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Income Responses to Tax Changes – Evidence from the Norwegian Tax Reform

Abstract:
Several studies, conducted on U.S. data, have found rather strong income responses to changes in marginal tax rates, when treating tax reforms as "natural experiments" and applying the differences-of-differences estimator on individual income data. The Norwegian tax reform of 1992 implied substantial increases in the net-of-tax rate (1 minus the change in the marginal tax rate) for high-income earners, and this paper provides measures of the elasticity of taxable income with respect to these tax rate changes. The natural experiment assumption of the differences-of-differences approach is discussed. Since the tax reform implied other tax changes and both demographic variables and shifting macroeconomic conditions might impact on income growth, we include other explanatory variables in addition to the net-of-tax rate changes. When including other explanatory variables, tax elasticity estimates are affected, but only modestly. Our estimates of the elasticity of taxable income due to changes in the marginal net-of-tax rate range from about -0.20 to about 0.14.

Keywords: Tax reform, Taxable income elasticity, Differences-of-differences estimator, Natural experiment.

JEL classification: C23, H2, H31.

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1. Introduction

The elasticity of taxable income expresses the percentage change of taxable income for a small change in the marginal net-of-tax rate. The marginal net-of-tax rate is defined as 1 minus the marginal tax rate. Much attention has been given to tax elasticity estimates, since knowledge about this relationship is crucial in welfare evaluations of tax systems and for predictions of tax revenue effects. This measure is also essential in discussions of "flatter" tax systems, which is a major policy issue in many countries, Norway included.

One way to reveal the elasticity of taxable income is to test whether income changes more among those who have experienced large changes in the net-of-tax rate, compared to those who have faced small changes. The tax reforms of the last decade entail an excellent opportunity to test this relationship since a common thread in these reforms has been an increase in the net-of-tax rate at high income levels and small (if any) changes at lower income levels. Several analyses of data from the U.S., treating tax reforms as "natural experiments" and applying the so-called differences-of-differences estimator (diff-of-diff) (cf. for example Feldstein 1995; Feldstein and Feenberg 1996; Moffit and Wilhelm 1998), have shown that the elasticity of taxable income seems to be particularly high among high-income earners.[1]

Despite numerous papers on this issue in the U.S., we have seen few similar studies conducted on non-U.S. data. This is surprising, because several OECD countries have reformed their tax systems in a fashion inspired by the ideas underlying the U.S. Tax Reform Act of 1986. Norway was no exception in this respect, and undertook a major tax reform in 1992, also including a substantial lowering of marginal tax rates at high-income levels, and smaller reductions at lower income levels, cf. the diagrams in Appendix 1. In the present study we exploit the tax changes in 1992 to assess income responses to reductions in marginal tax rates, employing a panel data set of about 2 000 individuals. The work is based on the same underlying "natural experiment" assumption as applied in most diff-of-diff analyses– without the reform the income growth among low-income earners would be identical to the income growth among high-income earners.

[1] Numerous interpretations of these findings have been presented. Feldstein (1995) suggests that the marginal tax rate has a large impact on work effort and tax rate reductions therefore induce people to work more. Others state that high-income earners are able to reshuffle their income both across time and assets and thus counteract the effect of marginal tax rate changes (Slemrod 1996; Auerbach and Slemrod 1997). The large elasticities may therefore reflect income shifting and timing effects rather than increased efforts. A third possibility may be an increasing wage gap between high-income earners (high-

One major motivation for this work is that analyses of non-U.S. data could shed more light on the underlying forces shaping the changes in taxable income through time, partly due to different institutional settings between countries. Wage and income dispersion in the Nordic countries, for example, have been quite stable over time compared to developments in the U.S. (cf. e.g. OECD 1996; Gottschalk and Smeeding 1997). Secondly, this study seeks to take account of some potential sources of disturbances when exploiting the diff-of-diff approach to estimate the responsiveness of taxable income. Several authors, as Heckman (1996), Auerbach (1996), Goolsbee (1998), Triest (1998), have questioned the validity of the natural experiment assumption of the diff-of-diff approach. For instance might macroeconomic phenomena impact differently on control and treatment groups, and the income responses might result from other tax-induced behavior. Here, the diff-of-diff estimator is estimated by various regression specifications, which makes it possible to include a number of additional explanatory variables, including other tax factors, non-tax factors (as age and education) and variables that represent shifting macroeconomic conditions. By this, we assess to what extent estimates for the taxable income elasticity is affected by the inclusion of other sources of income growth.

Since marginal tax rates are a function of taxable income, the diff-of-diff approach involves an identification problem. We apply two sets of instruments for the tax change regressor. One is to use the pre-reform marginal tax rates as instrument in a two-stage-least-square procedure (2SLS), another is to construct exogenous changes in marginal tax rates by a tax-benefit model simulation. The former method is analogous to the tabular method applied in Feldstein (1995). The latter method will be called the "synthetic-tax-rate" approach in the following, and is related to the approach by Carroll (1997) on U.S. data.

Our main contention is that the inclusion of other explanatory variables impact on tax elasticity estimates (the relationship between taxable income and the net-of-tax rate), but only modestly. We see some effects from individuals'age (life-cycle adjustments), marital status, number of children under 10 years of age, and education. While most specifications give negative elasticities, specifications that include instruments for the reversion-to-the-mean effects[2] yield non-negative tax elasticity estimates, the highest at 0.14. Still, this estimate is much lower than estimates on U.S. data, and suggests that

skilled) and middle/low income earners (low-skilled) (Moffitt and Wilhelm 1998). So far, however, there seems to be little consensus regarding which explanation that fits the findings best (Samartino and Weiner 1997).

