovered that incentives matter and taxation could generate essential distortions. Also, a well-designed tax and benefit system will recognise that all groups in the population can be reasonably sensitive to taxes and benefits in many different dimensions. However, incentives had mixed results on how men and women were affected, and if they were educated or not. For women with young children and low educated men, tax and benefit incentives are important considering the participation decision. Conversely, taxes did not affect how highly educated men worked or not, and how many working hours they worked in a week or a year (Meghir & Phillips, 2010).

Eissa (1995) examined the Tax Reform Act of 1986, where she used a natural experiment to identify the labour supply responsiveness of married women to changes in the tax rate. Through a natural experiment, she determined the responsiveness of married women's labour supply to changes in the tax rate. By applying the differences-in-differences methodology, she found evidence that the labour supply of women with high-income increased due to the reform. Conversely,

[3] Earn income through either capital income, salary or dividends.

poor women had relatively smaller labour elasticities. Kaygusuz (2010) used static heterogeneous agents' model with two-member households where they decided to work or not. His results also showed that there were significant changes in the earnings of the female workers and college graduates. The fraction of college graduates in the population increased significantly, whereas the labour force participation rate of married women increased by 13 per cent between 1980 and 1990 (Kaygusuz, 2010).

Eissa & Liebman (1996) studied the expansion of the earned income tax credit (EITC)[4] in the Tax Reform Act of 1986. They examined how the reform impacted the labour force participation and hours worked on single women with children. By comparing the change in the labour supply of single women with children to the change for single women without children, they identified the impact of the EITC. They discovered that single women with children increased their labour force participation by 2.8 per cent, while there was no change in hours worked for women who were already working. Their findings contradict the economic theory that suggests that labour force participation should increase, and hours of work should decrease.

Feldstein (1995) emphasised that variations in labour supply are not the same as variations in taxable labour income. When the marginal tax rates are high, individuals will take their compensation for labour services in forms that are untaxed or subject to lower effective tax rates. Untaxed compensation involves traditional fringe benefits such as health insurance, childcare and low-interest loans. Conversely, taxed compensation with low effective tax rates includes pension contribution, life insurance and stock options. Individuals with high income and are self-employed, or part of a corporation's senior management can have substantial discretion about the form of compensation in response to tax changes. Hence, this is also true for those employees who do not directly shape their compensation arrangements (Feldstein, 1995). Further, higher levels of deductions for investment interest, health insurance, charitable contributions, can reduce taxable income, especially when tax rates increase.

[4] EITC is a refundable credit for low- to moderate-income working individuals with children (Internal Revenue Service, 2019).

2.3 Elasticity of taxable income (ETI)

The elasticity of taxable income measures the response in taxable income to a change in the net-of-tax rate (Thoresen & Vattø, 2013). After the article Feldstein wrote in 1995, there has been expanding literature of similar ETI studies from other countries. Among other things, one reason is that the ETI summarises the total efficiency loss in an increase in the marginal tax, without having to discuss in more detail what type of responses that lead to the change in income. Consequently, this means that one does not have to decide whether the reaction in income is due to changes in working hours, wage increases as a result of increased work effort or changes in tax evasion (Berg & Thoresen, 2016). Tax causes several behavioural responses intended to minimise the burden on the individual. Putting aside income effects, responses such as the absence of externalities and other market failure are sources of inefficiency. Thus, in principle, the ETI can capture all of these responses. Therefore, deriving estimates of the ETI from microdata has become a popular empirical strategy for measuring the efficiency costs of taxation (Saez, Slemrod, & Giertz, 2012). Auten & Carroll (1997) and Saez (1999) presented a framework that overcomes the implications of identification problems when computing the estimates to ETI. They controlled for relationships between income changes and lagged income levels.

The elasticity of taxable income can be seen as a sufficient statistic for welfare analysis. Thus, this is the case when private and social costs of changes in the marginal tax rate are equal since the optimal tax rate is a simple function of the ETI (Chetty, 2009). The ETI represents a summary measure of tax efficiency costs, which means that further information about the behavioural components regarding the ETI, is not required for its use in tax policy design. However, one should be cautious in the practical implementation of the approach. Since this is due to the social implications of the behavioural responses to tax changes can vary to the extent where there are external effects involved (Berg & Thoresen, 2016). Externalities may arise because the ETI captures highly valued activities, like tax evasion. Still, the ETI literature includes contributions on how ETI estimates can be used to measure tax efficiency effects, in the presence of behavioural diversities with different social costs (Chetty, 2009).

Weber (2014) reviewed a method that provided a more consistent ETI estimate than previous literature[5]. She discussed a more accurate way to estimate ETI compared to previous approaches used in the ETI literature. Furthermore, commonly used methods tried to simultaneously adjust for mean reversion and heterogenous income trends by using different methods of base-year income splines, which provided two problems. The first problem was that the identification assumption lacked transparency because they mixed assumptions regarding mean reversion. The second problem was assumptions regarding changes in income inequality (Saez, Slemrod, & Giertz, 2012). Weber tried to separate these two issues and examined the problems both empirically and theoretically. However, given that she used a different way of estimating the ETI, her estimates were still inconsistent (Weber, 2014). She also emphasised that it is an extreme nature of assumptions that is necessary in order to produce consistent estimates. Additionally, it is likely that other obtained estimates for other countries also are inconsistent, given they used the same methodology.

Blomquist & Selin (2010) addressed the tax reduction in Sweden between 1981 and 1991, where the top marginal tax rate decreased by 34 per cent. They estimated the elasticity of the hourly wage rate as well as the taxable labour income elasticity to the net-of-tax rate. Additionally, they estimated elasticities for non-labour income. They found a statistically significant response in wage rates for both married men and women when they analysed for hourly wage rates. Conversely, this is in contrast to Gruber & Saez (2002). They did not find significant income effects on US data from the 1980s, and the different use of methodology can explain the reason for the different results.

2.4 Norwegian studies

Thoresen & Vattø (2013) wrote a discussion paper of the tax reform from 2006. They showed how the ETI methodology could be used to validate predictions from a discrete choice structural labour supply model. The discrete choice labour supply model is a tool that is often used to analyse a wide range of hypothetical tax and benefit reforms. They derived the ETI from specific tax reforms and measured the average effects for the individuals treated by the reform. Thus, it can be misleading

[5] She estimated an ETI of 0.858, which is twice as large than estimates found by other prominent articles (Weber, 2014).

when comparing average wage elasticities from the labour supply model with average net-of-tax rates. Their findings indicate that the estimated results from the structural model are not far from the results of the panel data analysis[6] (Thoresen & Vattø, 2013).

