NBER WORKING PAPER SERIES

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Working Paper 6759
http://www.nber.org/papers/w6759

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
October 1998

Comments from participants at a seminar at Uppsala University and the TAPES conference in Copenhagen 1998 have been helpful. Financial support from the Bank of Sweden Tercentenary foundation is gratefully acknowledged. The views expressed here are those of the author and do not reflect those of the National Bureau of Economic Research.

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NBER Working Paper No. 6759
October 1998
JEL No. C14, D31, H31, J22

ABSTRACT

This paper evaluates the tax reforms carried out in Sweden between 1980 and 1991. We use a recently developed nonparametric estimation technique to account for labor supply responses. We decompose the tax returns to study how the separate components influence hours of work, tax revenues, and income distribution. The results indicate that the reform was underfinanced and that the increased indirect taxation and redesigned transfer system almost eliminated the positive effects on hours of work due to the decreased marginal taxes on labor income. Further, we compare the results to the predictions of a parametric estimated labor supply model. The responses of the parametric model is almost twice the size of the nonparametric.

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1. Introduction

The Swedish tax system has during the last 15 years been transformed in several important ways. Marginal tax rates reached a peak around 1980. However, since this system with very high marginal tax rates was combined with a system of fairly liberal rules for deductions of various forms, many economic agents could avoid the high marginal taxes by using the system of deductions in a clever way. During the eighties there was a series of tax reforms, decreasing marginal tax rates and limiting the scope for various forms of deductions. The series of tax reforms culminated in 1991 with a large change in marginal taxes between 1990 and 1991, several types of base broadening and the introduction of separate taxation of labor and capital income.

Several motivations have been given for implementing the tax reforms. The need to reduce the negative incentive effects of high marginal tax rates on household behavior such as savings and labor supply is probably the single most important one. Another motivation was a concern that the distributional effects of the old tax system were not the ones intended. The use of deductions could in many cases lead to high income earners paying very little in taxes.

The tax reform has been a continuous and gradual process for a long period of time. We therefore have a choice of what part of this process to study. We have chosen to study the effect of the tax reform that took place between 1980 and 1991. This period is of special interest since the tax systems in these two years constitute two extremes. Marginal tax rates reached a historical high in 1980 and a low in 1991.[1] We do not cover all aspects of the tax reform but focus on four changes of large importance for individual behavior; a decrease in marginal tax rates, an increase in the VAT and payroll taxes, a

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[1] After 1991 there have been some increases in the marginal tax rates.

change in the rules for capital income taxation and deductions, and a change in the transfer system.[2]

The major purpose of our paper is to study how the tax reform has affected hours of work, tax revenue and the income distribution. We investigate the total effect of the tax reform, but also perform a decomposition so we can see the effect of its various parts. A novel feature of this study is that we use a nonparametric labor supply function to calculate how hours of work change in response to the tax reform. This should lead to more reliable predictions than if a parametric function was used. Since this method is still not developed for household models we only present calculations of how hours of work change for married or cohabiting men in ages 20-60. This group constitutes a major part of the labor force if measured by the part of the tax base it generates.[3]

When discussing the effects on the income distribution we do this for two types of income units. First of all we do it for married or cohabiting men. Using the nonparametric labor supply function we can study how important the labor supply response is for the distribution of income. We also study how the distribution of household income, corrected for the number of household members, is affected by the tax reform. In the past such studies have usually neglected the effects that follow from changed household behavior. We are able to partly include the induced changes in labor supply. We take account of the change in the husbands hours of work but not of the change in female labor supply. The transfer system was designed so as to correct for inequalities created by the tax reform. The objective was that the combined changes in the tax-transfer systems should be distributionally neutral. The politicians were especially concerned that families with children should not be hurt by the reform. To get at this

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[2] There has also been important changes in the corporate taxation, which is not covered in this study.

[3] Aronsson and Palme (1998), using a parametric household model, study how labor supply, tax revenues and income distribution are affected by the tax reform. Agell et.al. (1996) give a broad picture and evaluation of the tax reform.

latter aspect we calculate the effect on the income distribution where we account for the fact that different households consist of different number of consumption units.

As far as we know this is the first study that uses a nonparametrically estimated labor supply function to evaluate the effect of a tax reform. A second purpose of our study is therefore to compare the predicted effects using this nonparametric method to the results obtained using a parametrically estimated labor supply function.

The rest of the study is organized as follows. In section 2 we give a stylized description of the Swedish tax reform. The motivation for using nonparametric methods and a description of the parametric and nonparametric procedures used are given in section 3. In section 4 we describe how the tax reform is decomposed and present our calculations of the effect of the tax reform on hours of work and tax revenue. In section 5 we study the income distribution effects. Section 6 concludes.