[2] The diff-of-diff approach almost inevitably implies a reversion-to-the-mean problem, as some individuals experience temporarily swings in income over time (Moffitt and Wilhelm 1998).

progressive taxation is less harmful in Norway.[3] The 2SLS specifications and the "synthetic-tax-rate" approach give very similar results.

The next sections probe deeper into possible explanations of changes in taxable income. In Section 2 we discuss the interpretation of changes in taxable income, while Section 3 presents data and introductory statistics. We decompose the income growth and find that the driving force behind the changes in taxable income is changes in wage income. The differences-of-differences method is not without pitfalls. In Section 4 the validity of the natural experiment assumption is questioned with respect to the data restrictions. We find that results might be substantially influenced by life-cycle adjustments. This could be avoided by imposing further restrictions on data, when defining the final panel of individuals. The results from the regression analyses are presented in Section 5, while Section 6 concludes.

2. The interpretation of taxable income responses under the dual income tax

What do changes in taxable income actually reflect? Feldstein (1995) describes the relationship between taxable income and various responses to changes in net-of-tax rates. In contrast to traditional labor supply analysis, where wage and working hours are the main variables, taxable income includes both earned an unearned income, and income responses may therefore reflect a variety of tax-induced behavioral responses. It is therefore, to some extent, difficult to compare the results from labor supply analyses and measures for the taxable income response. However, traditional analyses of labor supply, based on Norwegian data, do not predict strong responses through adjustments of working hours for the affluent, cf. Aaberge et al. (1995).

For most individuals, wage is the most important income component. Changes in the total wage bill reflect promotions, changes in labor market participation, changes in labor supply (e.g. from part-time to full-time, overtime) and changes in labor effort. Labor effort should be separated from labor supply because some individuals can work harder within a given time-span and thereby induce a higher taxable income. Lower marginal tax rates might also impact the type of employment individuals will accept.

[3] However, one should be cautious when translating the results from policy experiments into universal mesures of efficiency costs, as emphasized by Blundell and MaCurdy (1998) and Slemrod (1998).

Thus, taxable income, in principle, might reflect a variety of individual decisions from labor market decisions to portfolio choices. It reveals more information about income formation compared to more traditional labor supply studies and holds the promise of more accurately describing the efficiency costs of taxation (Slemrod 1998). On the other hand, the same argument can be used in pointing out weaknesses with taxable income as a measure of income growth. Income can change over time due to income shifting, changing demand factors and temporarily income swings. If such factors dominate, results from diff-of-diff analyses will be of less significance, when discussing the relation between tax systems and effort in a broad sense.

Unstable macroeconomic conditions might constraint the validity of the natural experiment assumption. While for instance the U.S. tax reform was introduced in a period with a well-behaving macroeconomy (Auerbach and Slemrod 1997), and the Swedish reform was followed by a recession (Auerbach et al. 1995), the Norwegian economy went into a period of economic upswing shortly after the reform (Statistics Norway 1999). We doubt that the boom was driven by the tax reform, but it might "pollute" tax elasticity estimates, because demand side non-tax factors usually affect different groups unequally. The empirical analysis in Section 5 includes explanatory variables representing macroeconomic demand factors. However, we are aware that even if our data are rich, we are not in an ideal situation to handle this challenging issue.

The macroeconomic situation may also influence on the growth in dividends, capital gains and interest income. These incomes are particularly important among high-income earners. However, changes in these components over time will also reflect other tax-induced behavior, as income-shifting activities, timing activities, windfall gains and changes in the dividend policy. For example, an owner of a firm that shifts from a non-corporate to a corporate form, will receive dividends and wages instead of proprietor/partnership incomes. Thus, such effects may not reflect any real economic changes.

The potential for income-shifting activities are not at least evident in the Norwegian tax system, as it includes a dual tax rate system, known as the dual income tax (cf. e.g. Sørensen 1998). Under a dual income tax, labor income is taxed with a higher tax rate than capital income. Thus, there are incentives to classify labor income as capital income. The system was in work both before and after the tax reform, but the tax reform amplified this incentive by widening the gap between two tax rates. The possibility for income shifting, however, varies probably from taxpayer to taxpayer. It seems reasonable to believe that low- to middle-income wage earners have less discretion in income reporting than, for example, well-off self-employed. We neither find any evidence of large scale

income-shifting in the income growth decomposition in Section 3, nor any unambiguous results for the income shifting instrument in the regressions in Section 6.

3. The data and descriptive statistics

3.1. Data adjustments

We use personal income data covering the period 1991-1994. The tax reform came into effect January 1st 1992 and implied large reductions in marginal tax rate at high income levels and smaller reductions at lower income levels, confer figures in Appendix 1. Our natural experiment is based on a comparison of 1991 and 1994 outcomes, exploiting individual panel data.

The data are collected from Statistics Norway's Income Distribution Survey and they comprise the personal tax return, demographic information, and some social security information. Unlike most other OECD countries, wealth is taxable in Norway and the personal tax return therefore includes quite detailed information about real and financial assets.

In order to exclude effects that stem from other decisions, not necessarily affected by the tax reform, the panel has been restricted:

- We exclude all persons below 19 years of age in 1991 and persons who retired during the period 1991-1994.
- The analysis is restricted to income earners and self-employed individuals.
- We have also limited the analysis to persons with unchanged marital status and taxpayers with a fixed number of children.

