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Labour Supply and Income Tax Changes: A Simulation Study for Finland

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The views expressed are those of the author and do not necessarily correspond to the views of the Bank of Finland

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Abstract

It is well known that estimation of the labour supply function is complicated by the non-linearity of the individual's budget constraint. Non-linearity may be caused by a number of factors such as the structure of the tax/benefit scheme or overtime rates. Non-linearities also cause problems in interpreting the policy implications of the estimates. In this study we use a well-structured econometric labour supply model that mimics actual budget constraints as closely as possible to analyse the labour-supply effects of different income tax regimes and systems. In addition to the empirically-specified labour supply model, we construct, for the first time in Finland, a behavioural microsimulation model. Our intent is to contribute to the tax debate in Finland by simulating several suggested changes in the tax system. Our simulation results show that none of the proposed reforms are self-financing. Revenue-neutral move to a proportional tax system does not have major effects on labour supply. The most pronounced behavioural effects are achieved when marginal tax rates are reduced at the lower end of the income tax schedule.

Keywords: microsimulation, labour supply, taxation

Tuloverotuksen muutosten vaikutus työn tarjontaan Suomessa: tuloksia mikrosimulointilähestymistavasta

Suomen Pankin keskustelualoitteita 5/2000

Mika Kuismanen
Tutkimusosasto

Tiivistelmä

Työn tarjontafunktion estimoiminen ei ole yksinkertaista, mikä johtuu yksilöiden budjettirajoitteiden epälineaarisuudesta. Budjettirajoitteen epälineaarisuudet puolestaan johtuvat verojärjestelmän luonteesta. Tämän tutkimuksen taustalla on ekonometrinen malli, joka ottaa yksilöiden erilaiset budjettirajoitteet huomioon tutkittaessa erilaisten verojärjestelmien ja veroasteiden vaikutusta työn tarjontaan. Työssä hyödynnetään mikrosimulointimenetelmää, jossa otetaan yksilöiden käyttäytymisreaktiot huomioon arvioitaessa esimerkiksi veronkevennysten vaikutuksia. Tutkimuksessa arvioidaan erilaisten verojärjestelmien tehokkuutta ja tulonjakovaikutuksia. Tulokset osoittavat, että veronalennukset eivät ole täysin itseään rahoittavia ja että erityisesti siirtyminen saman verokertymän tuottavaan proportionaaliseen tuloverotukseen ei lisää työn tarjontaa merkittävästi. Suurimmat työn tarjontavaikutukset saadaan sillä, että verotaulukon alimpia marginaaliveroasteita alennetaan.

Asiasanat: mikrosimulointi, työn tarjonta, verotus

Contents

1 Introduction

The purpose of this paper is to contribute to the ongoing income tax debate in Finland using the behavioural microsimulation approach. As far as we know, there are no other studies which have used the behavioural microsimulation approach to analyse various tax proposals. Previous calculations have been mainly done using the so called TUJA-model, which is a model used and developed in the Government Institute for Economic Research. Our aim is to go through some of the most frequently proposed income tax reforms and discuss their implications from various points of view.

As the current tax debate in Finland shows, income tax and benefit systems create more debate than many other economic subjects due to many different reasons. Viewpoints are often politically or philosophically oriented and may relate to things like the equity-efficiency dilemma. Other sources of debate can be more practical ones, like taxation's incentive problems a la poverty traps etc. Partly due to the above mentioned factors a significant amount of research also in many other fields than economics has been devoted to tax issues. Particularly, in the case of income taxation research has mainly concentrated on the determinants of individual (or family) labour supply decisions. Majority of these studies, and rightly so, have concentrated on the difficult topic of how to estimate the labour supply function, either taking into account real life complications or not. Most of the studies report summary elasticities, but as it is well known, this information is not enough to answer interesting questions concerning the different tax reform proposals.

However, to answer these interesting questions is not a straightforward task to do. As mentioned above, summary elasticities do not contain the information needed to study the behavioural consequences of different tax reforms. This is due to the fact that the tax and benefit systems almost without an exception give rise to non–convex budget constraints, so that marginal tax rates differ across individuals. The other aspect is that the income distribution before and after the reforms are not similar. As Hausman[8] has written, in circumstances mentioned above a change in either the gross wage rate or some parameter of the tax system may cause individual to shift from one segment of the budget constraint to another and these movements cannot be captured without detailed knowledge of the labour supply curve for each individual in the sample to be used for tax reform analysis.

So, when tax laws and different kinds of rules of transfer programs introduce censoring and truncation and when sub-populations differ in behaviour, then models and calculations of average behaviour become inadequate to evaluate the impact of policy changes. At this point one usually turns to microsimulation. Microsimulation may be viewed as an attempt to model and simulate the whole distribution of policy target variables, not only their mean values. For example, in many cases we are interested to analyse the impact of an in-

come tax change on the whole distribution, who gains and who loses. One of the main advantages of microsimulation is that it allows us to deal with heterogeneous behaviour; all individuals (or firms) do not behave as the average economic agent.

The data in our simulations is the same which has been the basis of our empirical work, see Kuismanen[12]. In this paper we do not concentrate on statistical matters and thus many important and technically demanding subjects, like integrability conditions and functional form issues, will not be dealt in this paper. Interested reader should consult Blundell and Meghir[5] and Blundell et al.[3].

The paper proceeds as follows. In section 2 we want to outline the reasons why this simulation exercise is worthwhile to do. In this section we also describe our data source and go through some theoretical remarks on labour supply which are essential for the rest of the paper and for the general discussion. We have devoted a reasonably large space for justifying why microsimulation is a good tool to use in tax reform calculations. This is because the lack of this kind of behavioural analysis and majority of the calculations presented have been based on examples dealing with the representative individual or family. We also say some words concerning the simulation procedure.

Section 4 presents the results. First we will go through some basic calculations between different tax systems, like proportional taxation versus progressive taxation, Lump–sum taxation versus progressive taxation etc. After that we'll do some purely hypothetical calculations to get some touch how labour supply reacts in our simulation framework. The next subsection is devoted to the reforms which try to mimic those reforms presented in public debate as closely as possible. Basically we simulate three different types of reforms. The first one is a simple one percentage point reduction in the marginal tax rates in all tax brackets. The second one studies the effects if we reduce the marginal tax rates at the lower end of tax schedule and in the final simulation we reduce the top marginal tax rates.

Our results suggest that if we would change our tax system to a proportional income taxation in a revenue neutral way, then the marginal tax rate would be 28 per cent. It has to be kept in mind that this is a sample dependent result. Changing to proportional tax system does not have major effect on labour supply. The current progressive tax system creates deadweight loss and its magnitude is estimated to be approximately 15 per cent of the tax revenue. An interesting finding is that tax reductions and tax increases do not have a symmetrical labour supply responses. Also, behavioural effects are biggest in the case of a progressive income tax system. Reducing the marginal tax rates from the tax schedule's lower end has biggest labour supply effects and none of the reforms suggested are self–financing.

2 Motivation of the simulations

It is natural to ask why are we doing this simulation exercise and can we somehow contribute valuable information for the current tax debate in Finland? First, answer to the latter part of the question is yes, we do believe that our study will provide some fruitful ingredients to the general discussion and hopefully it will also generate more discussion concerning disincentive effects of income taxation. Our answer to the first part of the question presented above is a longer one and in below we will try to provide answer for it.

In the late 80's and early 90's a fashionable topic in economics and in general economical debate was the disincentive effects of the income tax systems. After the tax reforms in the US (in early and mid 80's) the debate arrived to continental Europe and to UK. Many countries like UK, Germany, France etc. followed the US example and simplified their tax systems and reduced their (top) marginal tax rates. In Appendix 3 we utilise the figures calculated by Maki and Viren[13] and present taxable incomes and marginal tax rates in 19 countries in 1995. Taxable incomes are converted to Finnish currency which makes the comparisons easy. Already from these figures we see that income tax systems vary considerably. For example, in Ireland and Sweden there are only two marginal tax rates and in Spain there are 17 marginal tax rates, in some countries income tax is paid from all income and in some countries there exist a tax threshold etc. If we would have compared the situation 25 years ago, then differences would have been even larger.

