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The Welfare Effects of a Capital Income Tax Reform in Sweden

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Abstract
The aim of the thesis is to assess if an elimination of the capital income tax in Sweden results in welfare gains on the aggregated level and for a majority of the population. Studies of the effects of capital income tax reforms in dynamic equilibrium models find that, while there are aggregated gains from such reforms, the distribution of capital and labor income has a large impact on the welfare gains on the individual level. We take this distributional aspect into consideration and assume that households are heterogeneous in their capital and labor income. The distributions of capital and labor income are set to correspond to Swedish data. This thesis argues that there are substantial welfare losses from an elimination of the capital income tax in Sweden, both on the aggregated level and across the majority of the households. However, a smaller reduction of the capital income tax does result in welfare gains both on the aggregated level and across the majority of the households. The conclusion is reached through simulations of changes in the capital income tax in a dynamic equilibrium model of the Swedish economy.

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1 Introduction

During the last decades the study of capital income taxation has been given substantial attention, both in neoclassical growth models and in the public debate. One reason behind these discussions is that a large part of the literature on reforms of the capital income tax finds that such a tax is welfare distorting and thus should be eliminated[1]. However, such findings are often drawn from steady-state comparisons in models based on homogenous households and complete markets. This means that the short-run welfare losses and redistribution effects of a tax reduction are not taken into consideration. To capture the redistribution effects and differences in welfare expectations a model must assume incomplete markets and heterogeneous households[2]. The findings of dynamic models under these assumptions are that welfare expectations differ across households and that tax reforms have redistributive effects.

In brief, we want to study the welfare effects from changing the capital income tax[3] in Sweden. Thus, we calibrate our model to capture the Swedish economy under the assumptions of infinitely lived households that are heterogeneous in their capital and labor income. One single unanticipated tax reform is introduced in period zero. To find the welfare effects of this change in the capital income tax we simulate the model economy. Welfare is measured both for the economy as a whole and for each household to see which capital income taxes bring about welfare gains.

Studies on the welfare effects of tax reforms have typically been done on the US economy. We therefore find it interesting to study the effects of an elimination of the capital income tax in Sweden, where the capital distribution and the tax system differ from that in the US. To our knowledge no previous study on the welfare effects of a capital income tax reform has been made on Swedish data where heterogeneous households are assumed, adding to the originality of this thesis.

More precisely the aim of this thesis is to:

[1] See for example Lucas (1990) or Cooley and Hansen (1991).
[2] See for example Auerbach and Kotlikoff (1987), Garcia-Milá et al. (2001), Domeij and Heathcote (2004) or Nishiyama and Smetters (2005)
[3] Capital income tax refers to the tax on the rate of return on capital assets.

1) *Construct a dynamic simulation model to assess the effects on welfare, on the individual and aggregated level, from a change in the capital income tax in the Swedish economy.*

2) *Discuss whether the welfare gains from a reduction of the capital income tax are large enough to provide an incentive for actual policy changes.*

The outline of the thesis is as follows. Section 2 provides an overview of the relevant literature. In section 3 the model is presented. Section 4 shows the calibration of the parameters and section 5 the simulation of the model. The results are presented in section 6, which ends with a sensitivity analysis of the model. Finally, in section 7 conclusions are drawn and suggestions for future research are made.

2 Literature Overview

Early research on taxation policies has shown that capital income should be subjected to zero taxation in the long run as such tax policies would lead to a significant increase in welfare. These results were presented by Chamley (1986) who showed that the optimal policy would be for the government to initially raise the tax on capital income and after a few periods start lowering it until it is eliminated[4]. According to Lucas (1990) the problem with such a policy is that it is hard to implement since the government is time-inconsistent, hence the policy can not be made credible. Instead the capital income tax should be set to zero in the first period and held constant over time as this would improve the aggregated welfare.

Even though the above studies on taxation policies impose some straight forward suggestions for tax reforms they have not led to any actual changes in the capital income tax. This is for example shown by Carey and Tchilingurian (2000), who report that the average tax rate on capital income in the OECD countries has remained on a high level[5].

[4] These results were found to be robust in models with uncertainties by Chari et al. (1994).
[5] Carey and Tchilingurian (2000) report that the average capital income tax over the years 1991-1997 in the OECD countries was 26.6%, when based on gross operating surplus.

Auerbach and Kotlikoff (1987) introduce the importance of looking at the transition period in order to study the short run welfare effects of a tax reform. The authors examine how a reduction of the capital income tax that is financed with a higher labor income tax would affect welfare. They find that the outcome depends on whether the transition period is considered or not. A comparison of the long run welfare effects from the tax reform finds that households are better off as a result of an elimination of the capital income tax. However, such a comparison ignores the short run distributional effects that arise when the tax burden is shifted from one household to another.

Garcia-Milà et al. (2001) study the welfare effects on heterogeneous households from an elimination of the capital income tax. Their study shows that an elimination of the capital income tax brings about aggregated welfare gains. However, the tax reform will redistribute the tax burden across households, decreasing the utility of households who are relatively more dependent on their labor income and leaving only those who are more dependent on capital income better off[6]. The authors find that a small reduction of the capital income tax in combination with a redistribution of the capital would be Pareto improving.

Domeij and Heathcote (2004) examine the effects of tax reforms when agents are heterogeneous and markets are incomplete[7]. They study welfare effects in a dynamic setting and find that in the short run households with little initial capital and low labour income pay a too high price in terms of welfare for a reduction of the capital income tax. Only a few wealthy households gain from the tax reform in the model. The paper thus concludes that not only assuming heterogeneity but adding the assumption of incomplete markets will enhance the tax reforms negative effect on welfare. [8]

[6] The authors find that, in a model with heterogeneous agents, where a zero capital income tax is implemented in the first period, at least 1/5 of the population will suffer welfare losses.

[7] Attanasio and Browning (1995) show that in order not to understate the welfare effects of a tax reform markets must be assumed incomplete. This means that agents are unable to insure against wage shocks.