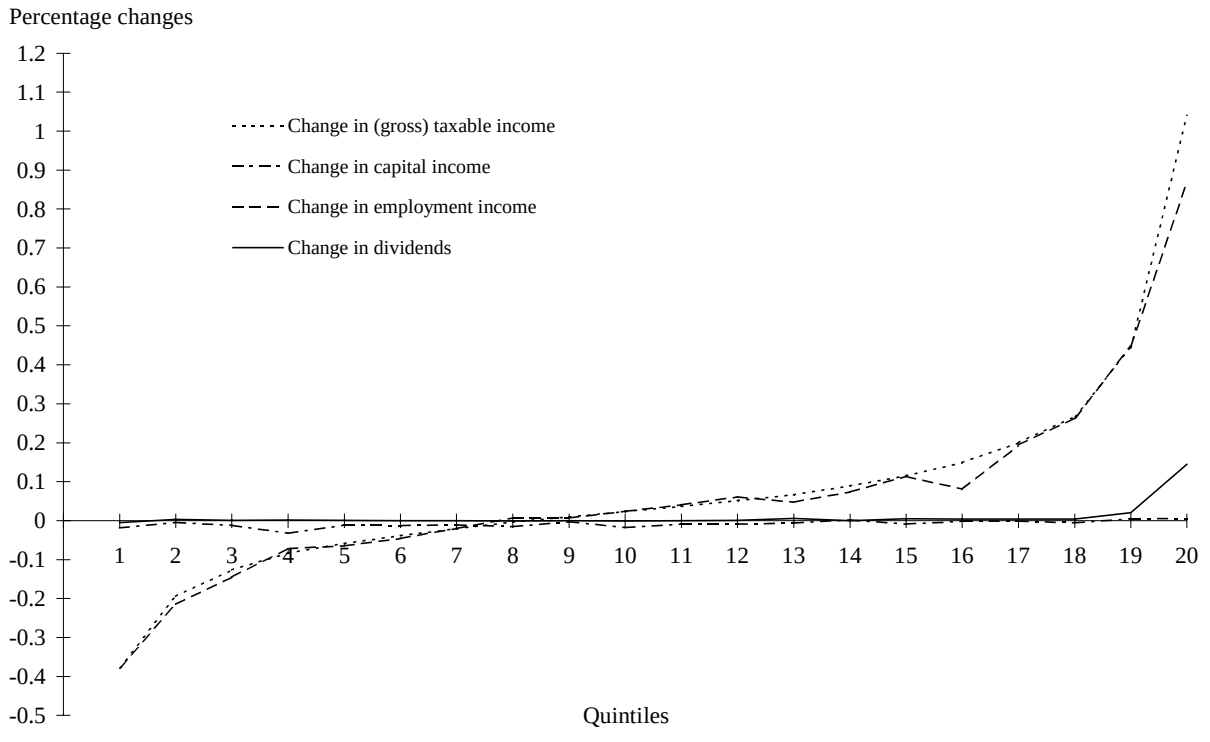
The resulting panel consists of 2 277 taxpayers. Because the tax reform implied tax base changes as well as tax rate changes, it is necessary to adjust 1991 taxable income to make it comparable with 1994 taxable income. Most importantly, we adjust income from self-employment for the reductions in tax depreciation rates, by calculating 1991 self-employment income given post-reform depreciation rates. In addition, we have made adjustments for other tax base changes, such as the removal of the basic relief in capital income. Due to very detailed data, we are able to carry out these adjustments with a high degree of accuracy.

3.2. Income growth decomposition

In order to obtain some preliminary information about the forces shaping the change in taxable income we provide an overview of the contribution from various income components in figures 1a and 1b, for income earners and self-employed, respectively.[4] The diagrams show the mean change in each quintile for the different income components, when individuals are ranked by the change in taxable income. The lowest quintile contains taxpayers with the largest reductions in taxable income, while the twentieth quintile comprises the persons with the largest increase.

We decompose income from self-employment into capital income and labor income shares. Since the tax reform involved a new method to calculate the labor income fraction of self-employment, we use this method of imputation in both 1991 and 1994. For married couples all calculations are done by pooling the couples' income and dividing it equally between the spouses. Survey-weights are employed in all calculations.

Figure 1a. Percentage changes in various income components from 1991 to 1994. Employees ranked by percentage change in taxable income. All income components in 1994-prices

