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# Taxable income responses to tax changes
## - a panel analysis of the 1990/91 Swedish reform*

by

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**Abstract**

The elasticity of taxable income indicates the effects on income from a change in the marginal tax rate. In a number of studies on U.S. data rather strong effects have been found, although estimates seem lower in more recent papers. Studies based on data from other countries are only a few and indicate lower effects. A difference-in-differences approach utilising differences in tax changes is the standard approach for analysis. Here a large Swedish tax reform is employed. Estimated effects of a tax cut are modest, in the interval 0.2 to 0.4 at the most. Problems of income variables and income groups for the analysis are extensively examined. According to an extended model there is a positive income effect of the tax change, implying a difference between the compensated and the uncompensated elasticity, contrary to earlier results for the U. S.

**Keywords:** Tax reform; taxable income elasticity; difference in differences
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# 1. Introduction

Large reforms in the taxation of personal income took place in many countries during the nineteen-eighties and the beginning of the nineties. Main features of these reforms were substantially lowered marginal tax rates and broadened tax bases. Supply-side arguments paved the way for the reforms. Influential economists argued that the marginal rates, generally considered as (very) high, hampered economic activity and resulted in large deadweight losses; some even feared that the marginal rates reduced public revenue.

By 1980 marginal tax rates in Sweden had reached a peak of over 85 percent for those with high income and no deductions; interest payments where to a large extent deductible, however. In a series of rate changes 1982 to 1985, marginal rates were reduced, but during the following years taxes again increased. The need for a simpler and more consistent system for income and assets' taxation was generally recognised. Other rationales for the large 1990-1991 Swedish reforms with large cuts in tax rates were to promote growth while retaining, or creating, a "fair" distribution of income. Tax avoidance should become more difficult and tax evasion less tempting. The reform was not fully financed, but in the light of recent labour supply analyses at the time, there was a belief that the lower tax rates would increase the total number of working hours and sustain tax revenue.

The effects of the tax reforms of the past decades have been analysed in a large number of studies for different countries. Labour supply has been in focus, but the analysis has been somewhat controversial. A general conclusion emerging though is that effects on the number of working hours for males working full-time are difficult to establish, while effects for (married) women seem to exist, implying an increase in the number of their working hours[1].

[1] Swedish studies of labour supply mainly indicate small effects for men. In earlier studies income elasticities, regarding the effect on labour supply of a change in income, are estimated in the interval -0.1 to 0.0 for married men 25-55 years of age, and -.24 to -.03 for women. Compensated wage rate elasticities are concentrated around 0.10 for men and estimated from 0.22 to 1.07 for women (see the summaries in Agell et al. 1995 and Klevmarken 2000). Most studies are based on cross-section pre-reform data, but panel analyses also indicate small effects for men (Ackum Agell and Meghir 1995, Klevmarken 2000). The latter, using pre- and post-reform panel data, finds a positive effect for women. In a recent study based on data from 1974, 1980 and 1990, Blomquist

From the mid-nineties there has been a renewed and growing interest in the effects of changes of marginal rates on individual income. The elasticity of taxable income with respect to the net of tax rate (one minus the marginal tax rate) has come into focus. Reasons for this interest in the change in taxable income for a small change in the marginal net of tax rate, the percentage change by some referred to as the tax-price elasticity, are several.

First, one has recognised that the traditional measure on labour supply, the number of hours worked and it's change, does not capture all dimensions of the work effort. Not included is, responses regarding the intensity of the work effort and the assumption of risk and responsibility, for example. Changes of job or job location are not considered, neither is the on-the-job acquisition of skills nor the amount of travel.

A second important reason to consider taxable income, partly as a complement to labour supply, is the difficulties to measure the number of working hours with good precision. The usual approach by means of retrospective survey questions concerning the preceding year implies questions no doubt difficult to answer for many individuals, at least as regards temporary variations and the timing of a permanent change. In the distribution of answers, spikes are usually found for standard working time, in Sweden 40 hours per week; many respondents state 40 hours for 52 weeks in the household income survey. Still, for a considerable number of individuals re-interview studies have revealed large variability in answers, indicating reliability problems for retrospective surveys covering longer time spans.

These problems are detrimental to measurements of hourly earnings, an important explanatory variable for labour supply analysis. For Swedish data it is found that there are large errors in hourly earnings as obtained from yearly earnings even when the latter are obtained from reliable register data. Errors for adjacent years are correlated and measurement errors are larger for women than for men (Selén 1995). Working hours from employer records have smaller errors, but then there are difficulties covering all jobs of an individual with more than one employer. Generally there are difficulties knowing hourly earnings on the marginal and separating voluntary from ordered overtime.

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et al. (2001) find a net increase of about 2 percent in the average desired hours of work for married prime-aged males. This is for a new non-parametrical approach and comparing the 1980 system with 1991, or the year with historical high marginal tax rates with the year with the lowest rates in the last decades.

An important motive in the literature to consider taxable income is considerations of the distorting effects of income taxation. This is partly based on the presumption that since labour supply elasticities seem so small there must be other responses not covered. Taxable income is a wider concept than quantitative labour supply, reflecting not only the number of working hours but work compensation more generally and also, at least partly, other income sources. Responses to changes in taxation may therefore turn up in taxable income although they do not appear in the number of working hours.

Generally individuals have different options responding to taxation. Legal responses involve timing of transactions, financial and accounting decisions in addition to responses concerning labour supply and savings. Avoidance efforts are incorporated by Feldstein (1999), arguing that (greater) deadweight losses then are more appropriately accounted for, and by Slemrod (2001) clarifying the relationship between avoidance efforts and real responses in a simple model.

While not including all response to income taxation, changes in taxable income summarise no doubt the marginal efficiency cost of taxation better than changes in a narrower measure such as labour supply or saving behaviour. In the literature one has also stressed that the size of the taxable income elasticity is helpful for determining the social marginal cost per unit revenue raised by the tax system for personal income, and thus is of importance in determining the optimal tax mix and the size of the public sector.

Pioneering studies for taxable income analysis are Lindsay (1987) using cross-section data and Feldstein (1995) using panel data, a practice which thereafter almost all have followed. Slemrod and Yitzhaki (1996), Slemrod (1998) and Triest (1998) concentrate on methodological issues. Slemrod and Kopczuk (2002), Saez (2000) and Gruber and Saez (2002) are concerned with questions on an optimal elasticity and optimal systems for re-distributional preferences respectively. Gruber and Saez (2002) summarise the results of estimated taxable income elasticities, from a number of studies of the U.S. tax reforms of 1981, 1986 or 1993.

The first studies indicated rather high taxable income elasticities. Lindsay (1987) obtains 1.05 to 2.75, with 1.6 as the central estimate, and Feldstein (1995) 1.1 to 3.05 for panel data, but with rather few high-income earners. For an extended income measure, adjusted gross income, Feldstein obtains an elasticity around 1. In the light of following studies, these estimates are high.

More elaborate regression modelling with efforts to control for effects of transient income (mean reversion) or the development of the income distribution over time, indicate estimates below 1 for most studies. Auten and Carrol (1999) obtain 0.75 (standard error 0.22), Carroll (1998) 0.5 and Saez (1999) and Gruber and Saez (2002) 0.4 (standard error 0.11). Elasticities for adjusted gross income are a bit lower, 0.25 for Saez, from 0 to 2 for Moffitt and Wilhelm (1998) and close to 0 for Sammartino and Wiener (1997), the latter with no controls for mean reversion.

All these studies are based on panel data but there are differences which individuals to include in the estimation, especially as regards the lower parts of the income distribution, and the reforms studied are different. For the longer period of 1922 to 1989, basing the analysis on aggregate data from tax statistics' tables, Goolsbee (1999) obtains taxable income elasticities from -1.3 to 2 analysing a variety of tax reforms.

Recent studies of taxable income responses on data other than American are difficult to find. An exception is Aarbu and Thoresen (2001), examining the Norwegian tax reform of 1992 with substantial reductions in tax rates for those with high income. Their elasticity estimates range from -.6 to .2. The Canadian tax reform of 1988 flattened the personal income tax schedule; Sillamaa and Veall (2001) utilising this reform, obtain a main elasticity estimate of about 0.25. In both these studies, estimates are lower than similar estimates for U.S. data.