[8] The findings of short run welfare effects resulting from a tax reform are supported by Nishiyama and Smetters (2005). They study an economy in a dynamic model with heterogeneity and incomplete markets, where the elimination of the capital income tax is financed with a consumption tax. The results are that while aggregate wealth and output will increase over the entire transition period, the

The literature on tax reforms has so far found that, in order to capture the welfare effects from a tax reform, the tax change needs to be assessed in a model that considers the transition period. When assuming heterogeneous households and incomplete markets these models show that households with less capital income relative to labor income will lose in terms of welfare from an elimination of capital taxation.

3 Model

3.1 Overview

We model an economy with infinitely lived rational individuals who maximize their utility through their choice of consumption and labor supply. Government spending is a function of the tax on labor and capital income and is assumed to be constant over time. There are $j = 1 \ldots\ldots q$ number of individuals who are divided into five heterogenic households ($i = 1, 2, 3, 4, 5$) with equal population size[9]. Individuals have perfect foresight but the tax reform is unanticipated, which means that the individuals will not change their behaviour with respect to the reform until period $t = 0$. Aggregated variables are denoted with capital letters while variables for the individual households are denoted with lower-case letters. The model is a simplified version of the Swedish economy and as such it contains assumptions that do not hold in a real economy[10]. It would be of interest to study the economy under the assumption of market incompleteness however, this is not within the scope of this paper[11].

3.2 The Households

We consider an economy with infinitely lived households whose utility depends positively on their consumption and negatively on their labor choice. Thus, each household has two choices to consider *(i)* the choice between consumption and saving and *(ii)* the choice between leisure and work. One period in the model corresponds to one year in the real economy and each household strictly prefers consumption today to consumption tomorrow. Households are assumed to be heterogeneous in terms of

assumptions of heterogeneous households and imperfect markets lead to a decrease in welfare for some households.

[9] The distribution of capital and labor income is illustrated in APPENDIX.A.1.

[10] For example, it is not realistic to assume that the productivity levels of households are constant over all periods.

[11] We consider our assumptions, even though they do limit our real world implications, to be legitimate and necessary for the scope of this paper.

their initial capital stock and their productivity[12]. The expected discounted life time utility is

$$\sum_{t=0}^{\infty} \beta^t U\left(c_t^i\right) - \phi \frac{h_t^{i,1+1/\gamma}}{1+1/\gamma} \tag{1}$$

Where β is the discount factor for the individuals, with $0<\beta<1$, c_t^i is the consumption for individual *i* and h_t^i is the labor supply for individual *i* in period *t*. The parameter ϕ is the weight of the labor supply. The parameter γ is the Frisch labor supply elasticity, which is assumed to be constant over all time periods. The temporary utility function is given by

$$U(c) = \frac{c^{1-\mu}}{1-\mu} \tag{2}$$

This gives the marginal utility $U'(c) = c^{-\mu}$. The parameter of relative risk aversion for consumption fluctuations is μ >0 and constant over all time periods. The households' budget constraint is given by

$$c_t^i + a_{t+1}^i = w_t(1-\tau^w)e_t^i h_t^i + \left(1+(1-\tau^r)r_t\right)a_t^i \tag{3}$$

Where r_t is the return on capital, w_t is the labor income, τ^w is the tax on labor income and τ^r is the tax on capital income. Households take the sequences for prices $\{r_t\}_{t=0}^{\infty}$ and $\{w_t\}_{t=0}^{\infty}$ and tax rates τ^r and τ^w as given. Capital assets (a_t^i) and the labor productivity (e_t^i) are heterogeneous across households and observed prior to the decisions made in *t=0*[13].

Households are rational and want to maximize eq. (1) which is done through a set of choices $\{x_{jt}\} = \{c_{j,t}, h_{j,t}, a_{j,t}\}_{t=0}^{\infty}$, such that eq. (1) is maximized subject to eq. (3) and all other assumptions. This results in the first order condition

$$-U'(c_t^i) + \beta U'(c_{t+1}^i)\left(1+(1-\tau_r)r_{t+1}\right) = 0 \tag{4}$$

And in the labor supply choice

[12] The assumption that households are heterogeneous in their productivity and capital assets result in different levels of capital and labor income across the households. These distributions are illustrated in APPENDIX.A.1.

[13] That households are heterogeneous in terms of productivity can be seen as them having different levels of education.

(5) $$h_t^i = \left(\frac{w_t(1-\tau^w)e_t^i}{\frac{c_t^i}{\phi}} \right) \wedge \gamma$$

3.3 The Firms

The output per capita is produced in a Cobb-Douglas function, where output per capita is a function of the capital and effective labor supply per capita. The output is thus given by

(6) $$F(K, EH) = Y_t = K_t^{\alpha}(EH)_t^{1-\alpha}$$

Where $\alpha \in [0,1]$ is the capital's share to output. In this economy firms want to maximize profits, which in a competitive equilibrium means that all factor markets must clear. More specifically this means that factor returns must equal factor demands i.e.

(7) $$w_t = (1-\alpha)K_t^{\alpha}(EH)^{-\alpha}$$

(8) $$r_t = \alpha K_t^{\alpha-1}(EH)^{(1-\alpha)} - \delta$$

3.4 The Government and Resources

The households' savings decision (a_{t+1}) determines the development of the capital stock, which in turn determines the output and return to savings. The capital holding at date t is thus $K_t = \sum_{i=1}^{5} a_t^i$ and the effective labor supply is $EH_t = \sum_{i=1}^{5} e_t^i * h_t^i$.

Investments are equal to

(9) $$I_t = K_{t+1} - (1-\delta)K_t$$

Here $\delta \in [0,1]$ is the depreciation rate of capital. Government spending is a function of the tax on labor income and tax on capital income. The government makes no transfers and does not issue government bonds. This gives the following government spending

(10) $$G = \tau^w w_t EH_t + r_t K_t \tau^r$$

Output can be written as a function of consumption, government spending and future capital and thus the goods market can described as

(11) $$C_t + G + K_{t+1} - (1-\delta)K_t = C_t + G + I_t = Y_t$$

This property is the income-expenditure identity and must balance for a competitive equilibrium.