Taking into account that Finland is a typical Nordic welfare state where the size of the public sector is relatively large and the tax burden is high(see appendix 2), it is a surprise that this tax discussion was mild one here at the late 80's. One reason for this was the long lasting boom in Finnish economy and loosely stated it was felt those days that we do not have a need for any major tax reforms. In the late 80's only minor changes to the tax schedules and tax rules were done regarding taxes on labour income. At the very beginning of the 90's Finnish economical situation started to deteriorate rapidly and the recession to come was an unseeingly severe. Unemployment rate rose from app.4 per cent (1989) to 19 per cent (1993) and at that time many Finnish economists argued that the only thing which will lower the unemployment rate is a rapid growth of the economy and especially the export sector will be a key player in improving employment. At that time tax and benefit systems were seen as a secondary topics. The annual growth of Finnish economy has indeed been a very rapid since 1994; approximately 4,5 per cent per year. But, despite of that, the decline of unemployment has been more subdued than expected and at the moment the real unemployment rate is still approximately 14 per cent.[1]

[1]The official unemployment rate (from Labour Force Survey) is approximately 9.5 per cent. Official definition of unemployment (definition changed to correspond EU-definition) do not take into account persons who are participants in public sectors programs etc. Also ministry of labour's statistics shows higher unemployment rates than the official one.

Naturally this has started a hectic debate why unemployment rate still stays at that high level. The reasons suggested are familiar ones: unions, inflexible labour markets and especially the income tax system.

During the last year or so the role of income taxation and social security payments (either paid by employer or employee) have been the hot topic and sometimes it seems that these factors are the only ones which matters. Practically all discussants agree that the tax burden is too high, but at that point the consensus usually ends. It is not a surprise that according to the political status reform suggestions differ from each others; some have stressed that marginal tax rates should be cut mainly from the low income earners and others have stated they should be cut equally throughout the tax schedule. Some have even stated that we should abandon the progressive nature of the income taxation and move to the proportional tax system. Others have suggested that we should reduce the number of tax brackets to simplify income tax schedule etc.

A common denominator to all of these suggestions is that no calculations of the behavioural effects on labour supply and tax revenues have been presented by the proposal makers. Our aim is to try to provide such information concerning the implications of suggested reforms using the behavioural microsimulation model. We will go through the main proposals made in public debate and discuss practical implications of the reforms.

2.1 Data source and some theoretical remarks

In seeking data on actual families to analyse tax and benefit changes, the most appropriate source, at least in the Finnish case, is the Labour Force Survey data (LFS). It covers a great deal of information concerning the labour market activity. We are also able to merge register based income information from the tax authorities' data base for all the individuals in the LFS.[2] For more detailed information see Kuismanen[12].

In our analyses we use sample of a married women of age 25-60 drawn from the LFS for the year 1989. Kuismanen [12] describes more detail the data and its properties. The final sample size is 2037 individuals and it is exactly the same one used in our econometrical work.

But, what are then the theoretical justifications for lowering marginal tax rates? The answer is that if individuals will face a lower tax rate on **additional** income they will be willing to work more, *ceteris paribus*. Shortly stated, this is the incentive (or substitution) effect of a tax change. But, this is not the only effect because also the net incomes received by the individuals

[2]So, we avoid the problem that individuals do not fully report their incomes in surveys.

will rise. If leisure time is a normal good then higher net incomes may decrease the willingness to work more and this is called income effect. Thus, any change in tax or benefit system will create a complicated set of income and substitution effects and as Blundell and Walker[6] have stated, it is sometimes hard to distinguish whether people are referring to the total effect(income and substitution effects) of tax changes or to the substitution effect alone.

If one is referring to economic efficiency of the tax system then only the substitution effect is a relevant factor. That is because the *marginal* tax rate distorts the individuals economic decisions by creating a wedge between the wage rate an employer is willing to pay for an extra hour of work and the net wage rate the employee receives. Thus, the higher the marginal tax rate the bigger is the wedge. A positive marginal tax rate may make exchanges(hours of work for an hour's worth of pay) between agents unattractive while in the absence of the tax wedge they would be mutually beneficial. From the above we can conclude that lower marginal tax rates are to be preferred to higher ones.

However, efficiency is not the only dimension of taxation. The other important dimension is the equity. For equity we mean the objective of re–distributing incomes (from poor to rich). The tax system is re–distributive if the average tax rate faced by the rich is higher than the average rate on the poor.[3] So, re–distribution from rich to poor inevitable implies work disincentive effects because of the high marginal tax rates. This is the so called *equity–efficiency trade–off*. Ongoing Finnish tax debate indicates that the efficiency costs from an equitable tax system are regarded high and both the marginal and the average tax rates should be lowered to reduce efficiency costs.

In some statements it has been argued that tax rates in Finland are at so high level that tax increases do not yield more tax revenues or in other words, tax reductions yield revenue increases. This is the so–called Laffer–curve effect. The flatter is the compensated labour supply curve(the higher is the compensated labour supply elasticity) the more concave is the government's budget constraint ($\approx$ Laffer-curve). The government's problem is to choose a point from that constraint. So, government which put no weight on the degree of inequality will choose a solution where tax rate is zero. Thus, the most **efficient** tax system is no tax system at all. The other extreme is that if government cares only about equality it should raise as much money as possible since this benefits most the poor who have so low incomes that the required high marginal tax rates do not have any effect on them, see Tuomala[15]. Because the labour supply elasticity determines the concavity of the government budget constraint, it follows that the higher is the labour supply elasticity the lower will be the optimal marginal tax rate. Despite our aim is not to study optimal taxation in this paper the above reasoning is good to keep in mind when studying different tax and benefit systems.

[3]In other words, average tax rate should be an increasing function of income and that the marginal tax rate must be higher than the average rate.

2.2 Rationale for microsimulation

Despite the fact that, for example, budget proposals or tax reforms have allocational and distributional consequences, it is still a common practise that these effects are almost always ignored, at least in Finland, in policy discussion. Typically, only some macroeconomic measures are presented and these figures usually represent the first-round cash impacts and thus ignore any responses individuals may make. Actually, this is a bit illogical because the real purpose of many policy reforms is to create incentives for individuals to change their behaviour, so in that respect it seems odd if we do not try to include behavioural aspects into our analysis. Obviously, we do not claim that there always are such big behavioural effects.

It seems to be the case that if those who have suggested tax reforms have some calculations to support their views these are usually based on hypothetical individual/family examples. This is not necessarily the best way to proceed in this context because we know that the diversity of individual circumstances is a very import aspect in this kind of exercises. More preferably, the analysis should be based on the actual circumstances of a representative sample of individuals. Too often discussion concerning important policy issues is limited to simple calculations on a hypothetical individual who has average earnings, one or two children, married, lives in her own flat and has X amount mortgages etc. It has been shown that such calculations can be highly misleading, see e.g. Atkinson [1].

2.2.1 Two examples

In this subsection we shortly go through, using standard microeconomic tools, why the knowledge of labour supply function or the location of hypothetical individual is insufficient to analyse the outcomes from various tax reforms. Consider an individual who has exogenous income y and gross wage w. In a very simplified world without taxation her desired hours of work h^* are determined by the labour supply function

$$h^* = h(w, y). \tag{1}$$

This labour supply function is derived from her utility function and budget constraint. Now, income tax is introduced to the economy (to finance for example public healt care system) and individuals have to pay it at the rate t on all income above the tax threshold A. This reform means that individuals will face non-linear budget constraints. Let us assume that the tax she is paying is a positive amount, then we can write her labour supply function to be as

$$h^* = h[(1-t)w, y + tA]. \tag{2}$$

Note that we have written above equation in a way that individual pays tax on all her income and is reimbursed with a lump sum amount tA for the tax she was not obliged to pay on the first A units of income. The effect of changing the tax rate on the individual's desired working hours is[4]

$$\frac{\partial h^*}{\partial t} = -h_1 w + h_2 A. \tag{3}$$

Now, we can substitute the Slutsky-Hicks equation($h_1 = h_1^c + h_2 h$) into equation 3, so it can be written as

$$\frac{\partial h^*}{\partial t} = -\left[h_1^c w + h_2(wh - A)\right] \tag{4}$$

where h^c is the compensated labour supply function. After some rearranging above equation can be written in the following form

$$\frac{\partial h^*}{\partial t} = -w\left[h_1^c + h_2\left(h - \frac{A}{w}\right)\right] \tag{5}$$

From the above equation we can see that the effect of the tax on labour supply cannot be predicted from the knowledge of income and substitution effects alone but it depends on how close the individual's hours are to those that she would have to work to reach the tax threshold.[5] Specifically, for individuals near to the tax threshold the effect of raising the tax rate will be almost purely a substitution effect and there will be a reduction in the hours of work even if the income elasticity is negative. Because in our example individuals not paying taxes will be unaffected by the increase in the tax rate we see that the aggregate effect of the tax change will thus depend on the distribution of individuals around the tax threshold(and on the shape of the labour supply function).