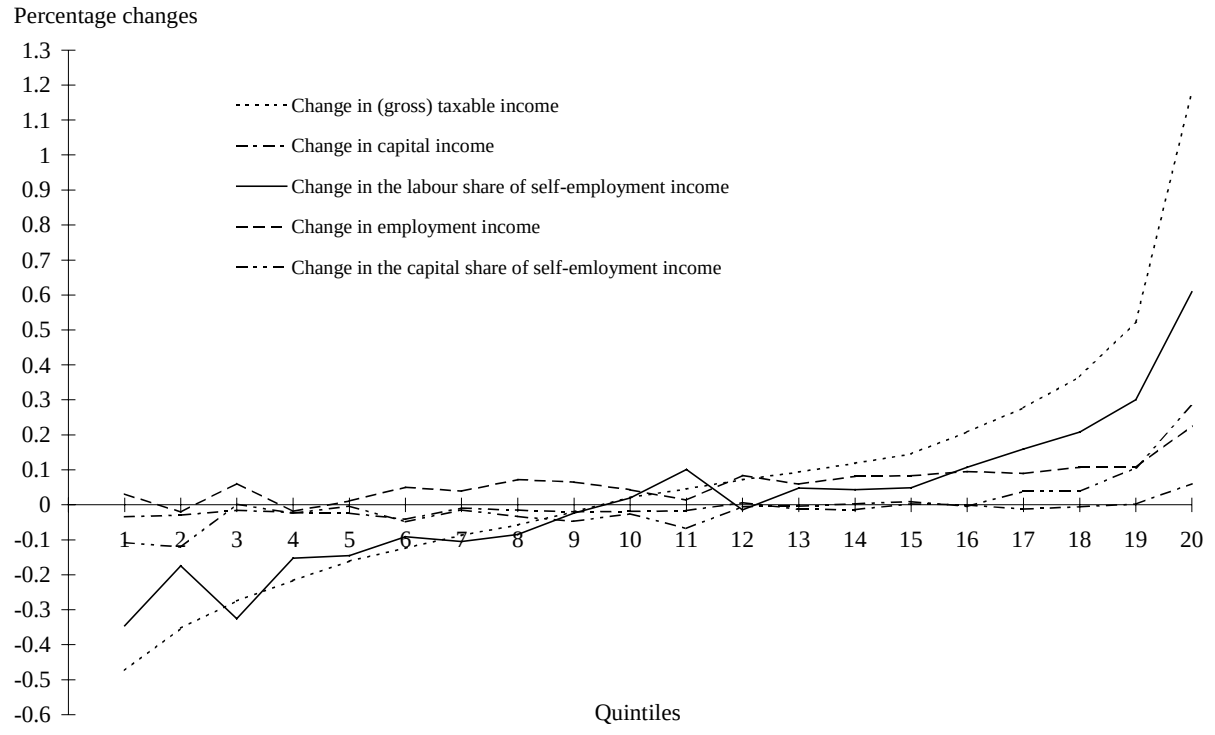


[4] A person is classified as partly self-employed if his self-employment share of taxable income in 1991 is greater than 20 percent of total income.

We focus on the main contributors to the income growth. Thus, figures 1a and 1b display changes in capital income less dividends, employment income, and dividends in addition to the total taxable income change. Figure 1b does not entail a separate curve for dividends, since the growth in dividends among the self-employed is fairly equally distributed.

Looking at the employees, we find that wage is the primary contributor to the change in taxable income. For those who suffer loss, the reduction in wages is larger than the total reduction in taxable income.[5] The "winners" (the twentieth quintile) have experienced a substantial increase in wage income. Approximately 86 percent of the increase in taxable income is due to wages. Another important contributor is dividends, which accounts for around 9 percent of the taxable income increase. For all other quintiles, dividends are a negligible part of the income growth.

Figure 1b. Percentage changes in various income components from 1991 to 1994. Self-employed ranked by percentage change in taxable income. All income components in 1994-prices



[5] However, some of the lost wage income is partly compensated by increased transfers and marginally higher self-employment income (not displayed in the figure). The increase in self-employment income may indicate a shift from employment to self-employment. Such an organizational shift will normally entail greater risk, and this group may contain those who invested in the bad projects.

Among the self-employed, self-employment income is the driving force behind the variations. The "losers" (taxpayers in the two lowest quintiles) had a decline in taxable income of more than 32 percent on average. About 80 percent of the decrease is due to reduced self-employment income. Most of the decline is due to a lower labor share. We find the same pattern among the "winners." Increase in self-employment income explains about 80 percent of the growth in taxable income. Contributions from other income sources are less significant, apart from wage income.

The figures above show large changes in income for a great number of persons. The main contributors to the changes in taxable income are employment and self-employment income. This indicates that income shifting is of minor importance for the change in taxable income, and we expect not to find any strong influence from the income-shifting instrument in the regressions to come. Moreover, the large income changes for many individuals call for a further examination of the driving forces behind these fluctuations. Is the substantial income growth driven by increase in the net-of-tax rate at high income levels?

4. Preliminaries – the importance of non-tax factors

In a preceding paper, covering the same issue (Aarbu and Thoresen 1997), we found a negative relationship between the net-of-tax rate and taxable income. However, we did not control for age and education effects, or other individual characteristics in the analysis. Blundell et al. (1998), in their analysis of responses in working hours in reform periods, show that these factors might have a profound impact on income growth.

To further examine the effects from socioeconomic variables, table 1 gives tabular diff-of-diff estimates of the relationship between the effects from tax rate changes and taxable income, when individuals are grouped by age, marital status and education. The implied elasticities are calculated by taking the difference of the income growth between the high and low marginal tax group divided by the difference of the net-of-tax rate between the respective groups. The cut-off point dividing these groups is set to a marginal tax rate of 45 percent in 1991. We exclude a small number of observations with missing information on education. All observations are weighted by survey weights.

Considering the small number of observations underlying some of the elasticities in Table 1, caution should be shown when interpreting the results. The table reveals that most elasticity estimates are small, except for the young and unmarried individuals. A closer look at the income growth among the young and unmarried shows that the large, negative elasticities stem from the "movements" of very

young individuals that start from low income levels in 1991. The younger a person is, the higher the income growth. Thus, we interprete the large, negative elasticities among the young, unmarried individuals as an expression of substantial life-cycle adjustments and macroeconomic demand factors. These effects are strong and might outperform the tax variables in a standard diff-of-diff approach, and demonstrates that there are other important factors that might bias the results from a natural-experiment-approach to assess income responses to tax changes. Thus, an approach that takes the influence from other variables into consideration is signified.