3.5 Competitive Equilibrium

All markets are assumed to be competitive and equilibrium is characterized as a set of prices, taxes, and aggregated variables such that the quantities demanded in the economy are equal to the quantities supplied in the economy, i.e. all markets clear. More specifically a competitive equilibrium requires that *(i)* the households maximisation problem is solved, i.e. that the consumption and labor supply choice is optimized *(ii)* the markets for savings clears, *(iii)* the government budget constraint is satisfied, *(iv)* the factor markets clear, i.e. eq. (7) and (8) are satisfied and *(v)* the goods markets clear, i.e. the income-expenditure identity is satisfied.

3.6 Welfare Measures

Welfare is defined in terms of utility, which is a function of consumption and leisure. We measure welfare as the percentual increase in consumption under the non-reform case that results in the same utility as when the tax reform is implemented[14]. For the individual households the welfare effects of a reform is the percentual increase measured by sigma (Δ_i). If sigma is positive the households have welfare gains from the tax reform, while if it is negative they prefer the non-reform case. More specifically, the welfare effects for households *i* is measured by the sigma (Δ_i) that solves the following equation

$$(12) \qquad \sum_{t=0}^{\infty}\beta^t\left(U(c_t^{iR})-\phi\frac{h_t^{iR,1+1/\gamma}}{1+1/\gamma}\right)=\sum_{t=0}^{\infty}\beta^t\left(U\left((1+\Delta_i)c_t^{iNR}\right)-\phi\frac{h_t^{iNR,1+1/\gamma}}{1+1/\gamma}\right)$$ [15]

The aggregated welfare is the sum of all households' welfare gains, i.e. the sum of all individual sigmas. The aggregated welfare gain is the sigma (Δ) that solves the following equation

$$(13) \qquad \sum_{i=1}^{5}\sum_{t=0}^{\infty}\beta^t\left(U(c_t^{iR})-\phi\frac{h_t^{iR,1+1/\gamma}}{1+1/\gamma}\right)=\sum_{i=1}^{5}\sum_{t=0}^{\infty}\beta^t\left(U\left((1+\Delta)c_t^{iNR}\right)-\phi\frac{h_t^{iNR,1+1/\gamma}}{1+1/\gamma}\right)$$

A utilitarian social welfare function means that the reform should be implemented if the aggregated utility is positive. A Pareto improving reform is such that all at least one household is made better of from the reform, without making any other household

[14] The reform case is denoted with *R* and the non-reform case is denoted with *NR*.
[15] More on the solution of sigma is given in APPENDIX A.2.

worse-off. More specifically this means that at least one of the households has a positive sigma, while no households have a negative sigma.

4 Calibration

To solve the model we need to find expressions for a number of parameters, which are then used in the model, as they are assumed to be constant over time. All parameters are illustrated in Table 3.

The Frisch elasticity of labor supply (γ) is set to correspond to the estimations of MaCurdy (1981) and Domeij and Flodén (2006)[16]. We set the capital's share of output (α) and the coefficient of relative risk aversion for consumption fluctuations (μ) equal to commonly used estimations of the parameters[17]. In the initial steady state the aggregated effective labor supply is normalised to be equal to one, i.e. $EH = 1$. The initial tax on labor income is set to 50% and the initial tax on capital income is set to 30%. These tax rates are set to approximately correspond to the tax rates in Carey and Tchilingurian (2000)[18].

The β and δ are set to replicate the capital/output ratio of 2.5 and the investment/output ratio of 0.2 respectively[19]. In steady state the capital stock is equal over all periods implying that investments is equal to

(14) $$I = K - (1-\delta)K = K - (1-\delta)K = \delta K$$

The depreciation rate is set to target the investment/output ratio and is calibrated by

(15) $$\frac{I}{Y} = \frac{\delta K}{Y} = 0.2 \Rightarrow \delta = \frac{0.2Y}{K} = 0.08$$

Using eq. (4) we then calibrate the β by

[16] According to MaCurdy (1981) most estimates of the inter-temporal labor-supply elasticity find that it is in the range between 0.1 and 0.5 for men. Domeij and Flodén (2006) estimate Frisch labor supply elasticity of 0.23 when not controlling for liquidity constraints. They show that these liquidity constraints cause a downward bias in the estimations and therefore re-estimate the elasticity while controlling for the constraints and find that the labour supply elasticity is 0.42.

[17] For example Domeij and Heathcote (2004) use α = 0.36 and μ = 1.

[18] Carey and Tchlingurian (2001) find that the average tax rates on capital and labor in Sweden in the years 1991-1997, were 30.5% and 48.5% respectively.

[19] These are the averages of the relative quantities in Sweden over the period 1995-2000 found in Edvinsson (2005, Table: "Net stock of various types of produced assets in Sweden 1800-2000")

(16) $$\beta = \frac{1}{\left(1+(1-\tau_r)r_{t+1}\right)} = \frac{1}{\left(1+(1-\tau_r)\left(\alpha\frac{Y}{K}-\delta\right)\right)} = 0.964$$

The initial wage rate is calibrated to satisfy eq. (7). The government spending is assumed to be constant over all periods and is calibrated using eq. (10). The weight of the labor supply (ϕ) is set so that the initial labor supply is equal to one, i.e. $H = 1$.

Data on the distribution of disposable income and net wealth across Swedish households is illustrated in Table 1.