In this paper the large Swedish 1990-1991 reform provides the 'natural experiment' used in the analysis. Thus a difference-in-differences approach comparing pre- and post reform income for individuals is employed. The approach is more generally discussed in section 2. A statistical model is introduced in section 3, a model which then is linked to the income supply model by Gruber and Saez (2002). Some basic estimation problems are introduced before the Swedish income tax system is presented briefly in section 4, with emphasis on the reform 1990-1991. Two panels of data employed are introduced in section 5.

Estimation and results are presented in detail in sections 6 and 7. In the estimation, basically, changes in income are compared for individuals affected differently by the reform. Estimation is introduced with Feldstein's tabular approach, but the emphasis is on instrumental variables estimation for various groups and selection of individuals as well as for different instruments. Effects for broader and narrower income concept are compared. The estimated effects are typically modest, and the findings are discussed in a final section.

# 2. The procedure

The analysis here is based on panel data. According to a classical before-after approach, and the procedure by now established for the analysis of taxable income responses, the outcome -income and tax rate- after a tax reform is compared to a pre-reform outcome. The changes in outcome are then compared for individuals treated differently by the reform. Thus, we are considering differences in changes, but the procedure is usually known as one of differences in differences.

A main difficulty in identifying the effects of a tax reform is that individuals with similar characteristics are treated similarly by the fiscal system. Those in the same income bracket are exposed to the same tax change, especially when taxation is purely individual. The variation in ”treatment” by the reform is between individuals in different original tax brackets. Since effects may be identified by a comparison of individuals treated differently, one usually compares the changes for individuals in different income classes who are also different in other ways and probably also behave differently. Unfortunately, most recent tax reforms leave little choice, with large changes in marginal rates for those with high income and smaller changes for the rest.

Therefore, the situation is very different from an experiment, where the assignment of individuals to groups treated differently is random, leaving no systematic a priori differences between these groups. Here we have to rely on assumptions instead, loosely speaking assumptions of response similarity for individuals in different tax brackets if they were to experience a similar change. Such assumptions are critical for unbiased estimation of effects and if individuals in different income classes have different attitudes to changes in marginal tax rates, for example, then the analysis is in jeopardy.

A second possibility for identification of tax rate effects is differences in local tax rates, which could be used alternatively to or in conjunction with pre and post tax reform data. The assumption of response similarity then concerns different municipalities rather than different income classes. While there are different local or municipal tax rates in Sweden, a main problem with this alternative here is that many communities with higher municipal rates are small and have economic difficulties. The labour market is different in many of these communities as compared to other communities, and it is likely that the probability to increase labour income is correlated with the municipal rate. In this paper, we will concentrate on

the comparison of different income classes, giving some attention to differences in rates between communities.

There are several other problems, which we need to consider in the analysis, among these the implications of different income concepts; there is not always a single taxable income and broader as well as narrower income measures may be interesting.

Changes in tax bases according to a reform, is a complication, since a straightforward estimation then concerns a mixture of elasticities: those of changes in rates and those of changes in the tax base.

Inflation may further be of importance for differences over time, an individual's positive change in current prices may turn up as a negative change in constant prices.

The sampling procedure in income surveys is often somewhat complicated, especially if those with very high income and large tax rate changes are to be included to a reasonable extent in the survey.

Mean reversion effects may disturb estimation, for example if some individuals "by chance" get a high income the first year but not the second, independently of their behavioural response to the tax reform.

Changes in the income distribution, for instance in the form of a secular trend independently of the reform, raise further problems as well as the influence of factors other than tax factors.

# 3. Taxable income effects

A statistical model written for individual i at time period t is

$$y_{it} = \beta\, z_{it} + \alpha_i + \tau_{it} + \nu_{it}, \qquad (1)$$

where y denotes the outcome or the response, usually taxable income in our case, and z the stimulus-related net of tax rate (NTR). The latter equals one minus the marginal tax rate or 1-v. The variables y and z are either linear or logarithmically transformed. $\beta$ denotes the effect parameter, $\alpha_i$ is an individual intercept and $\tau_{it}$ an individual time effect. The latter may be composed of a common time specific effect and of individual characteristics constant over time, but whose relationships to income changes over time, for example

$$\tau_{it} = \tau_t' + \beta_t X_i,$$

where $X_i$ is the vector of individual characteristics and $\beta_t$ a coefficient vector. The error term $\nu_{it}$ in (1) is symmetrically and independently distributed by assumption.

The post-reform pre-reform difference $dy_i = y_{it2} - y_{it1}$ is written

$$dy_i = \beta\, dz_i + d\tau_i + d\nu_i\,, \qquad (2)$$

as we subtract (1) for time period t1 from (1) for time period t2 (t2>t1) and ignore the period index. The individual parameters $\alpha_i$ cancel out. A tax reform with different changes for different income "classes" provides a natural experiment, where in contrast to a true experiment $y_{it}$ and $z_{it}$ are determined jointly by the individual, although the tax schedule is decided by parliament and by local assemblies.

Model (2) is a regression model where $dz_i$ is endogenous and $d\tau_i$ is unknown. Let us, for a moment, assume that (2) applies to two groups treated differently in the reform, each group consisting of identical individuals. Say that the groups differ by income and are indexed by the superscripts H and L for those with high income and low income, respectively. The difference between the post-reform pre-reform differences for the groups is obtained from (2) as

$$dy^H - dy^L = \beta[dz^H - dz^L] + d\tau^H - d\tau^L + d\nu^H - d\nu^L. \qquad (3)$$

If $d\tau^H - d\tau^L = 0$, a consistent estimator of the effect parameter $\beta$ is

$$b = [dy^H - dy^L] / [dz^H - dz^L] \qquad (4)$$

When $dy^H$ and $dy^L$ are based on averages and we relax the assumption of identical individuals within the groups, this is the type of estimator introduced by Feldstein (1995). The actual estimate in a finite sample is dependent on how the averages are calculated, here has different alternatives been tried, giving taxable income elasticities directly or after some transformation.

In a regression framework it is realised that (4) is obtained if instrumental variables are used for the estimation of (2) with a dummy variable defining the two groups as the instrument, that is a variable with values 1 for group H and -1 for group L.

For the estimator (4), we assumed that the comparison of the groups was perfect in the sense that the difference $d\tau^H - d\tau^L$ was zero. Such an assumption is often questionable in practice, which means a large sample bias,

$$E\ \{[d\tau^H - d\tau^L] / [dz^H - dz^L]\}. \qquad (5)$$

The sign of the bias depends on the sign of the numerator, given a typical tax reform. For a tax cut favouring the rich, an underlying trend of increasing income inequality would induce a positive bias. A transient component in income is likely to attenuate any effect. The component $d\tau^H$-$d\tau^L$ is the challenging difficulty in the estimation and there are a number of reasons why this component may exist but so difficult to adequately indicate and handle. Among the reasons are mean reversion and different properties and attitudes of the groups we try to compare in the quasi-experiment offered by the tax reform.

An income supply model in a microeconomic framework with two goods, consumption and income, derived by Gruber and Saez (2002), allows us an interesting interpretation and a specification of the $d\tau$-terms. The model is obtained as follows letting, as before, y and z denote income and net of tax rate respectively. The budget constraint following from a standard income tax system is piecewise linear and written $w = y\,(1-v) + r$, where w is consumption on a linear segment, r denotes virtual income and v is the marginal tax rate ($z=1-v$).

For a standard utility specification and maximisation, income supply depends on the slope and on virtual income $y = y(1-v,r)$ . A tax change affects both v and r for a given individual, and income supply is affected according to

$$dy = - [\delta y/\delta(1-v)]\, dv + [\delta y/\delta r]\, dr. \qquad (6)$$

This is rewritten

$$dy = - \beta^u\, y\, [dv/(1-v)] + \gamma\, dr, \qquad (7)$$

with $\beta^u = [(1-v)/y][\delta y/\delta(1-v)]$ for the uncompensated elasticity of income with respect to the net of tax rate z, and $\gamma$ as the income effect parameter $\delta y/\delta r$. For the compensated elasticity of income $\beta^c$, which according to the Slutsky equation is $\beta^c = \beta^u - (1-v)\,\gamma$, we can write (7) as

$$dy / y = - \beta^c\, [dv/(1-v)] + \gamma\, [(dr - y\, dv)/ y\,] \qquad (8)$$

Here dr-y dv is interpreted as the change in after-tax income due to a tax change for a given income y, it equals the change in tax liability.