Aarbu & Thoresen (2001) provided measures of the ETI with respect to tax changes in the tax reform from 1992, using difference-in-difference methodology. They discussed the relationship between growth in taxable income and changes in marginal tax rates. The Norwegian tax reform of 1992 created an opportunity to employ a natural-experiment approach. They compared the responses of individuals who experienced significant changes in marginal tax rates against those with minor variations. They estimated the net-of-tax rate range between -0.6 and 0.2. The elasticities are lower than similar estimates from the US. A reason for the different results can be from the net-of-tax sensitivity (i.e., behaviour) across countries (Aarbu & Thoresen, 2001). The article found evidence that flatter tax reforms will not induce high-income earners to increase their income-generating efforts to any great extent. They also indicated that policymakers should place more weight on enhancing work incentives for other groups. Additionally, focusing on income distribution issues when considering reforms of the tax system.

Berg & Thoresen (2016) discussed various underlying behavioural responses empirically on data of the Norwegian self-employed, exploiting the tax changes from the tax reform of 2006. Changes in marginal tax are typically assumed to have a more substantial impact on the behavioural responses of the self-employed, than the response from wage earners. Although the share of self-employed in proportion to the total workforce is low in Norway[7], their role in the economy receives considerable attention to how the tax system is designed (Berg & Thoresen, 2016). They estimated the ETI for the self-employed in the range from 0.1 to 0.17, which is relatively small. These elasticities are close to the findings for Denmark, reported by Kleven & Schultz (2014). Their estimates suggested that effects in working hours are the dominant response margin summarised by the ETI. However, they found lower ETI estimates when they derived weights for the probability of

[6] Estimated results from the structural model is ranging from 0.05 to 0.09. While the results from the panel data analysis are from 0.04 to 0.055 (Thoresen & Vattø, 2013).
[7] Share of self-employed is around 7-8 per cent (Parker, 2009).

changing organisational form. The ETI decreased from 0.17 to 0.12 after they changed shifting patterns that they controlled. Hence, this suggests a significant bias in their ETI estimates.

In 2013, Trine Vattø wrote a doctoral dissertation on the reform from 2006. She estimated labour supply models and analysed observation before and after a realised policy reform. She used ETI to measure the response in taxable income to a change in the net-of-tax rate and used data from wage earners in Norway. Standard labour supply approaches usually focus on the choice of hours work given an individual-specific wage rate. Whereas the ETI approach allows for a broader range of responses to changes in marginal tax rates, such as tax avoidance and evasion capture by the taxable income response (Vattø, 2013). The estimated net-of-tax elasticity was small, compared to other ETI studies. However, they were similar to the results in Kleven & Schultz (2014). Overall, the estimated real responses were small and fluctuated rapidly over time. Hence, this implies that it is not optimal for a worker to extend education or shift job because of adjustment costs.

3.0 Research Question

In the following section, the research question will be presented together with the limitations of the research question. When formulating a research question, we restrict our thesis to the discussed field of study. The purpose of this study is to measure the impact of a change in the tax schedule faced by a given individual on his income and calculate the ETI using the tax reform from 2006. From this, we formulate our research question:

How will a change in the tax schedule affect individuals labour supply responses?

Our motivation for the research question is the article written by Thoresen, Bø, Fjærli & Halvorsen (2011). They evaluated the effects of tax policy changes from the Norwegian tax reform in 2006 and used data from 2000 to 2008. Consequently, we thought that they did not give the reform enough time to settle in before examining it. Therefore, their findings can potentially have flaws since they wrote it in a short period after the reform. Thus, we now want to re-evaluate the tax reform with an expanded dataset.

3.1 Research question limitations

Considering our research question and the objective of our thesis, we have to address certain limitations. First, individuals might face different income growth rates along the income distribution, which can lead to mean reversion. For example, high income in one year tends to be lower in the following year, which can lead to a negative correlation between the error term and the first-period income in the regression analysis.

Moreover, it can occur underlying behavioural responses in the ETI estimates, which can also lead to unstable estimates. Berg & Thoresen (2016) discussed this problem by looking at the extent to which the revenues of Norwegian self-employed responded to changes in the marginal tax rates. They used the tax changes in the tax reform from 2006 to identify how tax changes affect income. Challenges related to this are endogenous sample selection and omitted variables. Therefore, they showed evidence that it is crucial to understand how the structure of the ETI matter because of the response margins that may cause estimation bias. Their results support the theory that tax evasion has been lower after the tax reform and, that most of the response in income as a result of working hours have increased after the reform.

Further, another limitation of our thesis is related to Microdata, which is the analysis program we use. The primary issue was that we had never encountered Microdata, so we had to use much time to understand how it worked. It is a relatively new analytical tool and, therefore, does not contain all necessary commands for the calculations. Thus, when estimating IV-regressions, we had to write all of these calculations manually. Since it is an online analytical tool and the program is not finalised, there have been times when we could not access the program for days because of bugs and errors in the program. There have also been times when the program has been so slow that it would take several hours to run easy calculations. Hence, it is safe to say that these problems have been a limitation in our thesis.

4.0 Data

The data we will use for our research is primarily from Statistics Norway. We were granted access to the online analytic tool, Microdata, which gave us access to Statistics Norway register data of the Norwegian population. Through this, we got access to detailed data on wage income and taxes between 2000 and 2015. Additionally, we used "Stortingsmelding 1" (from the National Budget) to find the different tax rates, minimum standard deduction rates and personal allowance of the years in question.

The empirical strategy is based on changes in income between pairs of years to the change in marginal rates between similar pairs of years. The time length between these pairs of years can vary in the literature from one, two or three years. Since we believe that it might take some time to react to a tax change, we will follow Feldstein (1995) and Gruber & Saez (2002) by using a time length of three years. Thus, this implies that we relate the year 2003 to the year 2000, 2004 to the year 2001 and so forth up to the year 2015 to the year 2012. Additionally, the tax system is progressive and therefore, it will at some points have different structural breaks. Consequently, we adjust the income to follow these structural breaks to be able to examine an unchanged tax system.