Table 1 - Wealth Structure 2004 for Households in Quintiles by Disposable Income

Mean Value in SEK thousands

Quintile	Disposable Income	% of Disposable Income	Net Wealth	% of Net Wealth
1	179	7%	680	8%
2	294	11%	729	9%
3	427	16%	1194	15%
4	625	24%	1702	22%
5	1063	41%	3657	46%
Total	**2590**	**100%**	**7960**	**100%**

Source: Wealth Statistics 2004, Statistics Sweden, p-26

The assumption of complete markets means that any distribution of the capital stock and disposable income is possible. In our model we set the distribution of capital and disposable income to correspond to the Swedish data in Table 1. More specifically the households' initial capital assets are set by multiplying their shares of the net wealth in Table 1 with the total capital stock K. The disposable income is calculated in the following function

(17) $$D^i = (w(1-\tau^w)e^i h^i) + ((1-\tau^r)ra^i$$

We set the households productivity (e^i) to capture the disposable income (D^i) for households i[20].

Using the distribution of capital and labor income we derive a ratio to illustrate the relative differences between the households. The net capital income/disposable income ratio shows how much of the households total income that is attained from their capital income. The households with the highest ratios are the ones that are the most dependent on their capital income and thus have the most to gain from a reduction of the capital income tax. Table 2 illustrates the households' net capital

[20] The disposable income for household *i* is calculated by taking the households share of the disposable income from Table 1 times the aggregated disposable income in the economy.

income/disposable income ratios. Households are listed by their share of the disposable income[21].

Table 2 - Hoseholds Relative Ratios

Quintile (Households)	Net Capital Income/Disposable Income
1	0.25
2	0.18
3	0.19
4	0.20
5	0.25

Table 3-Parameters

Initial tax on capital income	τ^r	0.3
Initial tax on labor income	τ^w	0.5
The depreciation rate	δ	0.08
Discount factor	β	0.964
Labor supply elasticity	γ	0.3
Capital share to output	α	1/3
Relative risk aversion for consumption fluctuations	μ	1
The level of the labor supply	ϕ	839.99
Productivity group 1	e^1	0.3397
Productivity group 2	e^2	0.5722
Productivity group 3	e^3	0.8727
Productivity group 4	e^4	1.2232
Productivity group 5	e^5	1.9987

Table 4-Initial Steady State Properties

Initial effective labor supply	EH	1
Initial labor supply	H	1
Initial aggregated capital	K	3.95
Initial aggregated investments	I	0.316
Government spending/output	G/Y	0.37
Initial rate of return on capital	r	0.053
Initial wage rate	w	1.054

[21] A comparison with Table 1 shows that households 1 have the lowest share of the disposable income, while households 5 have the highest share of the disposable income.

5 Simulation

Steady-state equilibrium is an equilibrium such that the variables and prices are kept constant over all periods i.e. $(h^i, c^i, a^i, r, w) = (h, c, a, r, w)$. The initial steady state is simulated by solving a system of the following non-linear equations: (3), (4), (5), (7), (8), (9), (10) and (11). As the labor supply, consumption and capital have to be solved for each household there are in total 23 non linear-equations that we need to solve for.

In period *t* an unanticipated tax reform is introduced. To maintain a period by period government budget balance the tax reform can be financed by an increase of the tax on labor income, which means that the labor income tax will alternate in each period over the transition to keep the government spending constant[22]. As a result of the new capital income tax the economy diverges from the initial steady state taking on a transition period only to return to a new steady state. In solving for the transition period it is of importance to once again take notice of the assumption of perfect foresight. The tax reform should be seen as an unanticipated change and thus, even though individuals have perfect foresight they do not expect this policy change.

The transition path is solved for by first assuming the number of periods it will take for the economy to reach the new steady state. We assumed that there are $n = 110$ periods between the steady states, each corresponding to one year[23]. Secondly, we solve for how the economy and its agents explicitly behave during the transition period. However, as we assume that individuals have perfect foresight they take future prices into account, which means one must solve for equilibrium in all transition periods simultaneously. The equations we need to solve for are (3), (4), (5), (7), (8), (9), (10) and (11). Once again consumption, labor supply and capital have to be solved for all households and thus in total there are *m=23* equations that we need to solve for in each period. More specifically this means that we solve a system of non-linear equations in *n* periods with *m* equations in each period, in total *n*m* = 2530

[22] One could look at alternative sources of financing however, we have chosen an increase in the tax on labor income as this result in larger redistributions of the tax burden across households. Domeij and Heatcote (2004) find that an elimination of the capital income tax implies smaller welfare losses when financed by a consumption tax than by a labor income tax.

[23] Our results remain the same if we change the number of periods to for example 80-200, but if we assume a considerably shorter period the economy in our model will not have reached the new steady state.

equations simultaneously. The new steady state is reached when the economy stays on the same path to infinity, conditioned that no other unanticipated changes occur.

6 Results

6.1 Welfare Gains

Our main results are presented in Table 5, which is found on page 16. The table illustrates the welfare effects, i.e. the sigmas, of different reforms of the capital income tax. From this table we extract four main findings. First of all, an elimination of the capital income tax results in welfare losses both on the aggregated level and for 3/5 of the households. The 2/5 of the households with welfare gains are those with the highest net capital income/disposable income ratio. Thus, the distribution of productivity and capital in Sweden do not support the elimination of the capital income tax. However, this does not mean that the current tax level should remain unchanged.

Secondly, a reduction of the capital income tax to 25% from the current 30% is supported by all the households. This is illustrated in the last column in Table 5 where it is clear that all households have positive sigmas, which implies that this is a Pareto improving tax reform. This is a somewhat similar result to what Garcia-Milà et al. (2001) find in their study on the US economy. However, Garcia-Milà et al. conclude that for a smaller reduction of the capital income tax to be Pareto improving the capital has to be redistributed across the households. From this we can draw the conclusion that the distribution of capital and labor income in Sweden, in contrast to the distribution of capital and labor income in the U.S., supports a small reduction of the capital income tax. Our results on the Pareto improving reform do not correspond to Domeij and Heathcote (2004), who do not find any Pareto improvements from a reduction of the capital income tax. This discrepancy in our results is due to Domeij and Heathcote's assumption of incomplete markets, which results in even greater welfare losses for households with relatively little initial capital.