In the regression analysis, which follows, unmarried persons below 38 years of age are excluded, due to the above findings. This leaves us with 1 805 observations.

Table 1. Differences-of-differences estimates of taxable income responses to changes in the net-of-tax rate. Tabular method

Age	Married	Education	Number of observations	Implied elasticity
	No	Low (<11)	156	-0.7
< 38		High	285	-1.2
	Yes	Low (<11)	117	-0.2
		High	206	0
	No	Low (<11)	72	-0.2
38–46		High	76	-0.1
	Yes	Low (<11)	326	-0.6
		High	237	0.2
	No	Low (<11)	77	-0.2
47+		High	37	0
	Yes	Low (<11)	386	-0.3
		High	272	0

5. Tax elasticity estimates – a regression analysis

5.1 Regressors

As emphasized above, analyses of the influence from changes in the net-of-tax rate on income growth should be carried out in a framework with other individual characteristics as explanatory variables. We describe these additional variables more closely in the following:

It is a well known fact that income creation partly depends on the age of the individual. Therefore, age is included to capture life-cycle income effects, as signified in Section 4 above.

Several authors, among them Atkinson (1997), have pointed out that education generates an earnings skill premium. The most convincing argument for this, is that education shortens the working career. To make the investment profitable, the educated individuals' earnings must grow faster compared to earnings for lower educated, or they must start from a higher level to start with. In Norway, at least, the first mechanism is the most apparent. To capture different growth rates in earnings we include a 3-stage categorical variable for education level (primary school only, high-school, and college graduate). We expect that higher skills (education) will result in higher income.

We also believe that marriage will have effect on income growth. Therefore, we include a dummy variable for married individuals.

Beacuse the precense of children constrain the time available for work, we also include the number of children below 10 as an explanatory variable. Furthermore, we also include a variable for the number of children over 10 years of age. We expect that more and younger children will mean less time available for work and therefore lower income growth.

The tax reform entailed a slight decrease in the average tax rate. Simulations done with a tax-benefit model indicate that the average tax rate declined with about 1 percentage point overall, but slightly more in the upper tail of the income distribution. A reduced average tax rate will increase disposable income, and if we assume that leisure is a normal good, it increases the demand for leisure and reduces taxable income. The increase in disposable income is calculated by the difference between one minus the average tax rate for 1994 and one minus the average tax rate for 1991. Since average tax rates in 1994 are endogenous, for the same reasons as the marginal tax rates for 1994 are endogenous, the average tax rates for 1994 are represented by simulated tax rates, calculated on projected 1991-incomes.

As pointed out above, the motive for income shifting is driven by the difference between the labor income tax rate and capital income tax rate. Because income changes entail changes in the marginal tax rate (an endogeneity problem) we have to construct an instrument for this difference. The difference between the "synthetic" tax rate difference in 1994 and the actual tax rate difference in 1991 is used as an explanatory variable. Income shifting will entail a simultaneous reduction in both the marginal effective tax rate and the average effective tax rate. Thus, it is difficult to predict the sign due to the possibility of counteracting income and substitution effects.

Interest rates fall and share values rise during the economic from in the period we are investigating here. Falling interest rates made mortgages easier to sustain and increasing share values increased the significance of dividends and capital gains. We expect that the reduced debt burden implies a reduction in the labor supply, similarly to the increase in disposable income. To capture this effect we apply an instrument for the decline in real interest rates. We calculate the decrease in the interest burden by taking the difference between the real interest rates in 1994 and 1991 times the debt in 1991. Because the debt is predetermined, this variable should be considered as exogenous.

Signs on shifting macroeconomic conditions do not always coincide in time in urban and rural areas. Therefore, we introduce two dummy variables, an Oslo-area dummy and an urban dummy. The Oslo-area includes inhabitants in the capital and the adjacent municipalities, while the variable urban also includes inhabitants in three other large cities. Since we believe that improved macroeconomic performance impact on residents in urban areas at first, and thereby their income growth, we expect to find a positive sign for these two dummies.

5.2. Specification

In the following we present elasticity estimates on taxable income, applying various regression specifications. We present results from two different approaches, one where we employ the pre-reform level of marginal tax rate as an instrument (as in Feldstein [1995] and Table 1 above) and another which defines exogenous tax rate changes by tax-benefit model calculations.

As shown by Moffitt and Wilhelm (1998) the tabular differences-of-differences approach is analogous to the instrument variable approach in a regression context. The differences-of-differences elasticity estimates are reproduced by applying a two-stage-least-square regression method. Since the regressor (change in marginal tax rate) is endogenous, the marginal tax rate in the initial period is usually applied as an instrument in order to identify the tax parameter. In the first stage, the income growth and change in the net-of-tax rate are regressed against the instruments. Thereafter, in the second stage, the predicted value of income growth is regressed against the predicted change in the net-of-tax rate.

Another way of dealing with the endogeneity problem is to apply tax-benefit model calculations to construct “synthetic” marginal tax rates, as suggested by Carroll (1997). In this approach the change in the marginal tax rate is estimated by first applying 1994 tax rules on inflated 1991 income and thereafter, subtracting the marginal tax rate in 1991 (which is predetermined).