An empirical model found "natural" by Gruber & Saez (2002) is for individual i and the t1 to t2 change in real income,

$$\log(y_{it2}/y_{it1})=\beta^c\log([(1-u_{it2})/(1-u_{it1})]+\gamma\log[(y_{it2}-s(y_{it2}))/(y_{it1}-s(y_{it1}))]+\varepsilon_i, \quad (9)$$

where s(y) denotes the tax liability. Here an income effect is added; we find the $d\tau$-terms in (3) specified as income net of tax, where the log ratio is an endogenous variable with $\gamma$ as the parameter.

An instrumental variables' estimation is a reasonable procedure for the models. We will come back to estimation and the choice of instruments more generally later. The so-called natural instruments, according to some writers, are interesting to discuss here as one has let them influence model specification even. The natural instruments are $\log([(1-u'_{it1})/(1-u_{it1})]$ and $\log[(y_{it1}-s'(y_{it1})/(y_{it1}-s(y_{it1})]$ where $u'_{it1}$ and $s'(y_{it1})$ are obtained using the new tax system on (real) pre-reform income, that is these variables are based on predicted taxes for the new system in period t2 if real income does not change from t1. The second instrument may be correlated with the equation error $\varepsilon$ and in an effort to purge the latter from the correlation, the suggestion is to include period t1 income, $\log(y_{it1})$, as a regressor. This is a subtle argument for the expanded model

$$\log(y_{it2}/y_{it1})= \beta^c \log([(1-u_{it2})/(1-u_{it1})]+\gamma \log[(y_{it2}-s(y_{it2})/(y_{it1}-s(y_{it1})]+ \kappa \log(y_{it1})+\varepsilon_i, \quad (10)$$

A second argument put forward by some writers for a $\log(y_{it1})$-term is, that this is a way to deal with bias due to mean reversion, that is that individuals with temporarily high pre reform income, in particular these one claims, will have decreased their income in the post reform period even if the marginal tax rates are lowered (Moffitt and Wilhelm (1998) , Auten and Carroll (2000), Gruber and Saez (2002)).

In particular Moffitt and Wilhelm (1998) have a thorough discussion of estimation issues. More generally it is important to control for the base year income for the identification of income effects, as is indicated in the previous section.

# 4. Swedish income taxation 1989-1999

The reforms of income taxation in Sweden 1990-1991 were similar to the reforms in many other countries at the time; the tax base was broadened and tax rates were reduced, especially for higher income earners. The Swedish reforms also included more taxes on consumption, increased transfer payments and a modification of capital income taxation. By 1989, capital income was partly taxed together with labour income and interest payments could be deducted from labour income, to a large extent. After the reform, all interest payments were principally deductible against capital income only. A result of the changes was heavier taxation on housing and transportation.

Swedish income taxes comprise municipal taxes and state taxes. The changes of the tax base due to the reform applied to both these taxes, while the changes in rates applied to the progressive state tax only. The maximal state rate was 42 percent before the reform 1990 to 1991, by 1992 the maximum was 20 percent. The municipal taxes are based on flat rates on income above a low threshold, the rate varied between 26.5 percent and 34.4 percent 1997 for the inhabitants in different communities. Each community sets the rates annually, but a rate ranking of communities is fairly stable over time. For most income earners the municipal taxes constitute the larger part of the income taxes.

The 1990-1991 reforms were not revenue neutral, increased labour supply was expected to compensate (some) revenue shortfall. Such an increase did not occur, Sweden experienced the biggest economic crises in decades and unemployment rose from below 2 percent 1988 and 1989 to almost 9 percent 1993. Public expenditure cuts followed and income taxes were raised again. A tax increase of 5 percent on higher income was introduced in 1995 (“värnskatt”).

# 5. The data

Our main database is the household income survey (HINK) of Statistics Sweden. Data on household structure, housing and details regarding employment are obtained by interviews in the survey, while data on income and benefits are obtained from registers of the tax authorities and the natio-

nal social insurance board, mainly. In the eighties the survey had a rotating panel design. Sampled individuals were included for two years and about half the sample was replaced each year. The number of households in the survey is about 10 000 each year and the number of adults about 16 000. The non-response rate for the interviews was about 15 to 20 percent.

The sampling design is stratified with different selection probabilities for different strata. Due to the lack of a register of households in Sweden, the register of the total population is used as a sampling frame. Since all members of the households of the selected individuals are included in the survey, the sampling is also a type of network sampling. The calculation of precision of estimates requires formulas adapted to these circumstances.

To enable evaluation of the 1990 to 1991 tax reform the panel design was changed by Statistics Sweden to include those in the 1988/1989 and 1989/1990 panels in the 1992 sample. Register data for the years in between the waves and for 1993 to 1995 have also been collected.

For calculation of marginal taxes, the tax-benefit micro-simulation system (FASIT) of Statistics Sweden and the Ministry of Finance was utilised. This system is developed for specially tailored databases of the household income survey. Here we had to adapt FASIT to our somewhat different databases and different years. With the databases and FASIT, taxable income is either known or is possible to calculate with high accuracy. Marginal rates are computed in a well-tested environment as regards tax rules and tax rates, the municipal tax rates are known for each community. Individual marginal rates are calculated comparing taxes before and after an increase in taxable income (or income from employment) of 1 000 SEK. for each individual.

# 6. Estimating the responses

Our main variables are taxable income y=TI (”beskattningsbar inkomst”), with some differences in definition over time) and net of tax rate, z=NTR, the latter equals one minus the marginal tax rate, NTR = 1 – MTR or 1-u. In the analysis, the change in taxable income $\Delta$TI is compared to the change in the net of tax rate $\Delta$NTR, essentially.

It is natural to use regression estimation for the analysis. We will start with the tabular alternative for averages used by Feldstein (1995). A tabular estimation can be regarded as an extended presentation of variables and

data and is easier to handle when a somewhat complicated sampling design has been used, as in the household income survey. Some tabular estimates may be obtained in a regression framework, as indicated in a previous section. After an introductory tabular estimation we will deepen the analysis with the help of regression considering some important changes in the model specification as well as changes in the selection of individuals for the analyses and changes in the estimation procedure.

The tabular estimation utilises averages of ΔTI and ΔNTR. Three versions have been used (Moffit and Wilhelm 1998), differing by the specification of the averages used for the comparisons of two differently treated groups, say those with high income and those with low income, identified by superscripts H and L respectively.

-I) A ratio of changes in arithmetic averages,

$$ra_I = [av(\Delta TI^H) - av(\Delta TI^L)] / [av(\Delta NTR^H) - av(\Delta NTR^L)],$$

where av is the average operator $av(z) = (1/n)\Sigma z$. This is converted to an arc elasticity at the average income and average net of tax rate,

$$e_I = ra_I [av(\Delta NTR^H) + av(\Delta NTR^L)] / [av(\Delta TI^H) + av(\Delta TI^L)]$$

-II) A ratio of relative changes from percentages computed from average differences,

$$e_{II} = [av(\Delta TI^H)/ av(TI^H_{t1}) - av(\Delta TI^L)/ av(TI^L_{t1})] / [av(\Delta NTR^H)/ av(NTR^H_{t1}) - av(\Delta NTR^L)/ av(NTR^L_{t1})],$$

where subscript t1 denotes the first time period, the ”before year”.

-III) A ratio of differences as computed from average relative individual changes.

$$e_{III} = [av(\Delta TI^H/ TI^H_{t1}) - av(\Delta TI^L/ TI^L_{t1})] / [av(\Delta NTR^H/ NTR^H_{t1}) - av(\Delta NTR^L/ NTR^L_{t1})]$$

The first and the third of these ratios (I and III), but not the second (II), may be specified as a regression parameter. Estimating the pertaining

models, endogeneity has to be accounted for, as changes in income and changes in tax rate between the two years are jointly determined.