From Table 5 it is clear that all larger reductions of the capital income tax are welfare distorting for some households even if there are aggregated welfare gains. Our third finding is that from a utilitarian perspective welfare gains are maximized by a capital

income tax between 18-22%. As there are welfare losses for at least 1/5 of the households at these tax rates it is questionable how much aggregated results can say about which tax reform should be implemented.

Finally, it is interesting to note how the welfare results differ across the households. As presented in Table 5, households 2 are the ones who first suffer welfare losses as a result of a reduction in the capital income tax. Households 1 and 5 are those who support all reductions. These results correspond to the net capital income/disposable income ratios, which are lowest for households 2 and highest for households 1 and 5. The effects on welfare are thus driven by the net capital income/disposable income ratios. When we change the assumptions of heterogeneous households and look at homogenous households we attain somewhat different results. Under the assumption of homogenous households a capital income tax of 5% would be welfare improving, which is a significantly lower tax rate than what is implied when assuming heterogeneous households. However, a total elimination of the capital income tax is still welfare distorting. The effect of assuming heterogeneous households is thus that, as households differ in their relative dependence of capital income the tax reform will result in a redistribution of the tax burden across households. This will in turn have an affect on the aggregated welfare gains and thus implications for the preferred reforms.

Table 5 - Welfare Effects of Different Capital Income Tax Reforms

Household	Net Capital Income/ Disposable Income	Tax Rates Welf. Gains	0% Δ_i	5% Δ_i	10% Δ_i	15% Δ_i	20% Δ_i	25% Δ_i
1	0.25		0,0040	0,0043	0,0044	0,0040	0,0033	0,0020
2	0.18		-0,0076	-0,0053	-0,0033	-0,0017	-0,0060	0,0001
3	0.19		-0,0053	-0,0034	-0,0018	-0,0006	0,0020	0,0004
4	0.20		-0,0041	-0,0024	-0,0010	0,0000	0,0006	0,0006
5	0.25		0,0032	0,0037	0,0039	0,0037	0,0030	0,0018
Aggregated -Utalitarian			**-0,002**	**-0,0006**	**-0,0004**	**0,0011**	**0,0013**	**0,0009**
Aggregated- Homogenous Households			**-0,0012**	**0,00005**	**0,0009**	**0,0015**	**0,0016**	**0,0011**

Source: Simulated results from Matlab RB 2006

Table 6 - Welfare Effects in Steady State

Households	Welfare Effects (Δ_i) of a Zero Capital Income
1	0,05
2	0,04
3	0,04
4	0,04
5	0,05
Aggregated -Utilitarian	**0,0429**

Source: Simulated results from Matlab RB 2006

6.2 The Effect of the Transitional Dynamics

In Table 6 we present the results from a pure steady state comparison. As can be seen this comparison implies that there are welfare gains to be made across all households by an elimination of the capital income tax. Thus, a pure comparison of steady states implies larger reductions of the capital income tax than when the transition period is taken into consideration. We therefore conclude that only comparing the welfare effects of a tax reform in steady states is highly misleading and one must take the transition period into consideration to capture the full welfare effects of a tax reform.

Figures 1-8[24] illustrate the transitional paths the variables in the economy take as a result of an elimination of the capital income taxation. The larger the reductions of the capital income tax the greater the effects on the economy will be. Markets are assumed to be complete which means that each households' share of the total consumption, labor supply and capital is constant over all periods, regardless of the tax reforms or size of the aggregated variables. This means that the paths of the variables for the households and the aggregated economy will be the same, which is shown by a comparison between Fig.1 (the development of the aggregated consumption) and Fig.2 (the development of the individual household's consumption). As can be seen each household's consumption develops in the same way as the aggregated consumption and all households have a constant share of the aggregated consumption. We therefore primarily illustrate the aggregated variables in the text while further graphs for the households can be found in APPENDIX A.4.

Fig.1 shows that the short term effect of a capital income tax reform is a drop in consumption. However, depending on the magnitude of the tax reform, consumption returns to the pre-reform level after *x*-number of periods[25] and then grows until it reaches the new steady state. All reductions of the capital income tax result in a higher consumption in the new steady state than in the initial but, the larger the reduction of the capital income tax, the larger is the growth of consumption between the steady states. Fig.3 illustrates that the labor supply will decrease as a result of a reduction of the capital income tax and the larger the tax reduction, the larger the reduction of the labor supply.

[24] Figures 1-8 are found on pages 19 and 20.

[25] The larger the reduction of the capital income tax the more periods it will take for the consumption to return to the initial steady state level. Under elimination it takes 17 periods, while under a capital income tax of 18% or 25% it takes 15 periods.

This is due to our choice of financing the reduction of the capital income tax with an increase in the labor income tax. Fig.4 illustrated the development of the labor income tax. A comparison between Fig.3 and 4 shows that the households will work less when the labor income tax increases as the marginal utility of an extra hour of work declines. Output is a function of the effective labor supply and the capital stock. The larger the reduction of the capital income tax the larger is the growth of the output.

Fig.6 illustrates the development of the capital stock. All reductions of the capital income tax will result in a larger capital stock. The larger the reduction of the capital income tax the faster the capital stock grows. With an elimination of the capital income tax the capital stock grows by approximately 20% between the two steady states, while under the Pareto improving reduction of 5% the capital stock grows only by approximately 4%. As can be seen in Fig.7 the after tax return on capital will decrease as a result of the tax reform and the largest reductions of the capital income tax will result in the lowest after tax return rates on capital. The capital income tax reform is financed by the labor income tax and consequently the larger the reduction of the capital income tax the larger the effects on the labor income tax will be. The after tax labor income will grow as a result of the growth in the capital stock and as a consequence the after tax labor income will grow in the opposite direction of the after tax return on capital, which can be seen by comparing Fig.7 and 8.