4.1 Filtering

The original dataset included 3.5 million observations. Therefore, to make the dataset more comprehensible, we removed all insignificant variables and observations. First, we started to eliminate all observations which did not have a reported wage income for all years in the span of 2000 to 2015. Further, we removed all observations with business income, both negative and positive. The reason for this is that generally, they do not have the same marginal tax rates as wage income. Also, the business income is more responsive to anticipated changes in the applicable tax rates (Saez, Slemrod, & Giertz, 2012). Additionally, we identified observations that had a negative income tax, and this could be real observations or inaccuracy in the dataset. However, to reduce noise in the regression, we excluded these observations, which led to a sample of nearly 900 000 observations spanning from 2000 to 2015. Furthermore, Microdata automatically filters the data, which led to a loss of many high earners in our dataset, whereas in the first three years

(2000, 2001 and 2002) there were no observations in surtax bracket two. Nevertheless, we will emphasise this further in the limitations of our thesis. The filtering in Microdata is presented in Appendix 2.

4.2 Definitions of variables

After filtering the dataset as described above, our dataset had a substantial number of observations and variables. Further follows a description of the variables defined in this paper, where Appendix 1 presents the data collected from "Stortingsmelding 1".

4.2.1 Income variable

The measure of the income variable is in NOK. The variable consists of cash wages, other taxable benefits and maternity benefits during the calendar year (Statistisk Sentralbyrå, 2019).

$$y_1 = \log\left(\frac{z_2}{z_1}\right)$$

We name the income variable y and take the log of income in period 2 (z_2) and dividing it by income in period 1 (z_1) because we can then use it directly in our regression analysis. We will explain the regression analysis further in Section 5.

4.2.2 Personal allowance

The personal allowance is a general deduction against ordinary income tax rate, i.e. it is given against all types of income (pension, salary and business income). In Norway, we have two brackets for personal allowance where all single taxpayers are taxed in bracket one. Taxpayers with providing responsibility for spouses are taxed in bracket two (Skatteetaten, 2019). In our thesis, we will assume that all taxpayers are in bracket one, which we will emphasise further in limitations.

4.2.3 Minimum standard deduction

The minimum standard deduction will automatically subtract from salaries, pensions and other similar income. It is calculated automatically based on information on income or pensions. We used the following equation to calculate the minimum standard deduction:

$$MSD = (z_i < l_i) * H_i + (z_i > l_i \,\&\, z_i < h_i) * (z_i * r_i) + (z_i \geq h_i) * H_i$$

$$z_i = Income\ year\ i$$

$$l_i = \frac{L_i}{r_i}$$

$$h_i = \frac{H_i}{r_i}$$

$$L_i = Lower\ Bound$$

$$H_i = Upper\ Bound$$

$$r_i = Minimum\ Standard\ Deduction\ Tax\ Rate$$

4.2.4 Tax

Tax includes personal allowance, minimum standard deduction, general income, national insurance contribution and surtax. National insurance contributions are calculated automatically on personal income and help to finance the national insurance scheme (Skatteetaten, 2019). General income is net taxable income and must be calculated by all those who are subject to taxation, both individuals and companies. All types of taxable income, after deduction of all deductible expenses, are covered (Skatteetaten, 2019). We obtain national insurance contribution and general income from the national budget. Respectively they have been 7.8 per cent and 28 per cent from 2000 to 2013. In 2014 and 2015 the national insurance contribution was increased to 8.2 per cent, and the general income reduced to 27 per cent. We used the following equation to calculate tax:

$$T_i = (z_i - PA - MSD) * GI + (z_i * NIC) + (z_i > SL_1) * (z_1 - SL_1) * r_1 + (z_1 > SL_2) * (z_1 - SL_2) * r_2$$

$$T_i = Tax\ rate\ in\ year\ 1$$

$$PA = Personal\ allowance$$

$$MSD = Minmum\ Standard\ Deduction$$

$$GI = General\ income$$

$$NIC = National\ Insurance\ Contribution$$

$$SL_1 = Surtax\ level\ 1$$

$$SL_2 = Surtax\ level\ 2$$

$$r_1 = Surtax\ rate\ 1$$

$$r_2 = Surtax\ rate$$

4.2.5 Marginal tax rate

The effective marginal tax rate corresponds to the percentage that an individual must pay on an additional NOK of income. Many tax rates increase at higher incomes, and the tax-free amount may be exhausted (Skatteetaten, 2019). We used the following equation to calculate the marginal tax rate:

$$m_i = NIC + GI + (SL_1 < z_i < SL_2) * r_1 + (z_i > SL_2) * r_2$$

$$m_i = Marginal\ Tax\ Rate\ in\ year\ i$$

There are three different levels of marginal tax for individuals. If an individual earns less than the lower limit in surtax bracket one, the individual will have a marginal tax rate equal to the national insurance contribution and general income. Consequently, if an individual earns more than the lower limit in surtax bracket one and less than the lower limit in surtax bracket two, the individual will have a marginal tax rate equal to the national insurance contribution, general income and surtax rate one. At last, if an individual earns more than the lower limit in surtax bracket two, the individual will have a marginal tax rate equal to the national insurance contribution, general income and surtax rate two.

4.3 Limitations

There are weaknesses and uncertainty related to our dataset. In Microdata, there is no possibility to look at the actual observations in the dataset, because of the built-in protection of the personal data. Thus, when calculating personal allowance, we must decide between the two different brackets, where bracket two are for those with providing responsibility for spouses, and bracket one are for the rest of the population. Since there is no way to control for which bracket the observations belongs, we assume that all observations are in bracket one. There is also a separate tax schedule for people in northern Norway (Finnmark) (Skatteetaten, 2019). Since it is not possible to identify these observations, we assume that they have the same taxation as the rest of the population in the dataset.

Further, the system is top-coded and bottom-coded for one per cent highest and one per cent lowest income values where the threshold values replace the actual values. To avoid this problem, we have set an upper and lower limit, which excludes the threshold values for each year. These limits are presented in Appendix 2. By excluding these values leads Microdata only to regress 98 per cent of the data, which is not optimal. Since there is no way to control the remaining observations, we assume that the filtering process is to some extent accurate. However, there is a probability that the dataset contains unwanted variables.