Instrumental variables are an obvious alternative for estimation. Among basic instruments are dummy variables identifying groups treated differently by the tax reform; such variables are required as the only instruments, if the tabular estimates are to be mimicked.

We will limit, here and later, the analysis to men aged 25 to 55 years to allow for comparison to earlier results and avoid some complications. Important for this restriction is that there were very few women among those with higher marginal rates 1988 in the database. Higher income individuals are essential to consider explicitly as a group, since those individuals are more affected by the changes in the marginal tax rates than those in other income brackets.

# 7. Results

## *7.1 Tabular estimates*

The large Swedish income tax reform took place 1990 to 1991, meaning that the new system is in action from the income year of 1992. Let us start with a comparison of the pre-reform year 1989 to the post-reform year 1992, using panel data from the household income survey, HINK.

*Table 1* shows, means and standard deviations for basic variables and four 1989 marginal tax groups. The chosen groups are rather distinct in the marginal tax rate distribution of our working ”prime-aged” men working at least 200 hours both years. The selection by age and by working hours is identical to that of Moffit and Wilhelm (1998) for the US. Those with very low marginal rates, below 30 percent 1989, are not included in the tables.

For *Table 1* we can account for the stratified sampling design of the HINK survey, through the weights. In *Tables 2 a-d* we employ the Feldstein tabular method to estimate elasticities mainly to present the relevant variables and data. Here special formulas are required for the standard errors.

***Table 1: Averages and standard deviations 1989 and 1992 for a panel of men aged 25-55 1989 with more than 200 hours of work both years by four marginal tax rate groups 1989.***

| | **Mean** | **Mean by marginal tax rate group (limits in percent))** | | | | **Standard deviation** | **Standard deviation by marginal tax rate group** | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **All** | **>66.8 %** | **56.3%-66.8%** | **45.0%-56.3%** | **30.0%-45.0%** | **All** | **>66.8 %** | **56.3%-66.8%** | **45.0%-56.3%** | **30.0%-45.0%** |
| N number of observations | 3711 | 900 | 1167 | 1165 | 479 | 3711 | 900 | 1167 | 1165 | 479 |
| Wage and salary 1989 | 153541 | 247743 | 161517 | 113588 | 53443.3 | 1303440 | 1257312 | 623764 | 741198 | 702796 |
| Wage and salary 1992 | 188987 | 297098 | 194163 | 144464 | 84554.5 | 1724537 | 1965445 | 1031186 | 1081730 | 1085086 |
| Earned income 1989 | 168859 | 263015 | 173994 | 129200 | 78847.0 | 1193994 | 1214963 | 407967 | 488010 | 550668 |
| Earned income 1992 | 206832 | 322855 | 208029 | 159190 | 111254 | 1757885 | 2147405 | 948570 | 939285 | 1044617 |
| Factor income 1989 | 170611 | 286061 | 171148 | 123676 | 76259.8 | 2068427 | 3387386 | 611433 | 541048 | 534033 |
| Factor income 1992 | 215362 | 349706 | 214775 | 160592 | 110892 | 2340472 | 3359947 | 1382010 | 1031537 | 1044608 |
| Taxable income 92 (taxerad inkomst) | 204262 | 319322 | 202047 | 158977 | 115253 | 1793775 | 2500747 | 793623 | 775530 | 919050 |
| Primary taxable income 89 (grundbelopp) | 135478 | 222094 | 137153 | 102905 | 49599.7 | 1808011 | 3149817 | 407546 | 404958 | 319728 |
| Secondary tax.inc 89 (tilläggsbelopp) | 159972 | 264440 | 161278 | 117833 | 70115.9 | 1885149 | 3154514 | 263804 | 388727 | 487761 |
| Taxable income 92 (beskattningsbar inkomst) | 184405 | 298479 | 182425 | 139044 | 97092.5 | 1779019 | 2492308 | 782433 | 762858 | 875471 |
| Marginal rate 1989 | 0.57 | 0.72 | 0.62 | 0.48 | 0.36 | 1.90 | 0.22 | 0.22 | 0.23 | 0.27 |
| Marginal rate 1992 | 0.39 | 0.49 | 0.40 | 0.33 | 0.33 | 1.61 | 0.97 | 1.75 | 1.06 | 0.69 |
| Relative change in taxable income | 0.25 | 0.17 | 0.13 | 0.22 | 1.04 | 24.80 | 7.11 | 4.63 | 19.28 | 59.79 |
| Relative change in net of tax rate | 0.49 | 0.86 | 0.58 | 0.28 | 0.06 | 5.41 | 3.48 | 4.66 | 2.05 | 1.20 |
| Hours of work 1989 | 2 124 | 2 218 | 2 116 | 2 078 | 2 110 | 7 353 | 6 441 | 4 944 | 7 098 | 12 388 |
| Hours of work 1992 | 2 083 | 2 176 | 2 091 | 2 003 | 2 135 | 8 263 | 7 126 | 6 882 | 8 647 | 1 1281 |
| Age in 1989 | 39.50 | 42.08 | 39.79 | 38.18 | 37.31 | 135.44 | 104.94 | 143.25 | 145.76 | 119.99 |
| Household size 1989 | 2.78 | 3.02 | 2.83 | 2.55 | 2.87 | 23.26 | 19.96 | 24.14 | 24.71 | 21.74 |
| Household size 1989 | 2.78 | 3.02 | 2.83 | 2.55 | 2.87 | 23.26 | 19.96 | 24.14 | 24.71 | 21.74 |
| Household size 1992 | 2.78 | 2.89 | 2.81 | 2.62 | 3.01 | 22.78 | 19.39 | 23.69 | 24.47 | 21.34 |
| Changing household size, proportion | 0.36 | 0.38 | 0.35 | 0.35 | 0.37 | 8.09 | 7.67 | 8.52 | 8.43 | 6.81 |
| No taxed wealth, proportion 1989 | 0.38 | 0.30 | 0.35 | 0.43 | 0.48 | 8.20 | 7.27 | 8.53 | 8.77 | 7.05 |
| Taxed wealth, log, those above lower limit. | 7.18 | 8.41 | 7.48 | 6.43 | 6.01 | 96.90 | 89.52 | 100.33 | 101.01 | 83.21 |
| University degree, proportion | 0.13 | 0.33 | 0.11 | 0.04 | 0.05 | 5.63 | 7.43 | 5.49 | 3.65 | 3.14 |
| Postgraduates, proportion | 0.01 | 0.04 | 0.00 | 0.00 | 0.00 | 1.66 | 3.13 | 0.86 | 0.51 | 0.33 |
| Weights (unweighted) | 284.80 | 249.45 | 318.84 | 313.38 | 198.77 | 148.53 | 113.60 | 131.64 | 167.56 | 147.41 |

***Table 2a. Average NTR (net of tax rate= 1-marginal tax rate (MTR)) and secondary taxable income (tilläggsbelopp) 1989 and 1992 for different marginal tax rate groups 1989.***

| | | | 1989 | | | | 1992 | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Grp** | **n** | **1989 MTR** | **NTR** | | **Income** | | **NTR** | | **Income** | |
| | | | Mean | s.e. | Mean | s.e. | Mean | s.e. | Mean | s.e. |
| 1 | 879 | .67- | .276 | .0005 | 263 367 | 7 150 | .511 | .0022 | 299 959 | 6 824 |
| 2 | 1 166 | .56-.67 | .382 | .0004 | 162 187 | 559 | .595 | .0031 | 185 902 | 1 453 |
| 3 | 1 163 | .45-.56 | .481 | .0004 | 117 385 | 664 | .664 | .0020 | 139 084 | 1 405 |
| 4 | 503 | .30-.45 | .598 | .0006 | 77 696 | 1 983 | .671 | .0025 | 106 002 | 3 133 |

From *Table 2a*, we find that the marginal tax rates on average were about 0.72 (1-0.276) for the top group (group 1) and about 0.40 for the bottom group for 1989. Average income in the top group in 1989 is 263 000 and 77 000 in the bottom group.