Figure 1

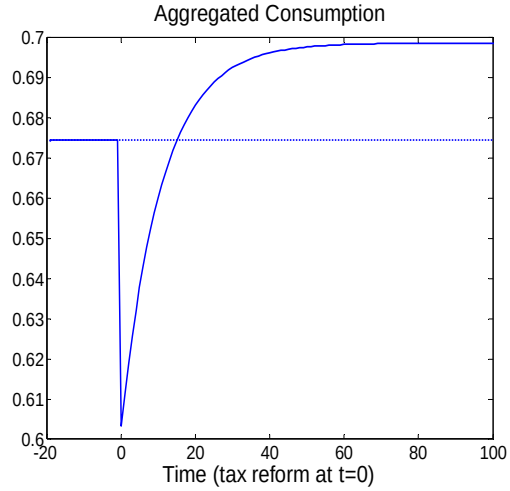


Figure 2

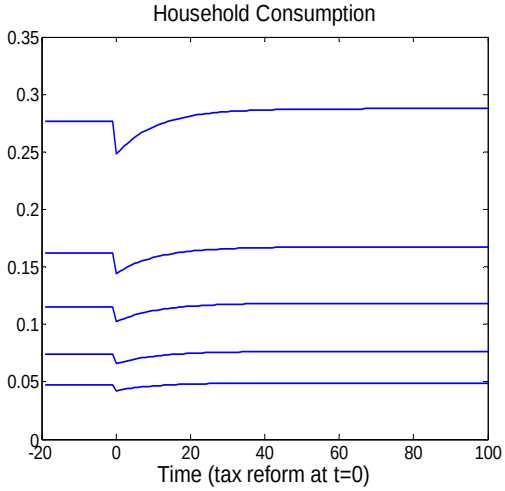


Figure 3

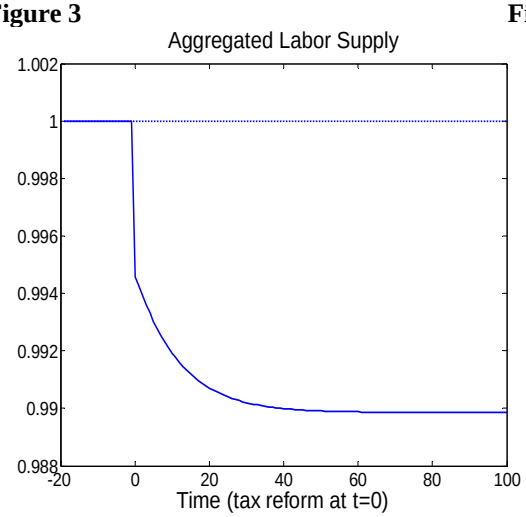


Figure 4

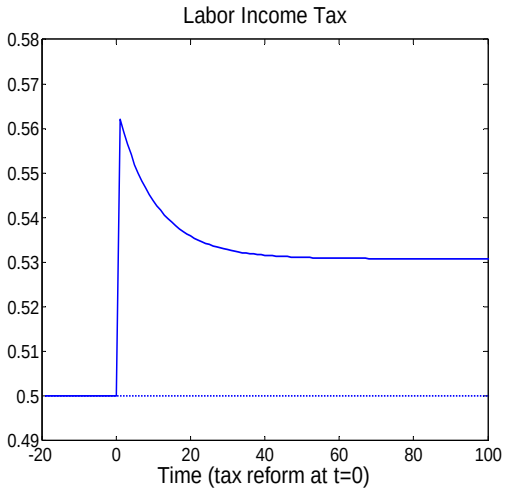


Figure 5

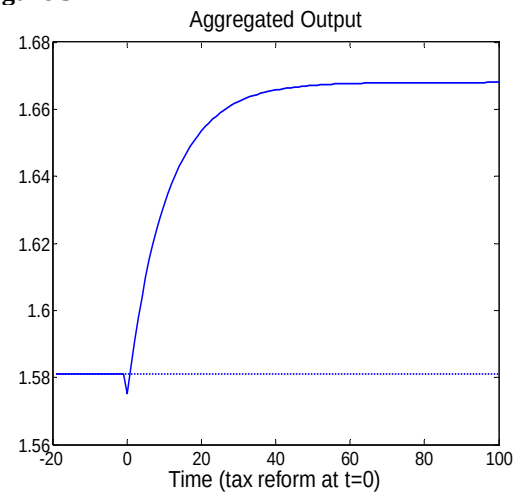


Figure 6

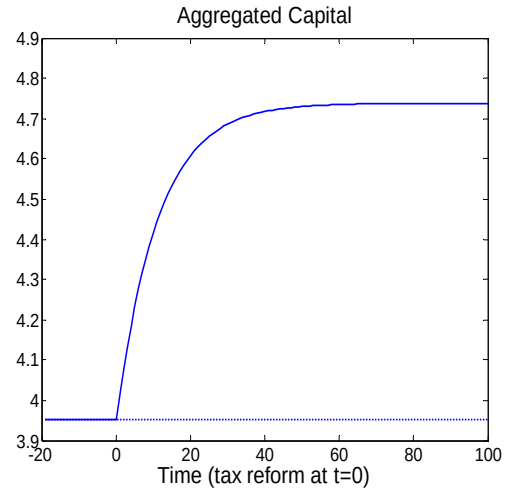


Figure 7

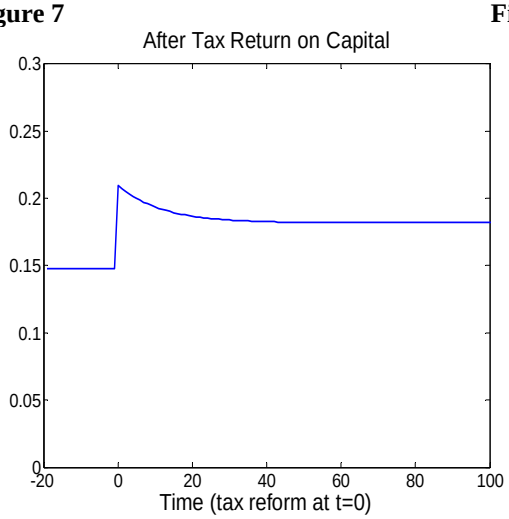
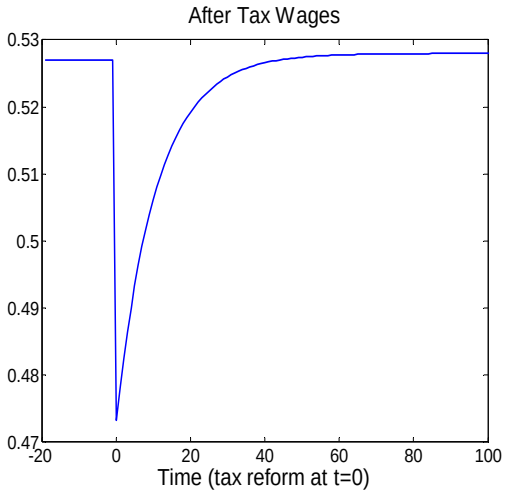


Figure 8



To sum up, we find no incentives to eliminate the Swedish capital income tax, even though this gives the most rapid growth of the capital stock, consumption and output, as this distorts welfare on the aggregated level and for the majority of the households. It is Pareto improving to reduce the capital income tax by 5% while a larger reduction results in welfare losses for at least 1/5 households. The aggregated welfare gains are maximized with a capital income tax between 18-22%. The results are driven by differences between households in their relative dependence of capital income.

6.3 Sensitivity Analysis

A sensitivity analysis is performed to investigate how robust our results are. We start by changing the parameters μ and γ. We compare our previous results of an elimination of the capital income tax with the welfare effects of the same reform using the new parameters. The results are illustrated in Table 8 in APPENDIX. A.4. An increase of μ resulted in lower aggregated welfare gains than in our initial setting and welfare losses for 3/5 of the households. A substantial increase of γ resulted in welfare losses both on the aggregated and household level, i.e. all sigmas were negative. Setting γ equal to zero corresponds to a removal of the assumption of endogenous labor supply. This change resulted in welfare gains for 4/5 of the households and for the aggregated level, i.e. there was more support for an elimination of the capital income tax than when using our initial γ.

We continue our sensitivity analysis by changing the net capital income/disposable income ratio to see which ratio a household must have to obtain welfare gains from an elimination of the capital income tax. The results are presented in Table 7 in APPENDIX.A.4. As can be seen, the initial net capital income/disposable income ratio for households 4 was 0.20, under which an elimination of the capital income tax resulted in welfare losses. We increase the net capital income/disposable income ratio for households 4 by changing the initial distribution of capital across households. When the net capital income/disposable income ratio is increased to 0.23 an elimination of the capital income tax results in welfare gains. Thus, in our model a net capital income/disposable income ratio equal to 0.23 is critical for obtaining welfare gains from such a tax reform. This highlights the importance of looking at the relative distribution of the capital and labor income across households, when evaluating tax reforms.

7 Conclusion and Suggestions for Further Research