Another example which illustrates the importance of knowing the shape of budget constraints and individuals' distribution on it can also been shown using the above framework. Consider the labour supply responses when the exemption level (A) is changed. For taxpayers the effect of this is given by

[4] h_1 is the first partial derivative of h etc.

[5] Note that the argument we are using in this simple example with only one kink point is also valid for more general and realistic cases with many kink points.

$$\frac{\partial h^*}{\partial A} = t * h_2 \tag{6}$$

and assuming that leisure time is a normal good, then hours will decline. For those individuals who previously worked less than A/w, there will be no effect on their supplied hours. But, for those individuals who chose to work right up to the tax threshold, but do not pay taxes, hours of work are given by

$$h^* = \frac{A}{w} \tag{7}$$

and thus for small changes in A we got

$$\frac{\partial h^*}{\partial A} = \frac{1}{w} \tag{8}$$

We can now express equation 6 in percentage terms

$$\frac{A}{h^*}\frac{\partial h^*}{\partial A} = \left[\frac{tA}{y + tA}\right]^{\epsilon} \tag{9}$$

where ϵ is the income elasticity of labour supply. Equation 8 becomes

$$\frac{A}{h^*}\frac{\partial h^*}{\partial A} = 1 \tag{10}$$

Because the income elasticity of labour supply is usually small in absolute magnitude, then if y is close to zero we see that the overall effect in equation 9 is likely to be small(in percentage terms), while the effect in equation 10 is large. Thus, a substantially small proportion of individuals located around the tax threshold(kink point) is needed for the positive effect(eq.10) to offset the negative effect in(eq.9) on aggregate. Whichever dominates, the overall effect of the change in tax allowance will depend on the distribution of individuals around the tax threshold.

2.3 Simulation procedure

When calculating optimal labour supply by a tax simulation, we need a behavioural model of labour supply (minimum requirement is the knowledge of the marginal wage rate and the exogenous income terms). Using our familiar notation this model can be written using the standard notation as in equation

1. Before going to actual simulations we need to estimate the above function econometrically. In this study we use the behavioural model (see appendix 1.) estimated by Kuismanen[12]. Estimating the labour supply function in the presence of non-linear taxation is a topic of its own and in this paper we are not going go into that discussion. An excellent overview concerning the estimation of labour supply functions is provided by Blundell and McCurdy[2].

However, we should mention that it would be practical if the estimated labour supply function used in simulations satisfies some requirements, see also Stern[14]. First, the functional form should be parsimonious but at the same time also flexible. It would also be practical, if we could find an explicit algebraic form for the indirect utility function; this allows a straightforward comparisons of utility levels (if needed). Finally, preference parameters should be theory-consistent for most of the data points.

The general purpose of the simulation procedure is to solve a series of constrained optimisation problems. Each individual in the sample faces a budget constraint which is non-linear because of the income tax(benefit) system. It is possible that budget constraint includes a range of kinks and discontinuities, but in our case it will be a basic piecewise linear constraint for all individuals.

In this case the budget constraint can be separated into a series of linear segments, each of which can be described by the following form

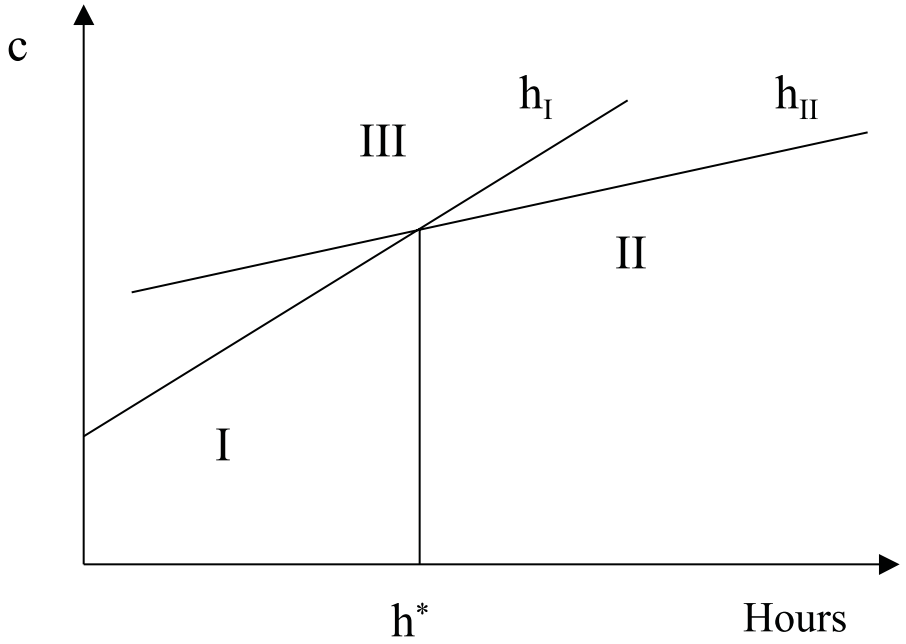
$$I = [1 - t(h)wh] + y(h) \tag{11}$$

where I represents net income and $t(h)$ and $y(h)$ represent functions for the marginal tax rate and virtual income respectively. Now, when we know the gross wage rate, the values of functions $t(h)$ and $y(h)$ depend on working hours.[6]

In the actual simulation, the algorithm proceeds by identifying the locally optimal choice (hours) from the desired one for all linear segments of the budget constraint. In the case when the optimal solution is calculated to be within the range of hours over which the linear segment is defined, it is said to be feasible. After all feasible local optimums have been calculated, the global optimum is established by calculating which of the feasible local optimums yield maximum utility. We can describe this procedure with the help of the figure 1 shown below.

[6]Observing the change in marginal tax rates and virtual income across adjacent budget segments it is possible to distinguish between convex and non-convex kink points and discontinuities.

Figure 1: A sketch of the simulation procedure



If the optimal solution h_1 for the lower budget segment, I, lies above the feasible range ($h_1 > h^*$) and the optimal solution h_2 for the upper budget segment, II, lies below the feasible range ($h_2 < h^*$), then the local optimum must be at the intersection of I and II. This is the case when feasible labour supply can be found at kink point, III.[7]

For non-participants in the sample, the budget constraint is modelled using a predicted gross wage rate from an estimated wage equation, see Kuismanen[12]. This allows us to generate a complete set of budget constraints under both the baseline tax system and reform system for all sample data points.[8]

3 Simulation results

Before going to the effects of income tax changes we will go through quickly the income tax system in year 1989, which will be our "baseline" solution and all

[7] If the indirect utility is only implicitly available then we can calculate the level of utility using the inverse demand function $w = w(h, y)$ to yield so called support wage. By duality, the substitution of the support wage into the indirect utility function at the optimal labour supply is sufficient to calculate the level of direct utility at the kink point. In more complicated situations(discontinuities, non-convexities) the algorithm compares all local optimums for the complete budget constraint and then returns the global optimum as the *maximum maximorum of utilities.*

[8] In the case of non-participants the gross wage that they would face if they work and the estimated stochastic error term of their preferences are both unknown. For participants these problems do not occur since the wage rate is observed and the stochastic term is taken to be the estimated residual.

the results shown below will be percentage changes from that baseline solution (except when stated otherwise).