5.0 Methodology Approach

The purpose of this thesis is to measure how the impact of a reduction in marginal taxes affects the individual's income. To achieve this, we will follow the perspective of Gruber & Saez (2002), who estimated the ETI on a series of tax reforms throughout the 1980s in the US. By using a similar methodology, we will estimate the ETI for the Norwegian tax reform from 2006.

To further examine the impact of a change in the tax schedule, we will use the basic labour supply model, with consumption and income. From this model, we develop a regression specification. To examine the ETI, we will define two different econometric models. Each model consists of an equation system with simultaneity in two structural equations. The first model is a regression specification without restrictions and the second model we control for mean reversion using log income. The OLS application to these equations will lead to biased coefficient estimates. Hence, we will use the two-stage least squares (2SLS) approach and introduce instrumental variables. At last, we will test the robustness of the model by introducing a placebo analysis with fabricated tax reforms.

According to Bjørnland & Thorsrud (2015), the two-stage least squares (2SLS) is a method for consistently estimating the compensated elasticity and the income effect elasticity. Applying this to our regression involves running three regressions in two steps.

The first step is to regress the endogenous regressors (x_1 and x_2) on the instruments (z_1 and z_2):

$$x_1 = \gamma_0 + \gamma_1 z_1 + \gamma_2 z_2 + \mu$$
$$x_2 = \theta_0 + \theta_1 z_1 + \theta_2 z_2 + \nu$$

Where we save the fitted values:

$$\hat{x}_1 = \hat{\gamma}_0 + \hat{\gamma}_1 z_1 + \hat{\gamma}_2 z_2$$
$$\hat{x}_2 = \hat{\theta}_0 + \hat{\theta}_1 z_1 + \hat{\theta}_2 z_2$$

The second step is to regress the dependent variable (y_t) on the fitted values ($\hat{x}_1$ and $\hat{x}_2$):

$$y_t = \beta_0 + \beta_1 \hat{x}_1 + \beta_2 \hat{x}_2 + u$$

to get the different elasticities $\hat{\beta}_1^{TSLS}$ and $\hat{\beta}_2^{TSLS}$.

5.1 Regression specification

The budget constraint of a taxpayer in a labour supply model is c = (1- τ)z + R, where c is consumption, z is wage income, τ is the marginal tax rate, and R is virtual income. The definition of virtual income is a taxpayer who chooses to maximise his consumption.

$$dz = -\frac{\partial z}{\partial(1-\tau)} d\tau + \frac{\partial z}{\partial R} dR \qquad (1)$$

Equation (1) shows how income supply is affected by changes in marginal income and virtual income. The first expression on the right-hand side is equivalent to $\frac{\partial z}{\partial \tau} d\tau$, which measures the elasticity to marginal tax rate without calculating the change. Therefore, we will use Equation (1) because it measures the elasticity with respect to (1-τ) and by subtracting the marginal tax rate, we obtain the impact of a change.

Further, in Equation (2), the definitions of elasticities are introduced. The uncompensated elasticity of income (ζ^u) with respect to net-of-tax rate expresses the relative change in the tax rate and the relative change in income before tax.

Hence, it specifies both effects. The formula for uncompensated elasticity as Gruber and Saez (2002) presented is; $\zeta^u = \frac{[\frac{1-\tau}{z}]\partial z}{\partial(1-\tau)}$ and the income effect parameter $\eta = \frac{(1-\tau)\partial z}{\partial R}$.

Thus, we obtain this term:

$$dz = -\zeta^u z \frac{d\tau}{1-\tau} + \eta \frac{dR}{1-\tau} \qquad (2)$$

Additionally, we use the compensated elasticity of income and the Slutsky equation to obtain the last equation before we can present our regression specifications. The compensated elasticity of income is only measuring the substitution effect and has the following formula; $\zeta^c = \frac{[\frac{1-\tau}{z}]\partial z}{\partial(1-\tau)}$ (Gruber & Saez, 2002). The Slutsky equation $\zeta^c = \zeta^u - \eta$ describes the relationship between the compensated and the uncompensated elasticities. When inserting these equations, we obtain:

$$\frac{dz}{z} = -\zeta^c \frac{d\tau}{1-\tau} + \eta \frac{dR - z d\tau}{z(1-\tau)} \qquad (3)$$

The left-hand side is the relative change in income before tax. The first expression on the right-hand side is the relative change in net-of-tax rate multiplied with the compensated elasticity. The second equation on the right-hand side is the change in after-tax income (dR-z dτ) multiplied with the income effect parameter.

Since Equation (1) shows the behavioural response in income induced by a small tax change, we can replace z with z_1 (income in year one). Following Gruber & Saez (2002) and other previous studies, we will use log-log specification because we have more substantial tax changes. Thus, we replace dz with log $(z_2 - z_1)$, dτ with log $[T'_2(z_2) - T'_1(z_1)]$, and $\frac{dR - z d\tau}{z(1-\tau)}$ [8] with log $[(z_2 - T_2(z_2) - (z_1 - T_1(z_1)]$. We get the following regression specification, which is the first of two models:

$$\log\left(\frac{z_2}{z_1}\right) = \zeta \log\left[\frac{1 - T'_2(z_2)}{1 - T'_1(z_1)}\right] + \eta \log\left[\frac{z_2 - T_2(z_2)}{z_1 - T_1(z_1)}\right] + \epsilon \qquad (4)$$

[8] Approximation: z(1-τ) ≈ z-T(z) (Gruber & Saez, 2002).

The first term on the left-hand side is the relationship between a change in income for year one and year two. The first term on the right-hand side is the compensated elasticity parameter (ζ) multiplied with the relationship between marginal tax rates in year 1 and year 2. Further, the second term is the income effect parameter (η) multiplied with the relationship between income after tax in year one and year two.