The first studies made on capital income tax reforms suggested that the capital income tax should be zero in the long run. These results were later derived in dynamic models with heterogeneous households, suggesting that there were aggregated welfare gains to be obtained from a reduction of the capital income tax. However, the assumption of heterogeneous households showed that not all households will gain from an elimination of the capital income tax. The uneven distribution of welfare gains showed that households that are relatively more dependent on their capital income will experience the largest welfare gains from a reduction of the capital income tax.

The choices of model and parameter values in this study have been made to resemble the Swedish economy. The welfare effects on households with heterogeneous capital assets and labor productivity are then studied in a dynamic simulation model, where an unanticipated tax change is made in the first period.

We have four main findings. First of all the distribution of capital and labor income in Sweden does not give any incentives for an elimination of the capital income tax. An elimination of the capital income tax is welfare distorting both on the aggregated level and for the majority of the households. Secondly, we find that it is Pareto improving

to reduce the capital income tax by 5%. Thirdly, the aggregated welfare is maximised under a capital income tax between 18-22% although this results in welfare losses for some households. One could therefore question whether the aggregated utility can be used to say anything about which reform should be implemented or not. Finally, it is clear that the expected welfare gains vary dramatically across households, which is a consequence of the differences across households in the net capital income/disposable income ratios.

The sensitivity analysis showed that our results are highly dependent on the initial distribution of capital and labor income across households and it is thus clear that the assumption of heterogeneous households is an important assumption when studying policy reforms. This simplistic model suggests that a small reduction of the capital income tax is Pareto improving and thus that there are welfare gains for all households from such a reform. Our contribution is thus that we find that there are strong incentives for a small reduction of the capital income tax in Sweden. The main drawback is that the model does not account for incomplete markets. Further research should take this into account to develop a more realistic model of the Swedish economy. In such a model it would be of interest to study if there still are Pareto improving tax reductions to be made.

8 Appendix

8.1 APPENDIX. A.1. – The Distribution of Capital and Labor Income

The data for the distribution of disposable income and net wealth is from Wealth Statistics (2004). We set the distribution of capital assets to correspond to the distribution of the net wealth in data found in Table 1. The distribution of labor productivity was set to correspond to the distribution of the disposable income in data, which is also found in Table 1. From these distributions and our calibrations we calculated the distribution of the capital and labor income, which is illustrated in Fig.9 and 10.