The details concerning the specifications are presented in appendix 2.

Table 2. Regression results from various approaches. Survey weights are employed in all regressions

	Two-stage-least-square, pre-reform marginal tax rates as instruments					Synthetic tax rate approach		
	Model 1, net-of-tax rate only	Model 2, including demogr. variables and education	Model 3, 6 marginal tax rate groups	Model 4, multi-variate	Model 5, reversion to-the-mean-effect	Model 6, net-of-tax rate only	Model VII, multivariate	Model VIII, reversion to-the-mean effect
Coefficient on the change in the-net-of-tax rate	-0.153** (0.061)	-0.129** (0.060)	-0.064 (0.046)	-0.198*** (0.066)	-0.061 (0.074)	-0.003 (0.050)	0.025 (0.057)	0.141** (0.059)
Constant	1.199*** (0.066)	1.390*** (0.071)	1.322*** (0.058)	1.429*** (0.079)	2.334*** (0.235)	0.018*** (0.006)	0.213*** (0.035)	1.499*** (0.200)
Age		-0.005*** (0.001)	-0.005*** (0.001)	-0.007*** (0.001)	-0.006** (0.001)		-0.006** (0.001)	-0.006** (0.001)
Dummy for marriage		0.034*** (0.011)	0.033*** (0.011)	0.042*** (0.012)	0.039*** (0.012)		0.029*** (0.010)	0.028*** (0.010)
Education, (1=primary school, 2=high-school, 3=college)		0.027*** (0.010)	0.026*** (0.010)	0.028*** (0.010)	0.030*** (0.010)		0.021** (0.008)	0.024*** (0.008)
Children 0–9				-0.015** (0.008)	-0.015** (0.008)		-0.011* (0.006)	-0.011* (0.006)
Children 10–17				-0.008 (0.009)	-0.007 (0.009)		-0.008 (0.008)	-0.006 (0.008)
Changes in average tax rates				0.651** (0.287)	0.848*** (0.293)		0.286 (0.257)	0.547** (0.257)
Income shifting				0.059 (0.118)	0.348** (0.137)		-0.174* (0.096)	0.246** (0.115)
Reduction in debt burden				-0.000	-0.000		-0.000	-0.000
Oslo-area dummy				-0.028* (0.016)	-0.020 (0.014)		-0.025* (0.014)	-0.016 (0.014)
Urban dummy				0.022 (0.014)	0.021 (0.014)		0.018 (0.012)	0.017 (0.012)
Pre-reform income					-0.087*** (0.021)			-0.108*** (0.017)

* significant at 0.10 level

** significant at 0.05 level

*** significant at 0.01 level

5.3. Results

Models 1-5 provide 2SLS estimates of the effect from changes in the net-of-tax rate. In model 1 there is only one regressor, the percentage change in the net-of-tax-rate. Model 2 includes other explanatory variables, for age, and categorical variables for marital status, and education. In model 3 we use six separate marginal tax rate groups, instead of 2. The specification in model 4 is extended by including other variables, while model 5 also includes a variable that seeks to control for reversion-to-the-mean effects. As stressed by Moffitt and Wilhelm (1998), the diff-of-diff approach almost inevitably implies a reversion-to-the-mean problem, as some individuals experience temporarily swings in income over time. Ignoring such effects might bias tax elasticity estimates in a negative direction. We introduce the natural log of taxable income in 1991 as an explanatory variable, as suggested by Moffitt and Wilhelm (1998), in order to deal with this problem. Thus, it is assumed that the initial income might influence on income growth.

Models 6-8 show the results from specifications where the tax change regressor is made exogenous by employing simulation results from the tax-benefit model. In the first variant under this approach, model 6, we only use the tax change instrument as a single regressor. In the second version, model 7, other explanatory variables are included, while model 8 also attempts to capture the reversion-to-the-mean effect.

In general. we see that the estimates for the taxable income response are affected by adding other explanatory variables into the regression equation. Thus, the refinement of the natural experiment impact the results from the diff-of-diff analysis. But the effect seem to be modest. Table 2 shows elasticity estimates ranging from -0.198 to 0.141. Hence, the income growth among high-income tax-payers does not deviate much from the income growth among low and middle income groups in the period. However, even a relatively small, positive elasticity estimate at 0.14 represent a non-negligible behavioral effect, which should be of importance for policy-makers considering changes in the tax system.

The estimates for the tax elasticity are not much influenced by the choice of regression method. The estimates from the 2SLS approach are negative or zero, while the only significant, positive estimate is found in the "synthetic-tax-rate" specification that attempts to control for reversion-to-the-mean effects.

Let us also consider the relationship between income growth and the other explanatory variables. As expected, education contributes to higher income growth in all regression approaches and the estimates are highly significant. The strong effect from education is in line with the literature concerning the relationship between skills and earnings dispersioncf. e.g. Atkinson (1997).

Furthermore, the results indicate that the income growth has been lower among the unmarried than married. There might be a variety of reasons for this result, a highly speculative hypothesis might be that marriage is correlated with skills that are rewarded in the labor market. There is still a negative effect from age, in spite of removing most of the very strong age-effect we pointed out in Section 5, Table 1. The effect from children has the expected sign, but only the parenthood of children under 10 has a significant, negative effect on income growth.

The positive relationship between change in the average tax rate and the growth in taxable income is difficult to explain. A possible explanation is that it is interrelated with the net-of-tax rate regressor. The sign for the income-shifting instrument is not stable across regression specifications.