5.2 Model selection

5.2.1 Basic elasticity model

We will run the regression using two-stage least squares (2SLS). The 2SLS provides better estimates of the regression coefficients when the instrument is correlating with the endogenous regressors. Also, to simplify the discussion, we assume that there are no income effects (η=0). Hence, the term $\log\left[\frac{1-T'_2(z_2)}{1-T'_1(z_1)}\right]$, which captures the tax rate change, will correlate with ϵ. The reason for this is if there is a positive shock to income, the tax rate will increase mechanically, due to progressivity (Gruber & Saez, 2002). Therefore, running an OLS regression of Equation (4) would lead to a biased estimate of the behavioural elasticity. Hence, the strategy is to use an instrument for marginal tax rate in year two and real after-tax income in year two. Therefore, we compute T'_p, which is the marginal tax rate for the individual in year two if his real income did not change from year one. Also, we compute T_p, which is the real tax liability in year two, which the taxpayer would face if his income did not change in real terms from year one.

Equation (5) illustrates how we implement the instruments in the regression specification. Even though we assume η=0, we still add the income effect term when we run the regression. Consequently, in our analysis, we run Equation (4) to get the ETI estimates, but $[T'_2(z_2)]$ is replaced with the instrument $[T'_p(z_1)]$, and $[z_2 - T_2(z_2)]$ is replaced with the instrument $[z_1 - T_p(z_1)]$.

$$\log\left(\frac{z_2}{z_1}\right) = \zeta \log\left[\frac{1-T'_p(z_1)}{1-T'_1(z_1)}\right] + \eta \log\left[\frac{z_1 - T_p(z_1)}{z_1 - T_1(z_1)}\right] + \epsilon \qquad (5)$$

We calculate the instrument coefficient by multiplying income in year 1 with an adjustment for income[9]. The numbers are presented in Appendix 3. We also use adjusted income when we calculate the marginal tax rate to obtain the new marginal tax rate for the individuals.

As mentioned above, running the IV regression of Equation (4) might also lead to biased estimates. Consequently, this is because the error term can correlate with z_1, which will lead to mean reversion. Mean reversion is the primary concern regarding our regression model. Thus, we will introduce a second econometric model where we include lagged income as a control variable in the regression model.

5.2.2 Elasticity model with a control variable

$$\log\left(\frac{z_2}{z_1}\right) = \zeta \log\left[\frac{(1-T'_2(z_2))}{(1-T'_1(z_1))}\right] + \eta \log\left[\frac{(z_2 - T_2(z_2))}{(z_1 - T_1(z_1))}\right] + \alpha \log(z_1) + \epsilon \quad (6)$$

Equation (6) is similar to Equation (4), but with an additional term, which is the lagged income variable. Log income is supplemented in the regression to control for mean reversion bias. By adding this variable, we follow the same methodology as Saez (1999) and Auten & Carroll (1997). Auten and Carroll got more significant results when they added lagged income to the regression. Conversely, the instrument and the lagged income, do not necessarily operate linearly, so the net-of-tax rate might be blurred (Saez, Slemrod, & Giertz, 2012). However, as mentioned in Gruber & Saez (2002), it is required several years with data, where there are different changes in after-tax shares over time. Hence, it is still possible to identify tax effects by controlling for a rich data set for lagged income. Even though our dataset is abundant, we still rely on an identifying assumption. This assumption says that mean reversion or changes in inequality are not changing year-to-year in a way that correlates with year-specific changes in tax policy. Consequently, this implies that we are allowing the relationship between the error term and z_1 to be constant over time, i.e. non-linear (Gruber & Saez, 2002).

[9] For each year the Ministry of Finance increase the surtax limits, and we used this rate to adjust income.

5.2.3 Placebo analysis

Based on the two equations above, the last method controls for the robustness in the two models. By supplementing with a placebo analysis, we can exploit the fact that the assumptions have implications for the data beyond those exploited in the two models (Athey & Imbens, 2017). Therefore, we will use fabricated tax reforms to control for robustness in the models. Thus, we create a fabricated tax reform in the years between 2009 and 2012, where there initially have been no changes in the marginal tax.

The reform consists of a one-year reform and increases the surtax brackets, where they increase from 9 per cent and 12 per cent to 13.5 per cent and 19 per cent which is equivalent to the 2004 tax system. We used the rates from 2004 because the rates from 2005 were transition rates before the reform in 2006. The placebo analysis is only for the years between 2009 to 2012, because of the years before 2009 were still affected by the tax reform in 2006. We will run this method year by year, after changing the fabricated tax reform for each year. Additionally, we will test this for both the standard regression specification and the regression where we control for log income.

6.0 Results and Discussion

In the following chapter, we will present our empirical results from the two-stage least squares regression (2SLS), together with a discussion. The first part of the analysis is the results of the basic elasticity model. Then, we will continue with the results from the elasticity model with log income as a control variable. At the end of this chapter, we will show the results where we introduce fabricated tax reforms. To be able to find the impact of a change in the tax schedule for individuals, we will focus on the compensated elasticity. Hence, we will not focus on the income elasticity, because in the ETI literature, the income elasticity is under assumption close to zero.

6.1 Basic elasticity results

Table 1 shows the regression for the basic elasticity model. The table has three columns, where the top numbers for each pairs-of-years are the elasticity of taxable income, the first numbers in the brackets are the standard errors from the regression, while the second brackets show the standard errors from running Equation (5). Because 2SLS are not implemented in Microdata, the standard errors reported in our tables are ordinary least squares errors from the second stage regression. To test if we miss completely with our reported standard errors, we also report standard errors from the reduced form. See Chernozhukov & Hansen (2008) for how one can formally test 2SLS coefficients using the reduced form regression. The procedure suggested in the paper becomes complicated since we have two endogenous regressors and two instruments. However, the endogenous variable of interest is primarily affected by one of the instruments. Testing the significance of this instrument in the reduced form should roughly correspond to testing the significance of the regressor of interest in the equation of interest. The results from this exercise suggest that the OLS standard errors from the second stage may not be too misleading in our case. We will present the standard errors for each regression in the tables below, were we complement with the reduced form standard errors.

The reason why we chose these pairs-of-years presented in Table 1 is that the reform was implemented in 2006. Thus, we get an overview of how the reform affected the individuals before and after the tax change. Additionally, there had not been any changes in the tax schedule after the reform in 2006. Hence, the years after 2008 had biased estimates because the effects from the 2006-reform had declined.

Table 1: Basic Elasticity Results

	2003-2006	2004-2007	2005-2008
Elasticity	-0.09609	-0.04771	-0.04394
* Std	(0.00411)	(0.00425)	(0.00564)
** Reduced std	(0.00443)	(0.00476)	(0.00599)
Number of observations	754 426	758 139	763 359

Instrumental variable estimation. Estimates from 2SLS regressions without any control for mean reversion.