The income tax system consists two parts: a progressive state income tax and a proportional local(municipal) income tax. In addition, individuals contribute to the National Pension Insurance(NP, 1.55 per cent from the taxable income) scheme and National Health Insurance(NH, 1.25 per cent from the taxable income) scheme, which are proportional to income changes. Roughly speaking, the tax liability in state tax and municipal(or local) tax is the same excluding the tax deduction system. A further distinctive feature in the Finnish tax system compared to some other European countries is that all individuals are separate tax units. Husband's marginal tax rate does not affect wife's marginal tax rate.

In 1989 the state income tax schedule was composed of six marginal tax rates varying from 11 to 44 per cent. The following table shows the tax schedule for the state tax in 1989.

Table 1. Income Tax Schedule.

State income tax schedule — 1989		
taxable income	*tax at lower bound*	*margin. tax rate*
36 000 – 51 000	50	11
51 000 – 63 000	1700	21
63 000 – 89 000	4220	26
89 000 – 140 000	10 980	32
140 000 – 250 000	27 300	37
250 000 –	68 000	44

In 1989 the municipality tax rate varied from 14 per cent to 19.5 percent. We have developed a formula to calculate state tax deduction for all persons in the sample, see Kuismanen[12]. Estimated tax deductions varied from 0 FIM to 29 500 FIM.

3.1 Some preliminary results

In this subsection we will study the "properties" of our simulation model. We use our estimated labour supply function to calculate the labour supply reactions and deadweight losses between different income tax systems. In all calculations we use the simulation results from 1989 progressive income schedule as our baseline and results are presented as percentage changes from that baseline. We want to stress that all reforms are made using the 1989 case as a baseline and absolute values are not very informative in today's respect but

the direction of changes is. It also has to be kept in mind that we do not argue that our behavioural model underlying the simulation results are definitely valid in today's world(or in the 1989 world either), but it still provides us together with the simulation framework the best available tools to analyse income tax reforms in Finland.

Our analysis is of partial equilibrium type and thus only the supply side effects can be derived. So, we are not able to answer any demand side questions like what will be the effect of lowering the social security and pension contributions paid by the employers. It also has to be remembered that our calculations are based on a representative sample of females. A fair amount of empirical research supports the view that female labour supply is more flexible than male labour supply and this also seems to be the case in Finland, see Kuismanen[11].

We start comparing the actual income tax system to the proportional tax system yielding the same tax revenue, to the lump–sum tax system with same the tax revenue and to the no–tax case. There are several ways to calculate deadweight losses but in this study we are not going to discuss them, it is a topic of its own. For a good presentation see for example Hausman[7]. We use the definition, $CV - T$, where CV stands for the compensated variation and T denotes the tax collected at individual's optimum position.[9]

In a standard case the deadweight loss increases as the marginal tax rate increases, so it is interesting to calculate the average deadweight loss for a sample of Finnish females between progressive income tax system and proportional income tax system. Results are shown in table 1 below.

[9] Compensating variation is the lump-sum income necessary to increase individual's utility to the level that would be obtained if there were no taxes. Another possibility to define deadweight loss is $CV - T_c$, where t_c is the tax that would be collected at the compensated optimum. Results did not differ significantly whichever method we used.

Table 2. Simulation results: Different income tax systems.

Baseline: Progressive income tax			
Tax system	*%- change in average hours of work(1)*	*Participation rate*	*Deadweight loss(2)*
Prog.tax(baseline)	-	0.72	14.8%
No tax	13.3%	0.76	-
Lump-sum tax	17.0%	0.77	0
Prop. tax (0.28)	2.5%	0.72	4.8%

Note: *(1) Percentage changes in average hours of work relative to baseline simulation (progressive tax system)*
(2) Deadweight loss is calculated as percentage of tax revenue

As can be seen from the table the progressive income tax decreases hours of work by approximately 13 per cent compared to the no tax case and the deadweight loss of the progressive income tax is 15 per cent of tax revenue. Naturally the NO TAX case does not create any deadweight loss. Our calculations show that the proportional tax rate to collect the same tax revenue as in the baseline case would be 28 per cent in **our sample**.[10] If the proportional tax had been used then the deadweight loss would be approximately 5 per cent according to our calculations and labour supply would have been 2.5 per cent higher than in the actual progressive case. Calculations imply that that moving to proportional tax system does not increase labour force participation (only 4 cases) and the labour supply effects comes mainly from the upper end of the income distribution. Losers and winners can be easily identified. Winners are the high income earners and relatively the better is the situation after changing to proportional system the higher are the incomes. By symmetry, the biggest losers are the very low income earners.

In practise, a lump–sum tax is not that interesting for the real life purposes but it provides us a benchmark case of a tax system which creates zero deadweight loss. As known, lump–sum tax has only an income effect and if leisure time is a normal good, as according to our results it is, then labour supply should be higher than in no tax case, which is also confirmed by our results. It is interesting to note that labour force participation increases by 5 percentage points and the percentage change in average hours of work is 17 per cent. The individuals entering labour force are willing to work relatively few hours per year (all would like to work less than 350 hours) and thus only some 2.5 per

[10] According to calculations of the Taxpayers Association of Finland, the average worker paid 27 per cent marginal tax rate in year 1996 for the extra income.

cent of the increased hours is explained by these new entrants and the rest is explained by those already working but also they are willing to increase their hours of work.

Related to the Finnish tax debate it is interesting to calculate out how labour supply reacts when we change marginal tax rates by the same percentage points throughout the tax schedule. From the baseline case we decrease and increase the marginal tax rate by 2,4 and 6 percentage points in turn. For example, in the case of 2 percentage point reduction in the marginal tax rate, we have modified the tax schedule in the following way (table 3).

Table 3. Example for the reformed Tax Schedule.

Baseline and reformed tax schedule

taxable income	*tax at lower bound–baseline*	*margin. tax rate–baseline*	*Tax at lower bound–reformed*	*Margin. tax rate–reformed*
36 000 – 51 000	50	11	50	9
51 000 – 63 000	1700	21	1400	19
63 000 – 89 000	4220	26	3680	24
89 000 – 140 000	10 980	32	9920	30
140 000 – 250 000	27 300	37	25 220	35
250 000 –	68 000	44	63 720	42

In the reform shown above we have only changed the state income tax schedule and all other components were left unchanged. The rest five reforms were made following exactly the same procedure. Results from these calculations are shown in table 4.

Table 4. The effects of a change in the progressive income tax rate

Relative to Baseline						
Percentage change in	-6	-4	-2	2	4	6
Mean hour	7.5%	6.1%	4.0%	-1.0%	-3.1%	-5.0%
Mean tax revenue	-31.3%	-19.0%	-8.9%	7.8%	15.4%	22.7%

Then first and most important result is that the increases in hours are not big enough to compensate for the reduction in tax revenues. Even this result is expected it is still important, because as we mentioned in section 2 some discussants have assumed that such a tax reduction would increase tax revenues in Finland. Secondly, it is also interesting to note that reactions are not symmetrical. Percentage changes in mean hours and mean tax revenue relative to the baseline are bigger when decreasing the marginal tax rates. The main reason for this is that tax reductions lead more people to enter the labour market than tax increases lead people to step out.

Comparing the above results to the case where a proportional income tax system is used is quite interesting. Below, we use our proportional income tax system with 28 per cent tax rate as a benchmark. We simulate labour supply reactions after changing the tax rate to 22, 24, 26, 30, 32 and 34 per cent respectively. Note that these changes are not that small, for example a reduction in the marginal tax rate from 28 to 26 per cent represents a 7.2 per cent reduction in the tax rate. Similarly, increasing the marginal tax rate from 28 to 34 per cent represents a 21.5 per cent increase in the tax rate. Results are shown in the table below.

Table 5. The effect of a change in the proportional income tax rate

Baseline tax rate(0.28)						
Percentage change in	22%	24%	26%	30%	32%	34%
Mean hour	4.1%	1.8%	0.5%	-2.8%	-5.2%	-8.3%
Mean tax revenue	-27.2%	-17.0%	-7.6%	7.4%	13.4%	18.2%

Although results are not directly comparable with the previous exercise, simulations indicate that labour supply and tax revenue reactions are smaller

under the proportional tax system. This relates to our previous discussion about shape of the budget constraint and individuals distribution on it. In the case of non–linear budget sets small changes in marginal tax rates may lead to jumps from one budget segment to another. As in the basic calculations, labour force participation effects are very moderate.