The income concept here is taxable income 1992 and extended taxable income (tilläggsbelopp) 1989. The latter is more comparable to taxable income 1992 than the 1989 primary taxable income (grundbelopp) where interest payments had been deducted. The income distribution as indicated by group averages shows that the averages for the non-top groups 2, 3 and 4 were about 62, 45 and 29 percent, respectively, of the average income for the top group 1989 which comprise about 20 percent of the individuals in these comparisons.

In the leftmost columns of *Table 2b*, we see that the decrease in marginal tax rate, after the reform, is about 0.24 for the top group and about 0.07 for the bottom group. This means the marginal tax rates 1992 had fallen to about 0.49 and 0.34 for the two groups respectively; these rates are easily obtained from the net of tax rates (NTR=1-MTR) in table 2a, 1-0.511 and 1-0.671.

***Table 2b. Differences (changes) 1992-1989.***

| | **Change of average** | | | | **Relative change of average** | | | | **Relative individual change** | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | **NTR** | | **Income** | | **NTR** | | **Income** | | **NTR** | | **Income** | |
| **Group** | Est. | Se | Est. | Se | Est. | Se | Est. | Se | Est. | Se | Est. | Se |
| 1 | .235 | .002 | 35 592 | 9 224 | .853 | .008 | .135 | .038 | .855 | .008 | .178 | .020 |
| 2 | .213 | .003 | 23 714 | 1 302 | .557 | .008 | .146 | .008 | .559 | .008 | .147 | .008 |
| 3 | .183 | .002 | 21 699 | 1 316 | .381 | .004 | .185 | .012 | .381 | .004 | .250 | .036 |
| 4 | .073 | .003 | 28 306 | 2 982 | .121 | .004 | .364 | .042 | .121 | .004 | .939 | .202 |

### *Table 2c. Differences of differences (d-o-d), average change, group 1 compared to other groups*

| Grps | NTR | | Income | | NTR | | Income | | NTR | | Income | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| comp. | Est. | Se | Est. | Se | Est. | Se | Est. | Se | Est. | se | Est. | se |
| 1-2 | .022 | .004 | 11 878 | 9 316 | .296 | .012 | -.012 | .038 | .296 | .012 | .031 | .022 |
| 1-3 | .052 | .003 | 13 893 | 9 318 | .472 | .009 | -.050 | .039 | .473 | .009 | -.072 | .041 |
| 1-4 | .163 | .003 | 7 286 | 9 695 | .732 | .009 | -.230 | .056 | .733 | .009 | -.762 | .203 |

The relative change for the averages up to 1992 was largest for the bottom group, an increase of 36 percent, nominally. If individual relative changes are averaged instead, the result is 94 percent due to some extreme increases; the latter figure is also accompanied by a much larger standard error. Income increases for the groups do not generally correspond to similar changes in purchasing power, however, the consumer price index increased from 1989 to 1992 by 23 percent.

Let us go to table 2c, where we find differences of differences, or differences of changes 1992-1989 to be more precise. The larger increase in NTR for the top group, as compared to the other groups, is accompanied by insignificant differences in taxable income change, with exception for relative change and the top/bottom (or 1-4) comparison, where a negative effect is found implying a disadvantage for the top group.

For the elasticities in *Table 2d*, results are similar with significant negative effects only for the top/bottom comparisons based on relative changes. One might suspect that this depends on the bottom group containing a number of men not working full-time the whole year. However, an increase of the minimum number of working hours to 500 first, and then to 1 000 and 2 000 as a condition to be included in the analysis did not change conclusions. Also, a definition of groups by TI 1989 (taxable income) instead of MTR (marginal tax rate) 1989 gives similar results.

### *Table 2d. Implied elasticities, (d-o-d income)/(d-o-d NTR), different alternatives.*

| Groups compared | Based on change[#] | | Based on relative change[##] | | Based on relative individual change | |
|---|---|---|---|---|---|---|
| | Est. | Se | Est. | Se | Est. | Se |
| 1 with 2 | 4.040 | 2.8204 | -.039 | .1293 | .105 | .0745 |
| 1 with 3 | 1.958 | 1.0454 | -.106 | .0825 | -.152 | .0866 |
| 1 with 4 | .216 | .2623 | -.314 | .0758 | -1.038 | .2771 |

[#] arc elasticity, for example 4.040=(11878/.022)*(.235+.213)/(35592+23714)
[##] Example: -.039=-.012/.296

Inflation means that income changes are different whether taxable income is in constant or current prices. Elasticities based on taxable income differences are affected and since inflation was high - the consumer price index increased by 23 percent from 1989 to 1992 - results may differ. However, elasticities based on relative changes of yearly averages are easily transformed from constant to current price versions. It is easy to show that estimates are identical if all changes still are positive (or negative) after a transformation to constant prices, but if some individual changes change sign by a transformation, elasticities may be affected. This has only minor effects here, later we will consider a log model in constant prices.

## *7.2 A simple regression model*

In *Table 3*, the analysis is brought further with the help of regression. The main parameter corresponds to the third type of elasticity, based on relative individual change above. Regression analysis is also possible as regards absolute change, the first alternative with arc elasticity, but not for the second type of elasticity. The regression framework enables us to examine the results more closely as regards the importance of potentially disturbing factors, different groups for the comparison of changes, different selections of individuals for the analysis and different instruments for the estimation.

For any pair of two groups used in the comparisons in *Table 2a-d* and a dummy variable identifying those groups as an instrument, the point estimates there should be reproduced, and indeed we obtain 0.105 in the first row in table 3 for the two higher income groups. The variances differ; standard IV formulas were used for the regression estimates, this is disputable for a stratified sample. The standard error is understated, the estimate is 0.055 now compared to 0.075 earlier in *Table 2d*, this can be taken as an indication that significant results in our regression estimation for the household income survey should be interpreted with care.

In the following, we will see whether the obtained estimates hold for changes in the definitions of the different comparison groups and changes in the estimation procedure. The marginal rates for inclusion in the comparison groups are changed, the limit in yearly working hours is changed, comparison groups are defined by income, stable households with respect to the number of children and marital status are examined and the choice of instrumental variables for the estimation is varied.

In *Table 3* then, we first examine the effects of including individuals with midrange marginal rates 1989 as well as the effects of excluding individuals with working hours below 1 000 and 2 000 yearly hours, respectively, both years. The tendency is a smaller coefficient when the hours restriction is tightened; when individuals with lower 1989 marginal taxes are included the coefficient becomes negative and significant at a 5 percent level. That effect is verified by section C in the table where only stratum 4 in the survey is considered, thus the problems of variance calculation for a stratified sampling design is avoided (similar results are obtained when stratum dummies are included, this is sometimes an acceptable remedy; results are not shown).

Next, let us consider that the reform basically changed the state tax rate and thus only indirectly the total marginal tax rate (MTR). The municipal rates included in MTR may vary with as much as almost 8 percentage points for different communities, consequently the MTR for an individual with a given income may be larger than for an individual with higher income. MTR therefore lacks precision when used to identify individuals treated differently by the reform. A second difficulty is that the MTR may change considerably for individuals moving.

Since the identification of individuals treated differently by the reform is the key in a quasi-experimental evaluation of our kind, it is essential to examine the effects of this lacking precision. To this end, a grouping according to the extended taxable income ("tilläggsbelopp") is used for sections D-F. Preferably, we would like to define groups exactly according to the changes of the reform. But let us begin with a simple grouping into four groups with taxable income of 20 000 to 100 000 SEK, 100 000 to 140 000, 140 000 to 200 000 and 200 000 and more.

The result is, as before, a negative significant effect when all groups are considered, but when the two top groups only are used (the first row) the effect is positive and the p-value for the coefficient is 0.022 as compared to 0.054 for section A, the first row. When all four groups are considered but only the first is identified by a dummy variable in the first stage, then the negative effect seems to vanish (the third row); an increase in the coefficient for such an instrumentation is consistent with results of Moffitt & Wilhelm (1998).