** Standard error from running the regression of Eq. (4).*

*** Standard error from running the regression of Eq. (5) (instrumental variables).*

We expected the elasticities without any mean reversion control to be negative, as in Berg & Thoresen (2016). Hence, our elasticities are in the range within -0.096 to -0.043, which indicates relatively small effects. The intuition behind the elasticities is that if an individual earns 10 per cent less, they will work 0.96 and 0.43 per cent less, respectively. The elasticities are small compared to other ETI studies, such as Feldstein (1995) and Gruber & Saez (2002). One reason for the various results could be that we have examined different tax reforms. Another reason could be because of the different use of approaches. While we mainly focus on wage earnings, others have focused on overall taxable income. Further, Feldstein (1995) and Gruber & Saez (2002) also estimated the elasticity of taxable income for different income groups and used different definitions of income[10].

Our results are similar to Kleven & Schultz (2014), which found ETI estimates for tax reforms in Denmark. A possible reason for this is the use of the same methodology, where they also related changes in taxable income over time to changes in marginal tax rates over a three-year interval. Additionally, they used 2SLS to estimate the elasticities. Furthermore, individuals in Norway and Denmark can probably have some of the same preferences when it comes to choices in the labour supply model.

[10] They separated between broad income and taxable income.

By comparing our results to other Norwegian studies, we can see some similarities. Berg & Thoresen (2016) also got negative ETI estimates when they excluded log income in their model[11]. However, their estimates are not similar to our findings. One reason could be the use of different data since they also included data from self-employed individuals. Thus, changes in marginal tax are typically assumed to have a more substantial impact on the behavioural responses of the self-employed, than the response from wage earners. Further, Vattø (2013) also found small responses in earnings when she evaluated the Norwegian tax reform from 2006. Thus, the relatively small elasticities can also indicate that it is not optimal for a worker to extend education or shift job because of adjustment costs.

Further, Aarbu & Thoresen (2001) examined the Norwegian tax reform in 1992 and estimated the net-of-tax rate elasticity to -0.224. They identified that the elasticities for the taxable income response are affected by adding other explanatory variables into the regression equation, where the elasticities fluctuated from -0.58 to 0.21. Aarbu and Thoresen used difference-in-difference methodology, and the results they got indicated that it was essential to control for mean reversion in the analysis. However, they also found that the tax elasticity is marginally influenced by choice of regression method. Thus, the estimates from the 2SLS approach indicated more variation than the estimates from the "synthetic-tax-rate" specifications, which is the same method we use with the instrumental variable approach (Aarbu & Thoresen, 2001).

As mentioned earlier, the tax change in $\log\left[\frac{1-T'_2}{1-T'_1}\right]$ is likely to be correlated with the error term in Equation (4). To acknowledge mean reversion, we follow the theory from Auten & Carroll (1997). Thus, in the next section, we will present the findings from including log income as a control variable.

6.2 Elasticity results with a control variable

Further, we include log income as a control variable in the regression. Once log income is included in the model, our results change significantly. As Gruber & Saez (2002) specifies, the problem using log income is that it assumes that any changes in the income distribution are a log function of lagged income. Hence, it can be

[11] Net-of-tax rate elasticity was estimated to -0,963 (Berg & Thoresen, 2016).

difficult to weaken the assumption by only introducing one change since it can destroy the identification of the tax effects. However, by having a large dataset, can weaken this assumption. Therefore, we supplement with a log income variable to control for mean reversion. In this context, mean reversion refers to an observed negative correlation between initial income and income growth. Because of temporary shocks in income, changes in the income distribution can lead to correlations in both directions.

Table 2 shows the results from Equation (6). When we include log income, we see that the elasticities have increased in all the three years. However, this is an indication that at least some individuals had temporarily high or low incomes. Without the income control variable, the elasticity estimates would be biased downwards (Aarbu & Thoresen, 2001). Our elasticities are in the range within -0.037 to 0.006, which are close to zero. Thus, this is in line with the results presented in Aarbu & Thoresen (2001), although they used the tax reform from 1992. Their elasticity was -0.224 before log income was introduced, and after they controlled for mean reversion, the elasticity was -0.032. Further, in 2007, our elasticity is 0.006, which is similar to Berg & Thoresen (2016). Berg and Thoresen moved from having negative elasticities without control for income to positive elasticities when log income was included in the regression model.

Table 2: Elasticity Results with Control Variable

	2003-2006	2004-2007	2005-2008
Elasticity	-0.03766	0.006	-0.00407
Std	(0.00507)	(0.00503)	(0.00628)
Reduced form std	(0.00479)	(0.00507)	(0.0063)
Number of observations	754 426	758 139	763 359

Instrumental variable estimation. Estimates from 2SLS regressions with log income as a control variable.

Gruber & Saez (2002) got negative elasticities when they excluded control for mean reversion and income distribution changes, which contrast with previous literature on tax reforms in the US. However, when they controlled for log income, the elasticities became more sensitive, and the results changed radically. In their model, they separated the income groups into two groups; Broad income and taxable

income. The elasticity of the net-of-tax rate on broad income changed from -0.3 to 0.17 after log income was included. Taxable income changed from -0.462 to 0.611. Thus, the use of log income resulted in a dramatic change in their estimates, compared to our results. In our model, the elasticities fluctuate more when log income is included in the regression. Previous studies have discussed the implications of adding log income as a control variable. Saez, Slemrod & Giertz (2012), emphasised that by controlling for income, will make the problem with identification assumptions worse. These income controls could disturb the identification by absorbing informative variation in the tax rates, which are correlated with income.

The response elasticities in our and other Norwegian studies are considerably lower than the elasticities in the studies from the US. Thus, the discussion of why these deviations occur is beyond the scope of this thesis. However, it is not the use of a different methodology that is the only reason. Possible causes can also be different designs of the tax system[12] and different income distributions between the countries. Another reason for the different results in our thesis, compared to previous work, could be explained by the limitations in Microdata, which excludes the one per cent highest and lowest values for each year. Previous studies in the ETI literature has not used Microdata as their analytical tool, implying that they probably did not encounter the same difficulties. Eissa (1995) discovered that individuals with high income tend to have higher elasticities, which could have affected our results. Thus, if Microdata did not filter the data automatically, we could have ended up with different elasticities.