The variables for macroeconomic demand factors do not explain much of the income growth. There is no significant effect from the reduction in the debt burden, while the signs of the regional dummies indicate that that income growth has been largest in the three other major cities and not in Oslo.

The results are far from the elasticities in Feldstein (1995), estimated on U.S., and also substantially lower than other U.S. estimates (e.g. Goolsbee 1998). Discussions of sources for these deviations are beyond the scope of this paper. However, the results here do not indicate that different methodological approaches to the diff-of-diff estimator can fully explain these differences. Differing designs of the tax system, e.g. the scope for income shifting activities, and more fundamental differences in individual attitudes are potential causes.

Table 2 reveals that it seems particularly important to control for the reversion-to-the-mean problem in the diff-of-diff analysis. The inclusion of the log pre-reform income in the regression increases the income elasticity estimates. The parameter estimate for the reversion-to-the-mean instrument is negative (as expected), which is an indication that at least some individuals in the panel had temporarily high or low incomes in 1991. Without this correction, the elasticity estimates would be biased downwards.

6. Conclusion

This paper discusses the relationship between growth in taxable income and changes in marginal tax rates. The Norwegian tax reform of 1992 makes an opportunity to employ a "natural-experiment" approach, where we compare the responses of individuals that experienced large changes in marginal tax rates (the experiment group) against those with only minor changes (the control group).

This critical assumption in this approach to tax elasticity estimations is that the economic environment have the same impact on experiment and control group. In Section 4 we found signs of life-cycle adjustments in our data. The data were restricted according to age in order remove this potential source of bias. Moreover, in the regression analysis we include other explanatory variables, as demographic variables, other tax changes and instruments for macroeconomic demand factors. The tax elasticity measure is not unaffected by taking account of other explanatory variables. However, the sensitivity is only limited. The analysis reveals, however, that it is important to control for the reversion-to-the-mean problem in the diff-of-diff analysis.

Our estimates for the relationship between the change in taxable income and the change in the net-of-tax rate range between -0.20 and 0.14, much lower than similar estimates from the U.S. Overall, it seems that the income responses to increased return of earnings are small. The income growth among individuals that experienced a substantial lowering of tax rates in 1992 is not very different from the change in the "control" group. Thus, we are not able to reproduce the rather strong effects found in several analyses on U.S. data (e.g. Feldstein 1995). Since results are only to some degree affected by applying either the tabular version, as Feldstein, or a regression specification of the diff-of-diff approach, there are most likely other sources for the differing results. A discussion of possible explanations for the deviating results has not been a major issue in this paper. However, there might also be systematic differences in the net-of-tax rate sensitivity (i.e. behaviour) a cross countries.

According to the effects from the other explanatory variables on income growth, the most precise effects are seen from demographic characteristics and education. The educated experience a higher percentage growth in taxable income compared to the low- or non-educated, which is in line with the so-called "skill-premium" literature. The estimates for the influence from other tax changes are either mixed (as for the income-shifting instrument) or have the wrong sign (changes in average tax rates). The variables that represent macroeconomic demand factors do neither have a strong, unambiguous effect on income growth.

The small level of responses revealed in this paper is in line with previous studies, which have found that high-income earners are rather insensitive to changes in marginal tax rates. In several OECD countries, among them Norway, tax rate reductions are currently discussed. However, if our results mirror true relationships, it seems reasonable to claim that "flatter tax reforms" will not induce high-income earners to increase their income-generating efforts to any great extent. Therefore, one could argue that policy makers should place more emphasis on the work incentives for other groups and income distribution issues when considering reforms in the tax system.

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Appendix A

Figure A1. Marginal tax rates on wage income. 1992-rules and wage adjusted 1991-rules. Class 1 (single persons). No deductions except standard deductions