We have pointed out the complication of the two tax bases 1989, which makes the elasticity a combined effect. Let us try to shed some light on this problem by considering those with the same taxable income according to both bases; those with no deductible interest payments essentially. In

## *Table 3: Regression estimates of effects of tax rate changes on taxable income changes 1992-1989 with alternative regressors and instruments. Men 25-55 years 1989, different selections.*

| **Model, Selection**[#] | **n** | | **Instrumental variables**"" | **Second stage ΔNTR** | | **First stage** |
|---|---|---|---|---|---|---|
| ***A: MTR classes, .30-45, .45-55, .55- 67, .67-*** | | | | ***Coeff.*** | ***s. e.*** | $R^2$ |
| >200, >.56 | 2 036 | | 1 MTR | .105 | .055 | .25 |
| >1000, " | 2 004 | | 1 MTR | .097 | .055 | .25 |
| >2000, " | 1 662 | | 1 MTR | .060 | .047 | .26 |
| >200, >.45 | 3 166 | | 2 MTR | -.128 | .064 | .53 |
| >200, >.30 | 3 690 | | 3 MTR | -.601 | .100 | .62 |
| >1000, " | 3 531 | | 3 MTR | -.178 | .037 | .61 |
| >2000, " | 2 04 | | 3 MTR | -.185 | .041 | .60 |
| ***B: A and no change family size or cohabiting status*** | | | | | | |
| >200, >.56 | 1 294 | | 1 MTR | .053 | .070 | .25 |
| >200, >.30 | 2 345 | | 3 MTR | -.483 | .119 | .62 |
| >1000, " | 2 255 | | 3 MTR | -.176 | .044 | .61 |
| ***C: A and Stratum 4 only*** | | | | | | |
| >200, >.56 | 1 355 | | 1 MTR | .135 | .076 | .21 |
| >200, >.30 | 2 418 | | 3 MTR | -.675 | .111 | .58 |
| >1000, " | 2 293 | | 3 MTR | -.164 | .040 | .57 |
| ***D: Income groups 20-100,100-140,140-200,200-*** | | | | | | |
| >200,>140' | 2 076 | | 1 Inc | .160 | .070 | .15 |
| >200, >20' | 3 636 | | 1 Inc | -.018 | .044 | .26 |
| >200, >20' | 3 636 | | 3 Inc | -.180 | .031 | .52 |
| >1000, " | 3 491 | | 3 Inc | -.135 | .029 | .51 |
| ***D1: D and taxbases identical (no deductions for interest payments)*** | | | | | | |
| >200,>140' | 160 | | 1 Inc | .123 | .248 | .09 |
| >200, >20' | 606 | | 3 Inc | -.574 | .124 | .60 |
| E: D | | | | | | |
| >200,>140' | 2 076 | | 1 Inc 1 MTR | .105 | .052 | .27 |
| >200, >20' | 3 636 | | 1 Inc 1 MTR | -.154 | .028 | .61 |
| >1000, " | 3 491 | | 1 Inc 1 MTR | -.114 | .026 | .61 |
| ***F: D and variables: 5 age dummies, cohabiting status, change family size, change cohabiting status*** | | | | | | |
| >200,>140' | 2 076 | | 1 Inc 1 MTR | .101 | .052 | .28 |
| >200, >20' | 3 636 | | 3 Inc 3 MTR | -.135 | .029 | .62 |
| >1000, " | 3 491 | | 3 Inc 3 MTR | -.104 | .027 | .61 |
| ***G: F and Stratum 4 only*** | | | | | | |
| >200,>140' | 1 378 | | 1 Inc 1 MTR | .140 | .072 | .23 |
| >200, >20' | 2 397 | | 3 Inc 3 MTR | -.177 | .037 | .58 |
| ***H: State marginal tax rate (SMTR) classes (rates according to both taxbases added)*** | | | | | | |
| >200,SMTR>=.33 | 1 972 | Smtr=31, 42 | 1 SMTR | .100 | .056 | .25 |
| >200,SMTR>=.22 | 3 056 | Smtr=21 25 30 31 42 | 4 SMTR | -.027 | .028 | .53 |
| ***H1: H and extraplanatory variables: log(wealth), higher education dummies*** | | | | | | |
| >200,SMTR>=31 | 3 056 | Smtr=21 25 30 31 42 | 4 SMTR | -.065 | .028 | .54 |
| ***I: H and not changing municipality*** | | | | | | |
| >200,SMTR>=31 | 1 866 | Smtr=31, 42 | 1 SMTR | .096 | .058 | .25 |
| >200,SMTR>=21 | 2 875 | Smtr=21 25 30 31 42 | 4 SMTR | -.032 | .029 | .52 |

[#] This column indicates the selection of individuals for estimation. The first inequality on a row, >200 for example, shows the number of working hours required for both

years. The second inequality shows the marginal tax rate requirement for 1989 when the number is a fraction, but for a number like 140' the requirement is on taxable income for 1989, 140' meaning that at least 140 000 Skr is required.

## MTR classes or income classes are identified by dummy variables. The MTR classes are those of table 2. The notation "1 MTR" means that a dummy for the highest MTR class only is used, "2 MTR" means two dummies for the two highest MTR classes and so forth. There is a similar notation for income classes (1 Inc, 3 Inc etcetera). The explanatory variables for each specification are also used as instruments.

section D1 results for these individuals, who on the average have higher income and are older, are shown. Only 10 to 20 percent of the individuals remain after this selection. A negative effect is again the result when individuals from all four marginal tax groups are included.

In the following sections of the table, we first strengthen instruments by using dummies for both income classes and MTR-groups. Weak instruments, with low explanatory power in a first stage means a larger risk of bias; there may be a bias in the direction of the ordinary least squares estimator[2]. Results for "all", in section E and for stratum 4 only in section G are calculated with the same conclusions as before.

In section F we introduce dummies for age classes (25-29, 30-34, 35-39, 40-44, 45-49, 50-54), for family type (cohabiting or not) and for change in the number of children; changes in results are small.

In section H, state marginal tax rate groups are defined after both 1989 tax bases. That is, a cross-classification of income according to both definitions is used for a grouping of individuals. First we select those with the resulting rates of 31 and 42 percent, thereafter those with rates 21, 25 and 30 percent are added. The results with the corresponding dummy variables are that the coefficient is close to zero and non-significant, earlier it was negative. Addition of log wealth in the household (as stated to the tax authorities), a dummy for those with no wealth according to their income (and wealth) statements, and dummies for those with higher education (university at least three years, and postgraduate studies) has little effect, although a small coefficient is doubled.

There are small changes also if those moving to another community 1989-1992 are excluded in the estimation, section I. As is seen the percentage moving is small, about 5 to 6 percent. There are practical difficulties to treat change of community endogenously, good instrumental variables seem difficult to find.

[2] See Staiger and Stock (1997) for a recent discussion

The results so far show basically non-significant or negative effects, the latter when those with lower income are included. There are indications of a small positive effect when those in the higher income classes only are considered.

## 7.3. Examination of an extended model

Next, we will examine a log model with an income effect and pre-reform income (for 1989) as possible additional variables according to model (10). We will also analyse the importance of different income concepts. Beside taxable income the different income variables are as follows, ranging from narrow to wide income concepts: wages plus salaries, earned income, factor income, earned income combined with income from capital to a varying extent.

Estimation results for these alternatives are summarised in *Tables 4, 5* and *6*. The selection of individuals and the choice of instruments vary row-wise, in the same way as in *Table 3* before, so that rows A1 and A3 in tables 4 and 5 correspond to the first and third rows in section A in *Table 3*. Instrumental variables are used for the estimation with instruments as in table 3 including the ”natural instruments” based on predicted post-reform taxes and no income change -according to section 3- and in logarithms.

*Table 4* gives estimates of income elasticities for a model with the restrictions $\gamma=\kappa=0$, that is a zero income effect and a zero effect of pre-reform income. The main column for differences in taxable income, according to the same concepts as in earlier tables, is highlighted. Significant estimates on a 5 percent level are marked with stars.