3.2 Results from the tax reform proposals

3.2.1 One percentage point reduction in the state income tax schedule

The most frequently suggested reform is that marginal tax rates should be reduced by one percentage point throughout the tax schedule. The rationale behind this suggestion is its simplicity and its acceptability. It has also been suggested that this moderate reform will open the way for more "radical" reforms on the future.

Table 6. New tax schedule, -1%

Reformed tax schedule: (-1%)		
taxable income	*tax at lower bound*	*margin. tax rate*
36 000 – 51 000	50	10
51 000 – 63 000	1550	20
63 000 – 89 000	3950	25
89 000 – 140 000	10 450	31
140 000 – 250 000	26 260	36
250 000 –	65 860	43

When comparing the above tax schedule to the baseline case, we see that the difference between them is small, indeed. So are the differences between the results. Increase in the mean hours is only 1.8 per cent from the baseline and the reduction in mean tax revenue is approximately 5 per cent. Again, this reform has only a limited effect on labour force participation. All in all, if we only focus to labour supply effects, then reducing the marginal tax rates by one percentage point won't make any major difference compared to the baseline.

3.2.2 Reducing the marginal tax rate at the lower end of the tax schedule

It has been suggested in the Finnish discussion that the biggest effects to labour supply are achieved when marginal tax rates are cut from the bottom of the tax schedule. The intuition behind this is that individuals who do not earn that much are willing to increase their hours of work when their net wage increases. In other words, for them the substitution effect dominates more than for high income earners.[11] Also, if entering to the labour markets, then the new net wage might be higher than the reservation wage even if this was not the case before the reform.

Figure 2: Simplified example of the reform

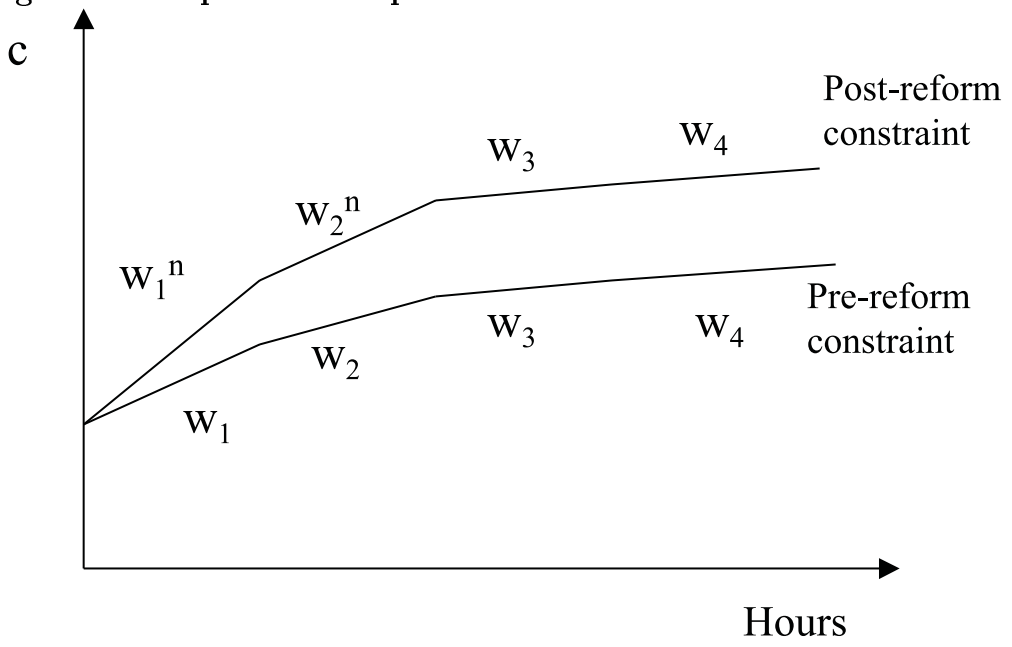


Figure 2 represents the simplified case of only four tax brackets, but our example can be generalised also to the more realistic situation except that graphs come easily quite messy. In figure two lowest marginal tax rates have been reduced and the new net wages are w_1^n and w_2^n instead of w_1 and w_2 respectively. Note that the two highest marginal tax rates w_3 and w_4 respectively are exacty same before and after the reform. But as can be seen from the figure, even we reduce the only the two lowest marginal tax rates, all individuals' net incomes will increase. In other words, reducing the marginal tax rates at the lower end of tax schedule does not only reduce the amount of taxes paid by low income earners as it has been many times wrongly stated in the public discussion. This can also be seen from the table 7 below which shows the actual implemented reform.

[11] Obviously, this is an empirical question and a common belief is that income effect starts to dominate after some point of labour income.

Table 7. Lower marginal tax rates reduced

Reformed tax schedule:		
taxable income	*tax at lower bound*	*margin. tax rate*
36 000 – 51 000	50	7
51 000 – 63 000	1100	17
63 000 – 89 000	3140	25
89 000 – 140 000	9640	32
140 000 – 250 000	25 960	37
250 000 –	66 660	44

In the above tax schedule we have reduced marginal tax rates in the three lowest segments. In the two lowest segments, the reduction is 4 percentage points and in the third segment it is one percentage points. From the column "tax at the lower bound" we see that compared to the baseline case these figures are lower throughout the tax schedule.

Results from this simulation are quite interesting. First, this reform seems to have a reasonably large effect on labour force participation, it increases by 4 percentage points. As above, individuals who would be willing to enter the labour markets are willing to work quite a few hours per year. Percentage change in mean hours relative to the baseline case is 8.8 per cent and the main response comes from individuals whose net incomes are in the lowest three deciles. It is also the case that their working hours are located at the lower end of the hours distribution.

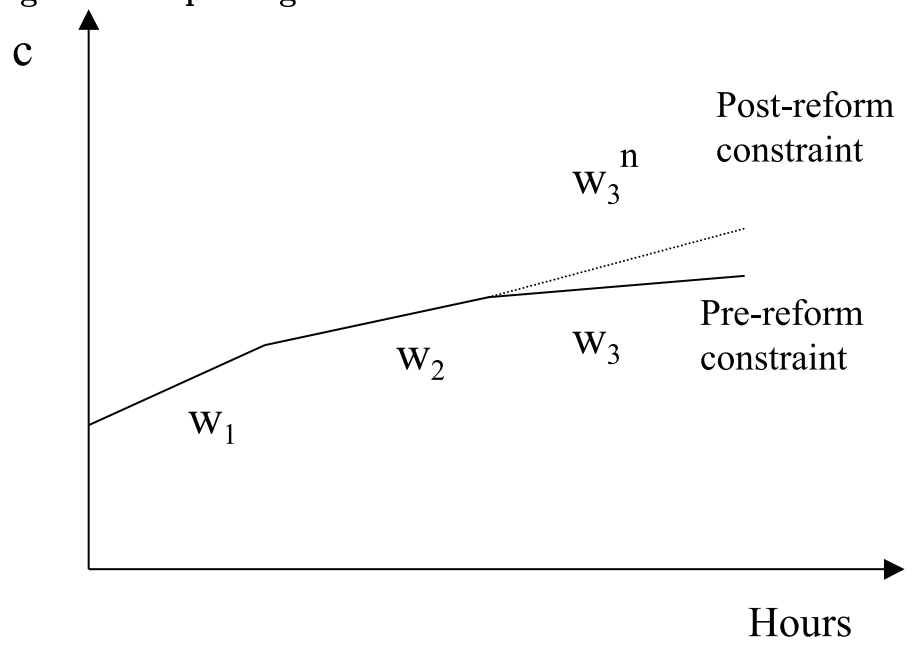
This reform had only a small impact on labour supply of the individuals whose incomes were above the median. Although this reform seems to have some attractive features the percentage loss in mean tax revenue is still approximately 12 per cent.