Figure 9

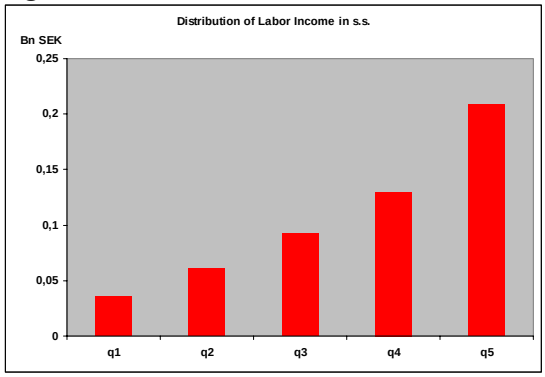
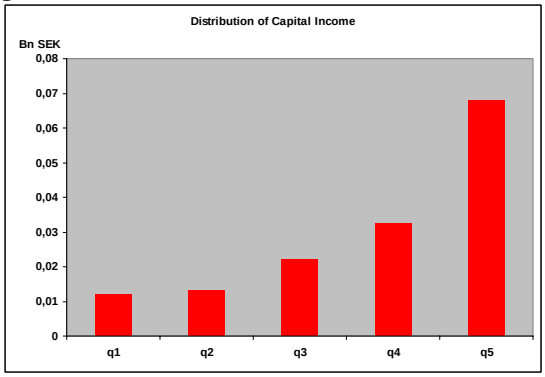


Figure 10



Source: Based on calculations from data (Wealth Statistics 2004, Statistics Sweden, Table 8) and Parameters in Table 3.

8.2 APPENDIX. A.2. – Welfare Calculations

As $\mu = 1$ then $U'(c_t) = \log c_t$, which means that we can rewrite eq. (13) to

$$(18) \qquad \sum_{t=0}^{\infty} \beta^t \left(\log(c_t^{iR}) - \phi \frac{h_t^{iR,1+1/\gamma}}{1+1/\gamma} \right) = \sum_{t=0}^{\infty} \beta^t \left(\log(1+\Delta_i) + \log\left(c_t^{iNR}\right) - \phi \frac{h_t^{iNR,1+1/\gamma}}{1+1/\gamma} \right)$$

We divide this equation into

$V^R = \sum_{t=0}^{\infty} \beta^t \left(\log(c_t^{iR}) - \phi \frac{h_t^{iR,1+1/\gamma}}{1+1/\gamma} \right)$ standing for welfare under reform

$V^{NR} = \sum_{t=0}^{\infty} \beta^t \left(\log\left(c_t^{iNR}\right) - \phi \frac{h_t^{iNR,1+1/\gamma}}{1+1/\gamma} \right)$ standing for welfare under non reform

The individual sigma (Δ_i) is the percentage welfare gain that household *i* require to be indifferent between the reform and the non reform situation. The individual sigma is calculated by

(19) $$V^R = V^{NR} + \sum_{t=0}^{\infty} \beta^t \log(1+\Delta_i) \Leftrightarrow V^R = V^{NR} + \frac{1}{1-\beta^t}\log(1+\Delta_i)$$

$$\Rightarrow \Delta_i = e\wedge\left(V^R - V^{NR}\right) * e\wedge\left(1-\beta^t\right) - 1$$

The aggregated welfare gain is solved following the same procedure.

8.3 APPENDIX. A.3. – The Households' Labor Supply and Capital

Figure 11

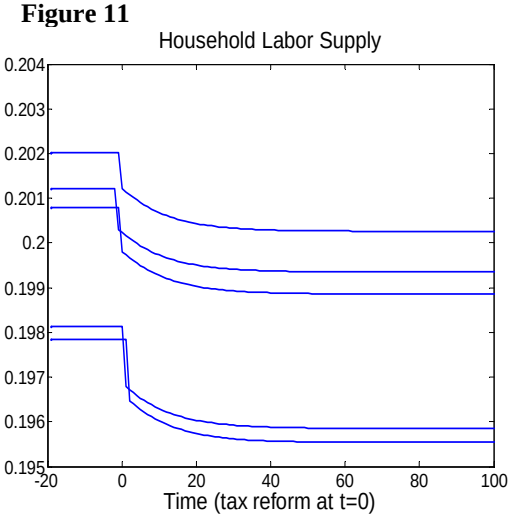
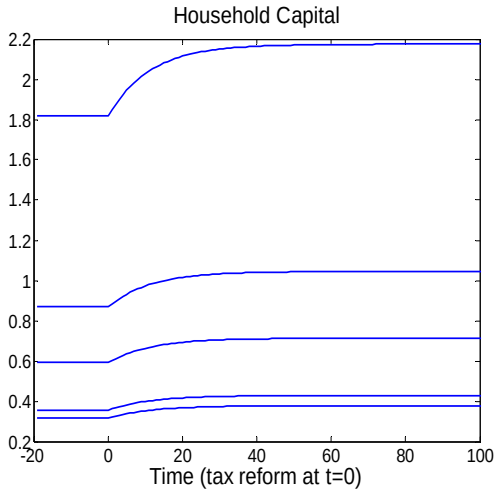


Figure 12



8.4 *APPENDIX. A.4. – Results from the Sensitivity Analysis*

Table 7 - Changing the Relative Income Ratios to find the Critical One

Household	Net Capital Income/Disposable Income in Sweden	Welf gains under zero tax with Swedish Ratios	Change 1 of Ratios, Net Capital Income/Disposable Income	Welf gains under zero tax with Ratios 1	Change 2 of Ratios, Net Capital Income/Disposable Income	Welf gains under zero tax with Ratios 2
1	0.25	0,0040	0.25	0,004	0.25	0,004
2	0.18	-0,0077	0.18	-0,0077	0.18	-0,0077
3	0.19	-0,0054	0.19	-0,0054	0.19	-0,0054
4	0.20	-0,0041	0.22	-0,0008	0.23	0,0009
5	0.25	0,0032	0.23	0,0012	0.23	0,0003
Utalitarian Welfare		**-0,002**		**-0,0017**		**-0,0016**

Table 8 - Results from Sensitivity Analysis

Household	$\gamma = 0$	$\gamma = 0.7$	$\mu = 3$
1	0,0110	-0,0028	0,0022
2	-0,0017	-0,0144	-0,0165
3	0,0027	-0,0121	-0,0131
4	0,0031	-0,0109	-0,0113
5	0,0102	-0,0035	0,0004
Aggregated -Utalitarian	**0,005**	**-0,0088**	**-0,0077**

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XV. WEALTH STATISTICS 2004, Statistics Sweden, Table 8a.