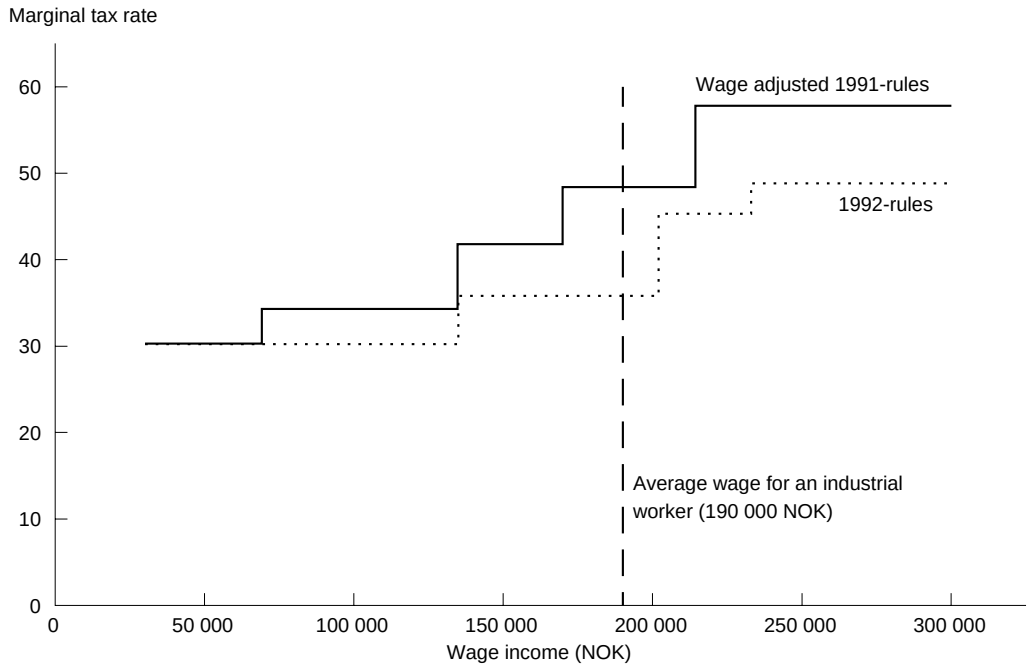
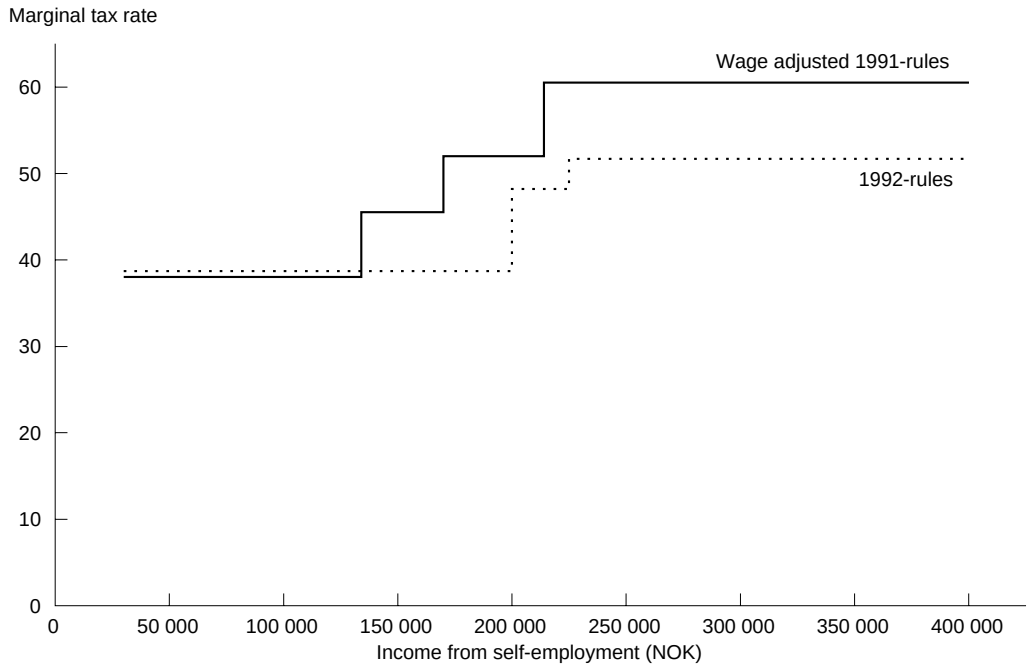


Figure A2. Marginal tax rates on income from self-employment. 1992-rules and wage adjusted 1991-rules. Class 1 (single persons). No deductions except standard deductions



Appendix B

The 2SLS regression

We define dummy (D1) as indicating the individuals that have a pre-reform marginal tax rate lower than 45 percent. The dummy takes the value 1 for those with lower value on their pre-reform marginal tax rate and zero otherwise. Similarly, dummy (D2) takes the value 1 for persons with a pre-reform marginal tax rate higher than 45 percent and zero otherwise. We denote taxable income by *I* and the net-of-tax rate by *NTR*. We then regress

$$\frac{I_{it+1} - I_{it}}{I_{it}} = \alpha_1 D1 + \alpha_2 D2 + \varepsilon_{it}$$

and

$$\frac{NTR_{it+1} - NTR_{it}}{NTR_{it}} = \beta_1 D1 + \beta_2 D2 + \varepsilon_{it}$$

where *i* denotes individual *i* and *t* the time period and ε_{it} is the disturbance vector. We see that *D*1 always is zero when *D*2 is one and *D*1 is one when *D*2 is zero. The estimated coefficients $\alpha_{1,2}$ therefore represent the mean percentage changes in income in the low and high pre-reform marginal tax rate group, respectively, while $\beta_{1,2}$ denote the changes in the net-of-tax rate. The regressions are, thus, equivalent calculate the percentage change in income and net-of-tax rate for each observation and thereafter taking the mean of the individual income and net-of-tax rate changes within each group.

The second-stage regression equation in the 2SLS case can be written as

$$\frac{\hat{I}_{it+1} - I_{it}}{I_{it}} = \eta \frac{\hat{NTR}_{t+1} - NTR_t}{NTR_t} + X_i \beta + \varepsilon_{it}$$

The $\hat{}$ symbol indicates that the fractions on both the left- and right-hand side are estimated through the first stage. The X_i variable represents other time-invariant explanatory variables (intercept included), β is a vector of parameters, and η is the elasticity of income with respect to changes in the net-of-tax rate.

The "synthetic tax rate" regression approach

In this approach the log of the following function is estimated

$$\frac{I_{it+1}}{I_{it}} = \frac{NTR_{t+1}}{NTR_t}^{\gamma} e^{X_i\beta+\varepsilon_{it}}$$

where the *NTR* in $t+1$ is estimated through the tax-benefit model LOTTE, using inflated 1991 income in order to achieve a exogenous regressor for the net-of-tax rate. The parameter γ measures the elasticity of income with respect to changes in the net-of-tax rate and X_i and β are defined as in the 2SLS framework.

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