Almost half the estimates are negatively significant in the first part; for the baseline model. These results are generally obtained when those with lower tax rates 1989 are included in the estimation. Positive significant estimates are obtained in the last column with a large difference in the income variables’ specifications; basically all positive capital income is included 1992 but only net capital income 1989, the latter is pre-reform primary taxable income (“grundbelopp”).

***Table 4. Income elasticities 1992-1989, different income variables and selections of individuals. Log variables, baseline model ($\gamma$=$\kappa$=0).***

| | | Estimates, different income variables[3] | | | | | |
|---|---|---|---|---|---|---|---|
| **Model** | **N[4]** | **Wage + salary** | **Earned income** | **Factor income** | **Taxable income** | **Taxable income[5]** | **Taxable income[6]** |
| A1 | 2094 | 0.089 | 0.151* | -.120 | 0.024 | 0.161 | 1.828* |
| A3 | 1705 | 0.045 | 0.097 | -.101 | 0.021 | 0.156 | 1.772* |
| A4 | 3206 | -.160* | -.012 | -.125* | -.114* | 0.032 | 1.778* |
| A5 | 3648 | -.317* | -.137* | -.248* | -.267* | -.333* | 1.855* |
| A7 | 2876 | -.266* | -.068* | -.159* | -.120* | -.174* | 1.920* |
| B1 | 1327 | -.118 | 0.043 | -.199* | -.026 | 0.059 | 1.561* |
| C1 | 1400 | 0.101 | 0.177 | -.072 | 0.022 | 0.192 | 1.748* |
| C2 | 2407 | -.346* | -.223* | -.311* | -.355* | -.411* | 1.560* |
| D1 | 2105 | 0.117 | 0.095 | -.168 | 0.096 | 0.000 | 1.736* |
| D2 | 3607 | -.113* | -.017 | -.139* | -.083* | -.233* | 1.641* |
| D11 | 166 | 0.372 | 0.370 | 0.293 | -.062 | -.062 | 1.259* |
| D12 | 595 | -.499* | -.195 | -.277* | -.208 | -.208 | 1.965* |
| E1 | 2105 | 0.065 | 0.058 | -.192* | 0.044 | -.012 | 1.697* |
| F1 | 2105 | 0.039 | 0.047 | -.197* | 0.014 | -.070 | 1.624* |
| F2 | 3607 | -.218* | -.058 | -.176* | -.127* | -.218* | 1.593* |
| G1 | 1405 | 0.058 | 0.056 | -.164 | 0.024 | -.023 | 1.540* |
| G2 | 2390 | -.233* | -.137* | -.243* | -.208* | -.279* | 1.379* |
| H1 | 2070 | 0.069 | 0.142 | -.107 | 0.032 | 0.160 | 1.835* |
| H2 | 3167 | -.125* | 0.052 | -.064 | -.095* | 0.100* | 1.556* |
| H12 | 3167 | -.172* | -.017 | -.132* | -.153* | 0.060 | 1.388* |
| I1 | 1958 | 0.036 | 0.133 | -.113 | 0.024 | 0.154 | 1.812* |
| I2 | 2979 | -.130* | 0.037 | -.105* | -.087* | 0.104* | 1.559* |

* significant on a 5 percent level

In *Table 5*, where the parameters $\gamma$ and $\kappa$ are free and estimated, positive and significant effects are dominating. For the main comparison there generally is a positive income elasticity ranging from 0.2 to 0.4. This result holds even when those with lower income are included, compare A1 and A5 for example. That the results here for the different models are concordant to this extent is quite a contrast to what we have found earlier. The only exceptions are rows D11 and D12 for those with identical tax

[3] Variables are denoted as follows. Wage+salary for the HINK-variables *illont* 1989 and *tlon* 1992, earned income for *isarb* 1989, *carb* 1992, factor income for *isfakt* 1989 and *cfakt* 1992, taxable income for *ssbeskb* or *sundtb* 1989 and *cbefvi* 1992, combined earned income and income from capital for *issam* (1989) *ctxfvi+kkap* (1992)

[4] For the estimates in the highlighted column.

[5] Deductions for interest payments allowed 1989.

[6] Capital income included, all 1992, net 1989.

bases, that is those with no interest deductions and probably not many with high income.

For the different income variables, that is when estimates are ranked by income definition or column-wise, we find that the effect gradually becomes smaller the more we diverge from taxable income, that is as we go

### *Table 5. Income elasticities 1992-1989, different income variables and selections of individuals. Log variables, extended model ($\gamma \neq 0$, $\kappa \neq 0$.)*

| | | Estimates, different income variables[7] | | | | | |
|---|---|---|---|---|---|---|---|
| **Model** | **N[8]** | **Wage+ salary** | **Earned income** | **Factor income** | **Taxable income** | **Taxable income[9]** | **Taxable income[10]** |
| A1 | 2094 | 0.146 | 0.240* | 0.393* | 0.411* | 0.095* | 0.506* |
| A3 | 1705 | 0.145 | 0.181* | 0.314* | 0.287* | 0.107* | 0.305* |
| A4 | 3206 | 0.231* | 0.359* | 0.439* | 0.364* | 0.140* | 0.020 |
| A5 | 3648 | 0.280* | 0.403* | 0.479* | 0.430* | 0.185* | 0.088 |
| A7 | 2876 | 0.171* | 0.222* | 0.374* | 0.219* | 0.174* | -.272* |
| B1 | 1327 | -.014 | 0.140 | 0.208* | 0.211* | 0.108* | 0.235* |
| C1 | 1400 | 0.162 | 0.254* | 0.415* | 0.418* | -.039 | 0.531* |
| C2 | 2407 | 0.268* | 0.347* | 0.399* | 0.384* | 0.098* | 0.406* |
| D1 | 2105 | 0.207* | 0.332* | 0.318* | 0.361* | 0.114* | 0.550* |
| D2 | 3607 | 0.143* | 0.225* | 0.278* | 0.275* | 0.167* | 0.383* |
| D11 | 166 | 0.400 | 0.251 | 0.295 | 0.025 | 0.025 | 0.107 |
| D12 | 595 | 0.397 | 0.401 | 0.603* | -.013 | -.013 | 0.036 |
| E1 | 2105 | 0.138 | 0.302* | 0.316* | 0.354* | 0.111* | 0.506* |
| F1 | 2105 | 0.116 | 0.288* | 0.308* | 0.324* | 0.105* | 0.492* |
| F2 | 3607 | 0.093* | 0.230* | 0.336* | 0.225* | 0.096* | 0.337* |
| G1 | 1405 | 0.137 | 0.312* | 0.323* | 0.344* | 0.007 | 0.512* |
| G2 | 2390 | 0.095 | 0.196* | 0.304* | 0.241* | 0.065* | 0.336* |
| H1 | 2070 | 0.149* | 0.212* | 0.346* | 0.413* | 0.092* | 0.498* |
| H2 | 3167 | 0.087 | 0.190* | 0.319* | 0.237* | 0.130* | 0.269* |
| H12 | 3167 | 0.085 | 0.186* | 0.301* | 0.221* | 0.134* | 0.249* |
| I1 | 1958 | 0.115 | 0.229* | 0.336* | 0.403* | 0.094* | 0.497* |
| I2 | 2979 | 0.063 | 0.142* | 0.278* | 0.235* | 0.135* | 0.258* |

* significant on a 5 percent level

[7] Variables are denoted as follows. Wage+salary for the HINK-variables *illont* 1989 and *tlon* 1992, earned income for *isarb* 1989, *carb* 1992, factor income for *isfakt* 1989 and *cfakt* 1992, taxable income for *ssbeskb* or *sundtb* 1989 and *cbefvi* 1992, combined earned income and income from capital for *issam* (1989) *ctxfvi+kkap* (1992)

[8] For the estimates in the highlighted column.

[9] Deductions for interest payments allowed 1989.

[10] Capital income included, all 1992, net 1989.

to the left from the main column. Thus the effect is smaller for factor income than for taxable income, still smaller for earned income and smallest for the most narrow income concept; wages and salaries[11]. For the two rightmost columns, where income from capital is treated differently for the two years, we find that the estimates are lower when net capital income is largely deducted 1989 but not 1992 (the second last column) and higher when positive capital income is included 1992 but only net capital income 1989 (the last column).