3.2.3 Lowering the top marginal tax rates

In our third reform we want to study what are the labour supply effects when top marginal tax rate is reduced. In the baseline case the top marginal tax rate is 44 per cent and the second highest marginal tax rate is 37 per cent if the taxable income is over 140 000 FIM. Now, we have changed tax schedule in a way that the highest marginal tax is going to be 35 per cent for all individual whose taxable income exceeds 140 000 FIM.

The idea behind this reform can be clarified by looking the the simplified tax system presented in the figure 3 below.

Figure 3: Top marginal tax rate reduced



This reform does not, of course, have any effect on those individuals whose labour supply is on the first segment. Those individuals whose optimal hours were on the second segment and especially close to the kink point may increase their hours of work. Marginal tax rates at the two lowest segments are not affected by the reform.

This reform is related to the discussion that highest marginal tax rates are at a level that it prevents individuals to increase their hours of work and that the deadweight losses for the whole economy are simply too big. It has also been stated that exactly those high income earners are the driving force in our economy and we should create incentives for them to stay and work in Finland. This has become a more and more popular topic because of the current Information Technology boom which has created an unseen amount of new wealth to some individuals.

Table 8. Introducing top marginal tax rate–35%

Reformed state income tax schedule (top marg. rate 35%		
taxable income	*tax at lower bound*	*margin. tax rate*
36 000 – 51 000	50	11
51 000 – 63 000	1700	21
63 000 – 89 000	4220	26
89 000 – 140 000	10 980	32
140 000 – 250 000	27 300	35

In table 8 the reformed tax schedule consists of five tax brackets instead of six and the highest marginal tax rate is 9 percentage point lower than in the baseline case.

Our results from this simulation are the following ones. First, cutting the top marginal tax rates does not have any effect on labour force participation. Secondly, the percentage change in mean hours is 4.5 per cent and the biggest labour supply changes are found from the three highest income deciles. This reform improves high income earners' position relative to rest of the population, because their after reform net incomes inrease. An interesting aspect is that the loss in tax revenue is relatively large, approximately 13 per cent relative to the baseline. This is due to the fact that tax revenue losses are big in the three highest income deciles.

4 Discussion and conclusions

Before summarising and discussing our results it is worthwhile to comment some limitations in our analysis. First, it is a partial equilibrium analysis and only supply side effects can be taken into account. We have not been able to answer questions like what happens to labour demand if employers social security and pension contributions were reduced. Luckily, there is some Finnish evidence concerning this question. Holm, Honkapohja and Koskela[9] and Honkapohja, Koskela and Uusitalo[10] have calculated that reducing the above mentioned contributions will increase labour demand and this effect is strongest when it is done in low salary occupations like in the service sector. This result in a way matches with our analysis and thus it is likely that the biggest effects will be achieved if marginal tax rates and employers social security contributions of low income earners are reduced simultaneously.

Secondly, labour supply is a dynamic phenomenon but our analysis is based on the assumption of no intertemporal effects. We would need to estimate a dynamic labour supply function to get an estimate for the intertemporal elasticity of substitution before we could do dynamic simulations. This is a topic for further research. In empirical work it has been found that estimates of the intertemporal elasticities of substitution are usually quite small, see e.g. Blundell and Walker[4]. This does not mean that dynamic effects are necessary negligible because variations in preferences and changes in life situations may be important since reservation wages for women are sensitive to the demographic changes. So, it might be the case that intertemporal labour supply may not be as sensitive as labour supply in one period, but obviously this is an empirical question.

Thirdly, in our analysis tax unit is an individual and not a household. Unlike many other countries, we have an independent income taxation and so this

choice is legitimate. Of course, even in independent tax system household behaviour matters. Unfortunately, our data does not allow to study this matter and we had to leave it outside our analysis. At this point, we also have to comment the most frequently stated criticism against this kind of research, namely that most of the people work standard hours and that is decided collectively between unions and employers, at least in a country like Finland. One has to keep in mind that we have estimated the desired labour supply and we can only answer questions concerning what would be individual's desired reaction in different kind of reforms, but this is as far as we can proceed using econometrics.

Despite the limitations of our analysis we think that this work has something to give to the Finnish tax debate. At least, it is the first microsimulation study which takes behavioural responses into account and thus serves as a basis for hopefully forthcoming similar studies. One purpose of writing this paper was to indicate why microsimulation studies are needed and what are the advantages compared to the "representative individual or household" case and cash effect studies. This is done in sections 2 and 3.

Our main findings are the following ones. If we would move from progressive income taxation to proportional taxation in a revenue neutral way then the marginal tax rate would be 28 per cent (for to our sample) and the labour supply effects of this change are reasonably small. In efficiency terms the current tax system could be improved upon because its estimated deadweight loss is approximately 15 per cent of tax revenue, whereas in the case of proportional tax it is approximately 5 per cent. The biggest effects in terms of labour supply are achieved by reforms which cut marginal taxes at the low end of the income distribution.

Our results indicate that none of the reforms we did are self-financing. Increases in labour supply are too moderate to offset reduced tax revenues. Although this result seems a very simple one, it is still quite important due to the following fact. In general discussion a variety of reforms have been suggested and some have claimed that these reforms are definitely self-financing ones. It has even been suggested that some tax cuts could increase tax revenues, thus we would be on decreasing side of the Laffer-curve. This is not the case according to our results. Our conclusion is that if we would like to lower income taxes then we would also have to think how we can reduce public expenditures.

Finally, many other types of reforms also could have been possible to analyse, but we assume that the ones we did represent a good portfolio of reforms. Many other possible scenarios will be placed between the ones we analysed and then the outcomes are very likely to be somewhere between our results. Needless to say, a further work is needed to get a better picture of the labour supply responses in Finland.

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Appendix 1: Labour Supply Equation, Wage Equation and Variable Definitions

Labour Supply Function

Labour Supply Functions		
Variables	*Coefficients*	*Asymp. Standard Errors*
Constant	-2.57905	(0.55650)
Ln W	0.37046	(0.12135)
Exog. inc	-0.00045	(0.00022)
Cdum1	-0.33917	(0.09948)
Cdum2	-0.00487	(0.10437)
Cdum3	0.09616	(0.10050)
Cdum4	0.14310	(0.07690)
Age	0.16118	(0.02484)
Age*Age	-0.00227	(0.00028)
Sosio	0.19945	(0.09521)
Nkids	-0.08419	(0.03235)
σ_ϵ^2	0.98208	(0.01907)
Ln L	-2669.61	

Note: In both models above, dependent variable(yearly hours) is divided by 1000. In model 1 the exogenous income variable contains only own exogenous income components(net) and it is divided by 100. In model 2 the exogenous income variable includes also husbands net incomes and it is divided by 1000.

Wage Equation

Wage Equation. Dependent variable: ln hwage.		
Variables	*Coefficient*	*Standard Error*
Constant	2.83342	0.2511
Age	0.01753	0.0135
Age2	-0.00017	0.0001
Educ10	0.06881	0.0024
Educ12	0.19534	0.0297
Educ14	0.27270	0.0469
Educ15	0.51690	0.0469
Exp	0.01659	0.0053
Exp2	-0.00027	0.0001
Tenure	0.02410	0.0038
Tenure2	-0.00045	0.0001
Pjob	0.04720	0.0299
Husb	0.00760	0.0290
Stat	0.10338	0.0241
Socio	0.23919	0.0366
Nchild	-0.03065	0.0104
South	0.15898	0.0222
Exo+hnet	3.95e-07	1.67e-07
Occ. dummies	Yes	
Ln L	-1221.91	

NOTE:The selection index is a function of the individual, geographical and demand side variables. The selectivity effect was statistically significant. Reference group for occupation is manufacturing workers.