6.3 Placebo analysis

To check if our model is robust, we introduced a fabricated tax reform in the years between 2009 to 2012, since they were not affected by the 2006-reform. Applying the fabricated tax reform to the years after the real tax reform could give us an indication of the robustness of the model. Table 3 shows the results when we implement the reform, respectively, for each year.

[12] E.g. scope for income shifting activities, and more fundamental differences in individual preferences (Aarbu & Thoresen, 2001).

When creating the fabricated tax reform, we had two options. The first was to reverse the system back to before the real tax reform was implemented, and the second option was to create a whole new tax system by decreasing marginal tax as much as the real reform did in 2006. The reason for disregarding the latter choice was because we had to take several choices of how much we should reduce the taxes if we were to implement a new reform. Additionally, we would also have to adjust for different income levels for the new surtax levels. Since there was no obvious way to do this, it became natural to reverse the real reform.

Table 3: Basic Elasticity Model with Fabricated Tax Reforms

Year with tax-shock		Elasticity	Number of observations
2009			
	2006-2009	-0.53876	768 728
	Std	(0.01132)	
	Reduced form std	(0.0066)	
2010			
	2007-2010	-0.31902	778 682
	Std	(0.01461)	
	Reduced form std	(0.0055)	
2011			
	2008-2011	-0.38204	796 713
	Std	(0.01396)	
	Reduced form std	(0.00559)	
2012			
	2009-2012	-0.48321	810 763
	Std	(0.01167)	
	Reduced form std	(0.0069)	

Instrumental variable estimation. Estimates from 2SLS regressions without any control for mean-reversion when we introduce fabricated tax reform in the years between 2009 to 2012.

To the left in Table 3 presents the years where we introduce tax reforms. Then, we show the pairs-of-years that is affected by the reform in the first year. The elasticities are presented in the third column, where the numbers in the first brackets are the standard errors from 2SLS, and the numbers beneath are the reduced form standard errors.

According to Athey & Imbens (2017), when applying a placebo analysis on the primary analysis, the true value for the estimates are zero. Since our estimates are fluctuating between -0.53 and -0.31, we argue that there is a systematic bias in our model when we add the fabricated tax reforms of roughly -0.4. Saez, Slemrod & Giertz (2012), emphasised that by applying a placebo reform in the framework like the one we use, might cause bias in the estimates. Additionally, it is problematic to interpret the biased estimates because the research on placebo reforms are limited in the ETI literature. However, a potential reason for the biased estimates is that the fabricated tax reform is backwards, compared to the tax reform in 2006. Thus, while the tax rates decreased from 2004 to 2006, the tax rates in the fabricated tax reform increased. Second, it could also be errors in the data extracted from Microdata that cause biased estimates. However, this is difficult to control for, because of the built-in protection of the personal data.

Furthermore, we did the same robustness test for the fabricated tax reform with log income as a control variable in the regression. The results of these estimations where unstable, and not close to zero. Additionally, they were imbalanced and did not show any form of symmetry as it did in Table 3. Because of the extraordinary results, we found no reason for including the table in this section. We calculated these estimates in the same way as the model above, where the only difference was the control variable of log income. The reason why we got these results could be because this method is not applicable for this specific tax reform. However, this seems unrealistic because it seemingly worked without log income.

7.0 Conclusion

To summarize this paper, we have used a basic labour supply model and calculated the elasticity of taxable income for individuals in Norway between the years 2000 to 2015. The calculated elasticities are in contrast to previous work. We find that the elasticity is -0.096, -0.047 and -0.043 in 2006, 2007 and 2008 before we control for log income, which is lower than previous studies from the US. However, the elasticities are closer to other studies that have been examined Norwegian tax reforms. Furthermore, when we controlled for log income, the change in the elasticities were smaller than other studies. Which can indicate that our data does not respond as significantly as previous work.

Furthermore, the framework we have used in Microdata has given us some limitations regarding the method used and the data that has been extracted. First, the 2SLS has not been implemented in Microdata, which caused ordinary least squares errors from the second stage regression. Second, the automatic filtering in Microdata with low- and high earners resulted in a considerable amount of dropped observations. Gruber & Saez (2002) presented that their results were primarily driven by the response of very high real income taxpayers. Considering our estimates, this could have resulted in different elasticities if these observations were included. Moreover, it was these individuals that responded most significantly to changes in tax rules.

The main difference between our study and previous work is that we introduce a placebo reform. By introducing fabricated tax reforms respectively for each year, we found a bias of roughly -0.4. We also did this with log income as a control variable, but the estimates became unstable. Thus, the problems that occur in our analysis with fabricated tax reforms is beyond the scope of this thesis and should be investigated further in future research.

Overall, the tax reform from 2006 led to a decrease in the marginal tax rates. Our results indicate that individuals would change their preferences in the labour supply model marginally, by working less than before the reform was implemented.

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9.0 Appendix

Appendix 1: Variables

All the data in Appendix 1 is collected from Stortingsmelding 1 from the National Budget for each year. The sources are cited in our bibliography.

Personal Allowance
The table below is a summary of the personal allowance from 1997-2015.

Personal allowance		
Year	Bracket 1	Bracket 2
1997	24 100	
1998	25 000	
1999	26 300	
2000	27 700	55 400
2001	28 800	57 600
2002	30 100	60 200
2003	31 600	63 200
2004	32 900	65 800
2005	34 200	68 400
2006	35 400	70 800
2007	37 000	74 000
2008	38 850	77 700
2009	40 800	81 600
2010	42 210	84 420
2011	43 600	87 200
2012	45 350	90 700
2013	47 150	94 300
2014	48 800	72 000
2015	50 400	74 250

Minimum standard deduction

The minimum standard deduction is a standard deduction which is automatically deducted from salaries, pensions and other similar income.