It is interesting to see how the large differences between these columns in the first section are considerably reduced in the second section, an illustration of how the additional variables help against yearly measurement differences similar to mean reversion problems; capital income is accounted for to different extents for the two years.

The estimates for the parameters $\gamma$ and $\kappa$ of the additional variables used for *Table 5*, as well as the effects of different combinations of these variables are shown in *Table 6*. We find that the important variable for the change in the elasticity estimate is pre-reform income. When this variable is included a significant and positive elasticity estimate is obtained. The coefficient for pre-reform income is negative, but the estimate is imprecise

***Table 6. Parameter estimates and standard errors 1992-1989 for different versions of A1 tables 4 and 5, with and without income effect or pre-reform income.***

| | **Base ($\gamma=\kappa=0$)** | | **($\gamma\neq0$, $\kappa=0$)** | | **($\gamma=0$, $\kappa\neq0$)** | | **($\gamma\neq0$, $\kappa\neq0$)** | |
|---|---|---|---|---|---|---|---|---|
| **Variable** | **est.** | **s.e.** | **est.** | **s.e.** | **est.** | **s.e.** | **est.** | **s.e.** |
| | | | | | | | | |
| Constant | -.121 | | -.121 | | 2.91 | | 2.601 | |
| | | (.044) | | (.044) | | (.413) | | (.320) |
| ΔNTR | .024 | | .022 | | .534 | | .412 | |
| | | (.083) | | (.085) | | (.108) | | (.086) |
| Inc.-eff. | | | .008 | | | | .272 | |
| | | | | (.086) | | | | (.059) |
| Preref. inc | | | | | -.271 | | -.245 | |
| | | | | | | (.036) | | (.028) |
| n | 2 094 | | 2 094 | | 2 094 | | 2 094 | |
| rmse | 6.09 | | 6.04 | | 6.76 | | 5.11 | |

[11] It should be noted though that the number of individuals not necessarily is constant across columns. Individuals with non-positive income net of tax according to the actual definition are excluded, this applies also for the instruments. Thus, there is a smaller variation of individuals column-wise. A limitation to those with positive income according to all income definitions resulted in minor changes only.

according to collinearity diagnostics. The income effect is positive for the full model in the last columns. The standard error or 0.086 for elasticity estimate in the complete model probably understates precision a bit. This income effect implies a difference between the uncompensated and the compensated elasticity, a difference not found by Gruber and Saez (2002).

Let us summarise results for the 1989 to 1992 estimation. A more standard difference in difference estimation gives somewhat different results mainly depending on whether those in the lower income brackets are included or not. Generally, it seems difficult to establish a positive elasticity. For the extended model, on the other hand, a consistent picture is obtained with a (smaller) elasticity in the interval 0.2 to 0.4 for taxable income. For the other income variables as consistently defined over time as possible, effects are smaller.

# 8. Discussion

Utilising the large tax reform 1990 to 1991, we obtain a central elasticity estimate between 0.2 and 0.4, for prime-aged men. This result is for the extended model with income for the pre-reform year included as an explanatory variable.

For a simpler more standard specification without pre-reform income, effects are difficult to establish: estimates are either non-significant or negative. Negative effects are found when those in the lowest income group are included in the estimation.

The use of income for the pre-reform year as a covariate has alternatively been suggested for treating mean reversion bias, that is, the effects of some individuals by extra ordinary circumstances, unrelated to the reform, obtaining a high income for one year. Generally estimates are increased after such inclusion (Moffit & Wilhelm 1998, Aarbu & Thoresen 2001) but the extent to which bias actually is removed and other estimation problems not introduced is unclear. There is scarce evidence that such inclusion is the general remedy for mean reversion problems. Simple simulation experiments cast doubts on the effects.

Our estimates and those of Aarbu and Thoresen (2001) for Norway are smaller than what has been found in most American studies. This difference is in line with the idea that more egalitarian societies will have lower taxable income elasticities (Slemrod and Kopczuk 2002). Likewise

our compensated elasticity is lower than the uncompensated elasticity, due to the positive income effect (table 6). This is in contrast to the similarity between these two elasticities found by Gruber and Saez (2002). The income dispersions in Sweden and Norway are among the lowest for the industrial countries and in contrast to the U.S., with Canada in between (Förster 2000). Elasticity estimates obtained from Canada are not in between, they are also low, however. Sillamaa and Veall (2001) comment on the difference only by paraphrasing Slemrod (1998), that different tax systems may have different elasticities. Sillamaa and Veall, with an impresssive sample size, get larger elasticities for high-income individuals. An increased responsiveness accompanying larger income is also observed by Gruber and Saez (2002), among others, and a similar tendency is found here.

A trend in inequality may affect results. From the beginning of the eighties there has been a gradual increase in income inequality in Sweden.[12] Accounting for the underlying trend in the income distribution would probably shift our estimates somewhat downwards, due to a difference in income change not driven by the reform.

Adjustments for tax-base changes were not made in our estimations; observed income was used for both years. Consequently, estimated elasticities depend on a mixture of changes in rates and in tax bases. Adjustments of the tax base for either year are somewhat speculative since information is incomplete in the database regarding the affected items.

Earlier multiplier-based adjustments for tax-base changes indicate a larger effect in the top of the income distribution, but small differences for broader income groups.[13] After adjustments, the 90$^{th}$ percentile was 5.6 percent higher than before, while the median was 2.5 percent larger and the 10$^{th}$ percentile 1.5 percent larger than originally as regards earned income for the pre-reform year, 1989. Average income is increased by about 4 percent for men in main socio-economic classes. The new broader tax base result in a somewhat higher Gini-coefficient, the estimate is 0.185 instead of 0.178 for 1989.

An idea of the results for the broader tax base both years is obtained using the tabular estimation in section 3. Let us consider the ratio of differences $e_{III}$. A change in tax base affects average income changes, the numerator, but not average net of tax rate changes, the denominator. Suppose we are comparing a high-income group with a middle-income group. In *Table 2*, the high-income group includes about 22 percent of the

[12] Income distribution survey different years, Statistics Sweden.
[13] Statistics Sweden, income distribution survey 1996.

individuals and using the 90$^{th}$ percentile as an indicator of income change due to the base broadening 1988, average income increases by about 5 percent. For the middle group the change in median by 2.5 percent is taken to indicate average income change. Straightforward algebra then shows basically, a negative factor, which decreases the numerator and thus the effects. The group difference (high-income group – middle income group) in relative income increase is reduced by roughly 0.023.

Changes in income are affected by the business cycle. As pointed out in the introduction, Sweden experienced a recession in the beginning of the nineties, following a period with very low unemployment rates for all workers. For the difference-in-differences approach, this is critical to the extent that different income groups are affected differently, but not necessarily otherwise. Labour market data shows that unemployment did not hit those with university education as much as those with less education. (Labour force surveys, Statistics Sweden).

In our tables, indications of the effects of these differences are obtained comparing estimates for different restrictions on the number of yearly working hours. Thus in *Table 4*, rows A3 and A7 show results for those with more than 2 000 working hours both 1989 and 1992. For the extended model in section 2, estimates decrease with these restrictions. For the main taxable income variables there is a decrease from about 0.4 for all those with more than 200 hours to 0.2 – 0.3 for those with more than 2 000 hours (row A3 compared to A1, A7 compared to A5). Effects for the baseline model are more mixed ranging from almost no effect (A3 compared to A1) to a smaller negative effect (A7 compared to A5)

Summing up: the complications here point in the negative direction and the already modest effect of 0.2 to 0.4 therefore seems an upper bound for the elasticity. Similarly to studies for other countries, we have found that results are sensitive to the choice of income concept and the choice of individuals to include along the income scale. The highest effects are obtained for taxable income as used for taxation and likewise when individuals in the higher income classes only are considered. Negative effects appear when those in the lowest income class are included.

For the period examined here a large reform and a slump in the labour market coincided. It is not obvious that the effects for smaller reforms are similar to those for larger reforms, and it is probably more difficult to control for disturbing factors during rapidly changing macro-economic conditions than otherwise. The feasibility of the results is best examined by analysis of other reforms or tax differences.

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