Definitions of the variables

union=1, if the respondent is a member of an union
age=Age of the respondent
age2= Age squared
educ10=1, if the respondent has 10 years of education. Otherwise zero.
educ12=1, if the respondent has 11-12 years of education. Otherwise zero.
educ14=1, if the respondent has 13–14 years of education. Otherwise zero.
educ15=1, if the respondent has 15+ years of education. Otherwise zero.
ueduc=1, if the respondent has university degree from the following fields: Technology,business,law,natural science and social sciences
nchild=Number of dependent children.
cdum1,...,cdum4= Dummy variables for the youngest child. Age groups are 0–3,4–6,7–9 and 10+.
schild=Number of children aged 0–3.
cchild=Number of children aged 4–6.
bchild=Number of children aged 7–9.
exp= Working experience
exp2= Exp. squared
tenure= Duration of the current job
tenure2= Square of tenure
pjob=1, if respondent has a permanent job
phusb=1, if respondent's husband is working
stat=1, if the respondent is a white–collar worker and 0 if a blue–collar worker.
socio=1, if the respondent is a upper white–collar worker. Otherwise zero
hwage= Hourly wage rate.
shwage= Subjective Hourly wage rate.
exo= Unearned income.
exo+hnet= Unearned income+husband's net incomes.
south=South Finland.
west=West Finland.
east=East Finland.
middle=Middle Finland.
north=North Finland.
lapl=Lapland.

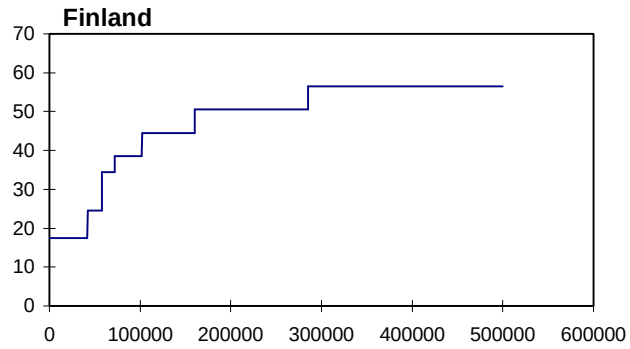
Appendix 2: Share of Taxes on Income, Wealth etc. of the GDP

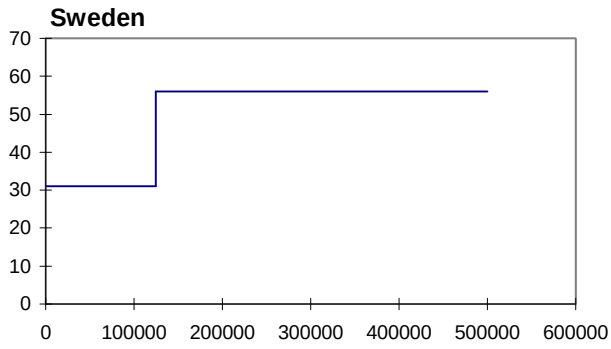
Share of Taxes, Wealth etc. of the GDP				
Country	1998	1997	1996	1995
EU–15	13.7	13.2	13	12.6
Belgium	17.7	17.1	16.7	16.7
Denmark	29.4	30.1	30.6	30.4
Germany	11.5	11.2	11.5	11.2
Greece	8.5	7.9	7.1	7.4
Spain	10.3	10.5	10.3	10.1
France	11.5	9.5	8.9	8.5
Ireland	13.8	14.3	14.2	13.7
Italy	14.4	16.1	15.3	14.7
Netherlands	12.2	12.4	12.9	12.4
Austria	13.8	13.5	13.1	12
Portugal	10.4	10.2	10	9.3
Finland	18.9	18.5	18.9	17.5
United Kingdom	16.5	15.1	14.9	15

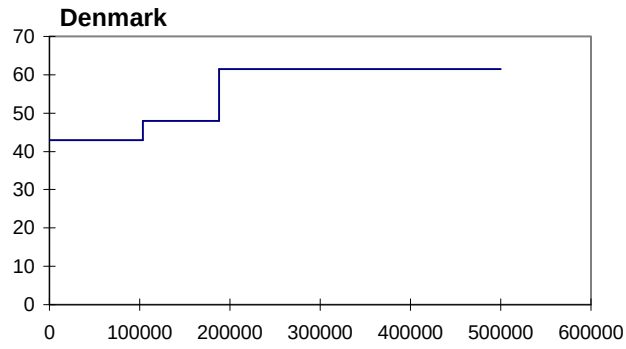
Source: Eurostat

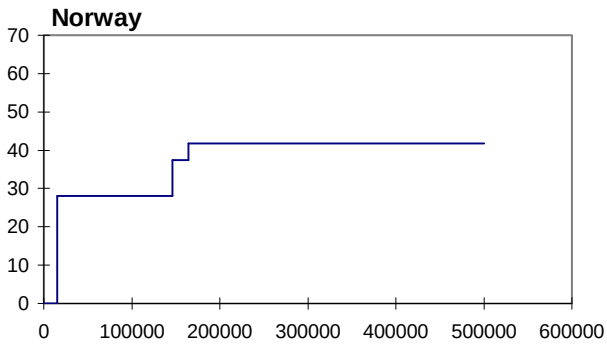
Appendix 3. Taxable Income and Marginal Tax Rates In Different Countries

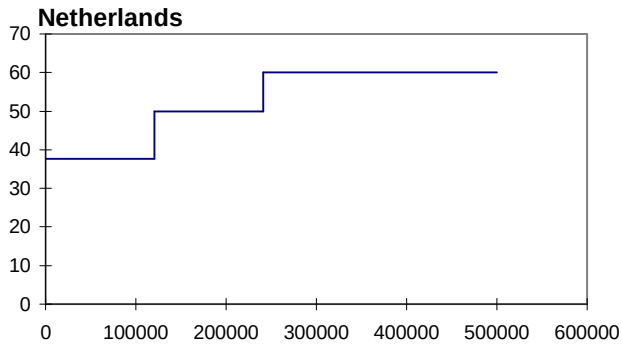
Taxable Income (in Finnish Currency) and Marginal Tax Rates in 1995. Source: Mäki and Viren(1998)