General Income			
Year	Tax rate*	Upper limit**	Lower limit
1997	20 %	31 300	3 700
1998	20 %	32 600	3 700
1999	21 %	34 900	3 900
2000	22 %	36 600	4 000
2001	22 %	44 300	4 000
2002	23 %	43 000	4 000
2003	24 %	45 700	4 000
2004	24 %	47 500	4 000
2005	31 %	57 400	4 000
2006	34 %	61 100	4 000
2007	36 %	63 800	4 000
2008	36 %	67 000	4 000
2009	36 %	70 350	4 000
2010	36 %	72 800	4 000
2011	36 %	75 150	4 000
2012	38 %	78 150	4 000
2013	40 %	81 300	4 000
2014	43 %	84 150	4 000
2015	43 %	89 050	4 000

* Taxpayers with only salary income, will receive the highest of the allowances for salary income and the special allowance in employment.

** The sum of the minimum standard deduction from salary income and the minimum standard deduction from pension income is limited upwardly to the upper limit on the minimum standard deduction from salary income, i.e. 89,050 NOK for 2015.

National Insurance Contributions and General Income

National Insurance Contributions

- It is calculated on personal income, and it helps to finance the National Insurance scheme.

General Income

- General income is net income and must be calculated by all those who are subjected to taxation, this yields for both individuals and companies.

National Insurance Contributions	
Year	Rate
1997	7,80 %
1998	7,80 %
1999	7,80 %
2000	7,80 %
2001	7,80 %
2002	7,80 %
2003	7,80 %
2004	7,80 %
2005	7,80 %
2006	7,80 %
2007	7,80 %
2008	7,80 %
2009	7,80 %
2010	7,80 %
2011	7,80 %
2012	7,80 %
2013	7,80 %
2014	8,20 %
2015	8,20 %

General income	
Year	Rate
1997	28 %
1998	28 %
1999	28 %
2000	28 %
2001	28 %
2002	28 %
2003	28 %
2004	28 %
2005	28 %
2006	28 %
2007	28 %
2008	28 %
2009	28 %
2010	28 %
2011	28 %
2012	28 %
2013	28 %
2014	27 %
2015	27 %

Surtax

The surtax is calculated on personal income, gross income from employment and pensions above a certain amount. Individuals must pay a surtax on their income that exceeds an annual fixed tax-free amount. The surtax is an income tax to the state.

	Surtax level 1		**Surtax level 2**	
Year	Rate	Income from	Rate	Income from
1997	9,50 %	233 000	13,70 %	262 500
1998	9,50 %	248 000	13,70 %	272 000
1999	13,50 %	269 100	13,50 %	318 600
2000	13,50 %	277 800	19,50 %	762 700
2001	13,50 %	289 000	19,50 %	793 200
2002	13,50 %	320 000	19,50 %	830 000
2003	13,50 %	340 700	19,50 %	872 000
2004	13,50 %	354 300	19,50 %	906 900
2005	12 %	381 000	15,50 %	800 000
2006	9 %	394 000	12 %	750 000
2007	9 %	400 000	12 %	650 000
2008	9 %	420 000	12 %	682 500
2009	9 %	441 000	12 %	716 600
2010	9 %	456 400	12 %	741 700
2011	9 %	471 200	12 %	765 800
2012	9 %	490 000	12 %	796 400
2013	9 %	509 600	12 %	828 300
2014	9 %	527 400	12 %	857 300
2015	9 %	550 550	12 %	885 600

Marginal tax rate

The marginal tax rate is the percentage an individual must pay in tax on the next NOK one earns. The marginal tax rate will increase as income rises.

Marginal tax rate			
Year	Tax	Bracket 1	Bracket 2
1997	35,80 %		
1998	35,80 %		
1999	35,80 %		
2000	35,80 %	49,30 %	55,30 %
2001	35,80 %	49,30 %	55,30 %
2002	35,80 %	49,30 %	55,30 %
2003	35,80 %	49,30 %	55,30 %
2004	35,80 %	49,30 %	55,30 %
2005	35,80 %	47,80 %	51,30 %
2006	35,80 %	44,80 %	47,80 %
2007	35,80 %	44,80 %	47,80 %
2008	35,80 %	44,80 %	47,80 %
2009	35,80 %	44,80 %	47,80 %
2010	35,80 %	44,80 %	47,80 %
2011	35,80 %	44,80 %	47,80 %
2012	35,80 %	44,80 %	47,80 %
2013	35,80 %	44,80 %	47,80 %
2014	35,20 %	44,20 %	47,20 %
2015	35,20 %	44,20 %	47,20 %

Appendix 2: Filtering in Microdata

This table shows the lower- and upper bound of the filtering process in Microdata. Individuals that earn lower than NOK 13 633 in 2000 are all filtered together as "one group", which means that we do not get the correct data on individuals that earn below NOK 13 633. The same yields for individuals that earn higher than NOK 736 662 in 2000.

Microdata filtering		
Year	Lower bound	Upper bound
2000	13 633	736 662
2001	14 521	791 271
2002	15 089	839 736
2003	15 560	865 760
2004	16 080	897 688
2005	16 833	928 989
2006	17 851	1 030 223
2007	19 486	1 127 626
2008	20 983	1 177 851
2009	21 279	1 205 068
2010	21 899	1 242 353
2011	22 746	1 301 973
2012	23 769	1 353 360
2013	24 836	1 408 953
2014	25 918	1 447 131
2015	24 696	1 475 839

Appendix 3: Adjustment for income

To explain how we calculate the adjustment rates, it more comfortable to give an example. The adjustment rate for 2013 is calculated by multiplying the initial rate for 2015, 2014 and 2013 together. For 2012, we multiplied the initial rate for 2014, 2013 and 2012, and so on for each year.

Adjustment for income			
Year	Surtax level 1	Rate 1	Adjustment rate
1996	220 500		
1997	233 000	1,057	1,2204
1998	248 000	1,064	1,1923
1999	269 100	1,085	1,1653
2000	277 800	1,032	1,1891
2001	289 000	1,040	1,2264
2002	320 000	1,107	1,2260
2003	340 700	1,065	1,1906
2004	354 300	1,040	1,1564
2005	381 000	1,075	1,1290
2006	394 000	1,034	1,1024
2007	400 000	1,015	1,1193
2008	420 000	1,050	1,1410
2009	441 000	1,050	1,1219
2010	456 400	1,035	1,1111
2011	471 200	1,032	1,1166
2012	490 000	1,040	1,1193
2013	509 600	1,040	1,1236
2014	527 400	1,035	
2015	550 550	1,044	