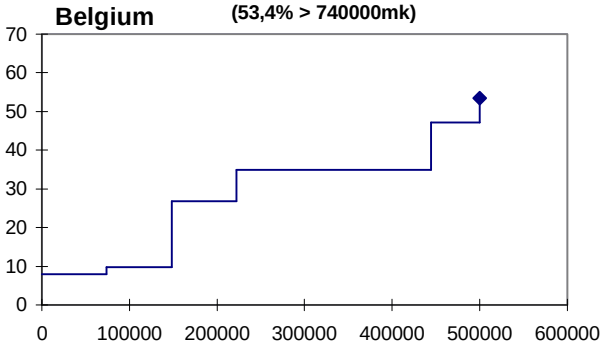


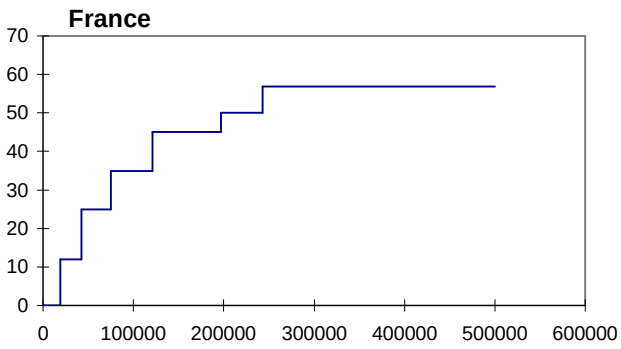


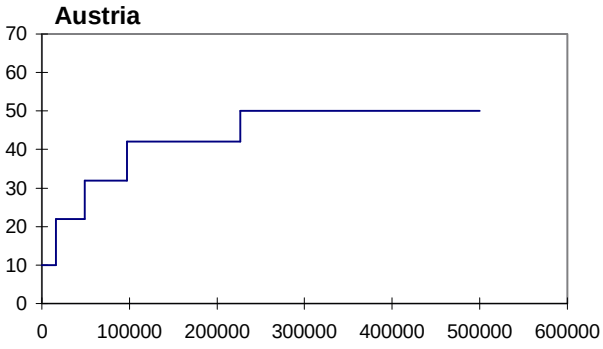




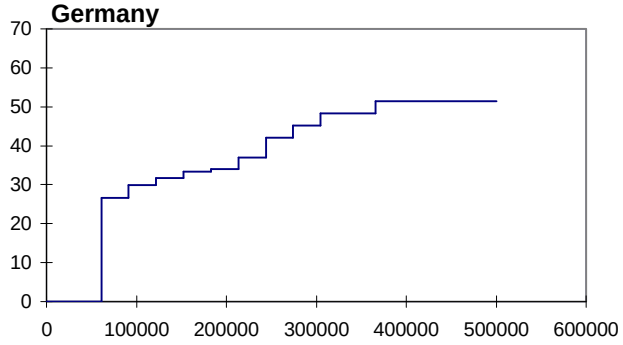




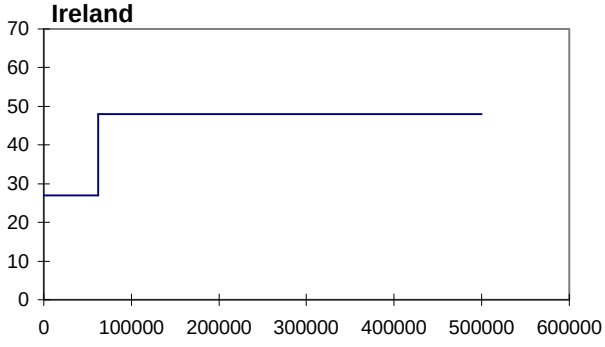




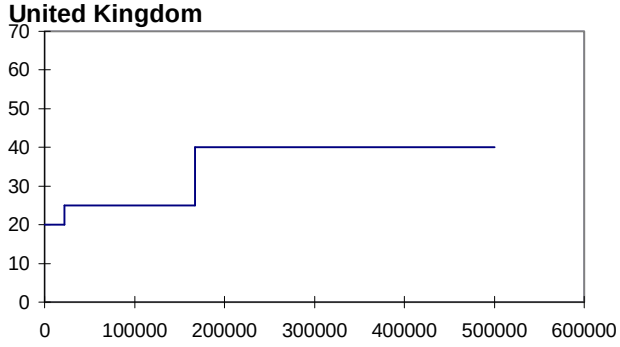
Germany



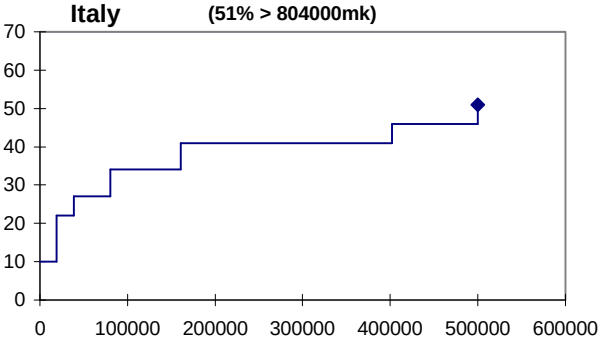
Ireland



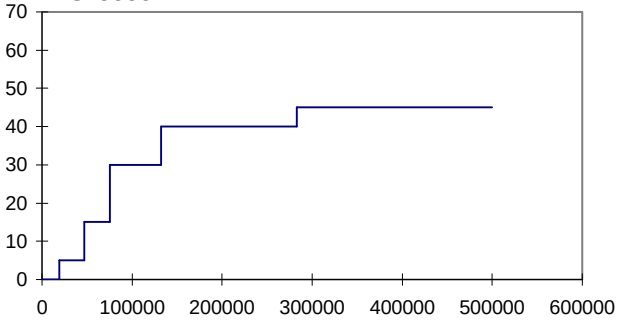
United Kingdom



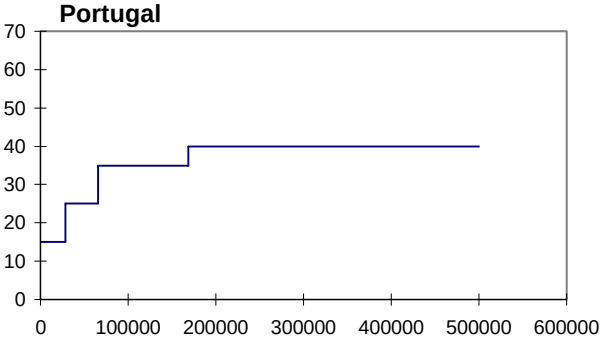
Italy **(51% > 804000mk)**



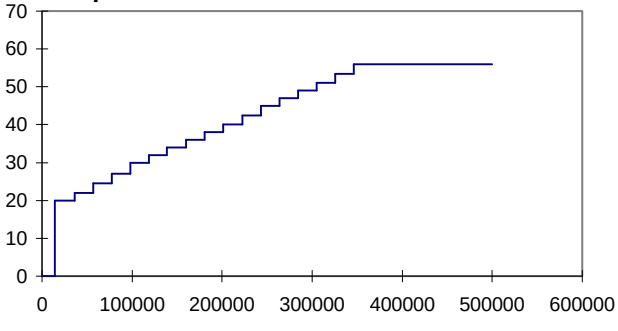
Greece



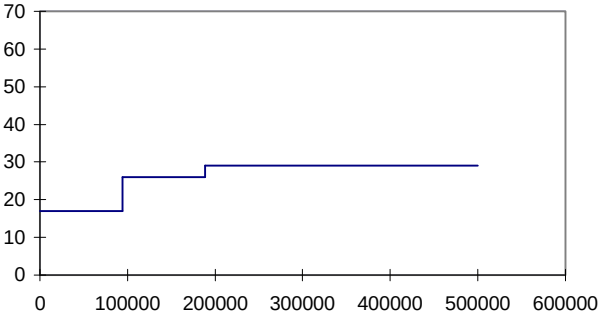
Portugal

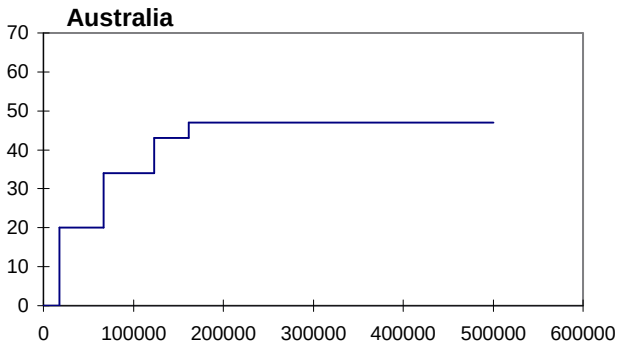


Spain



Canada




Australia
70
60
50
40
30
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0
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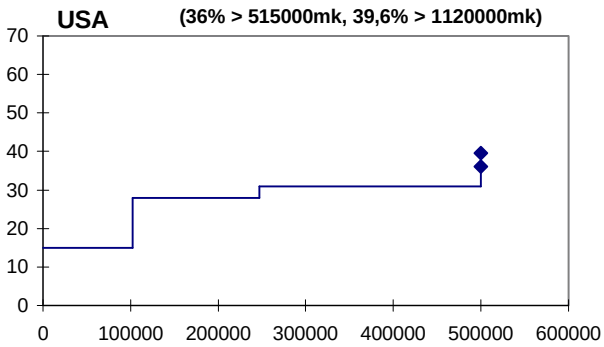
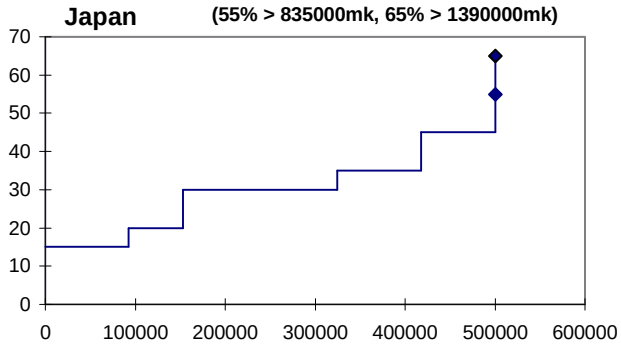
100000
200000
300000
400000
500000
600000


USA
(36% > 515000mk, 39,6% > 1120000mk)
70
60
50
40
30
20
10
0
0
100000
200000
300000
400000
500000
600000


Japan
(55% > 835000mk, 65% > 1390000mk)
70
60
50
40
30
20
10
0
0
100000
200000
300000
400000
500000
600000

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