2. Swedish tax reforms 1980-1991

In this section we describe the main differences in the 1980 and 1991 tax and transfer systems. We partition the personal income tax system into three separate parts: labor income taxation, capital income taxation and real estate taxation. Further, we analyze the transfer systems and indirect taxes as separate components of the reforms. In interest of brevity this section only presents the main features of the tax and transfer systems. A more extensive presentation of the 1991 tax and transfer system can be found in appendix A. Blomquist and Hansson-Brusewitz (1990) contains a presentation of the 1980 tax system.

Personal income taxation

Combining the marginal tax rates and the rules of personal deductions the 1980 federal tax schedule could be represented by 22 income brackets with marginal tax rates ranging between 0 and 58%. The income brackets referred to assessed income, defined as the sum of labor and capital income, an imputed rental income for owner occupied homes and other sources of income, minus deductions of various sorts. Further, local governments levied a proportional tax of about 30% on the same tax base as the federal

tax. Thus, the unconstrained top aggregate marginal tax rate equaled approximately 88%. However, to bound the marginal effects the 1980 tax system restricted the marginal tax rate at 80% for assessed income below SEK 174,000 and 85% for higher assessed incomes.

In the 1991 tax system the various sources of income were taxed separately. In particular, the federal labor income taxation was separated from capital taxation and taxes on real estate. The federal marginal tax on labor income was reduced to a top marginal rate of 20% for income exceeding SEK 81,175 and there was no federal tax on lower incomes.[4] The local taxes, also levied on labor income, were roughly unchanged and consequently the top aggregate marginal tax rate on labor was approximately 50%. Including the rules of personal deductions, the 1991 labor income tax schedule included 7 income brackets, with marginal tax rates increasing from 0 to 50%.[5] As indicated above, the 1991 tax base differs from the 1980 tax base. Hence, comparisons of marginal tax rates on labor income should be made with caution. Income from capital was taxed at a uniform rate of 30% in 1991. If the tax on capital was negative, i.e. if the taxed individual reported a capital deficit, the negative amount was reduced from the overall tax liability leaving the marginal tax rates unaffected. Hence, in contrast to the 1980 system of capital taxation, the 1991 construction in practice eliminated the link between the income of capital and the marginal tax rate on labor income. Finally, individuals who owned their homes paid a real estate tax of 1.2% of the ratable value of the house.[6]

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[4] Henceforth all values are expressed in 1980 price level, using as deflator a CPI of 2.271.

[5] The personal deductions ceased to be income dependent practically at the same point as the federal tax started to be levied.

[6] Actually the tax rate depended on the age of the house, but since we do not have this information we assume that all houses are older than 5 years. It should also be mentioned that the tax rate of 1.2% was intended to increase to 1.5%. Simultaneously with the reformation of property taxation the ratable value of the houses were adjusted. We have taken this into account by calculating the market value of the house (ratable value in 1980 times the purchase price index in 1980) and then dividing the market value with the purchase price index in 1991. (purchase price index = "köpeskillings-koefficient")

Transfer system

The income tax reform was predicted to reduce tax payments of high income households, thereby generating unwanted redistributional effects. In order to avoid this the transfer system was redesigned to improve the economic conditions of households with low income and/or many children. The child allowance, which was independent of income, increased from SEK 2,850 per child to SEK 3,963 per child plus an additional amount increasing with the number of children in the household. Further, the part of the unreduced housing allowance which was dependent on family composition increased from SEK 1,500 per year and child to a fixed amount of SEK 5,300 per year if the household included children. On the other hand, the allowance associated with housing costs decreased from a proportional rate of 80% of costs exceeding SEK 450 per month to an average rate of about 65% of costs exceeding approximately SEK 600. The allowance was then reduced depending on the household composition, income and wealth. The construction of the reduction was not changed in the reform although the rates and limits were redefined. However, as will be shown below, there is no doubt that the housing allowance was substantially increased by the reform. The reformed transfer system also made more households eligible for allowances.

Indirect taxation

The net tax revenue for the government was predicted to be reduced by the income tax and transfer reforms. To compensate for this the VAT and payroll taxes were increased. Simultaneous with a broadening of the VAT base, the VAT rate increased from 21.34% in 1980 to 25% in 1991, measured as percentage of net price. The base broadening gives us reason to use an average VAT on a consumption bundle as an approximation of the aggregate effects of the increased VAT and base broadening. The average VAT equaled 12.8% and 16.5% in 1980 and 1991, respectively. Further, the pay roll taxes, measured as percentage of net wage payments, increased from 35.25% to 37.47%. Although a part of the payroll tax sometimes is considered as an insurance fee we have chosen to treat it

as a proportional tax. We neglect general equilibrium effects and assume that the gross wage rates are constant throughout all reforms and that all disposable income is consumed.

Figure 1 illustrates the aggregate marginal effects of the income tax schedule, transfer system and indirect taxation faced by an average individual. The solid line represents 1980, and the dashed line corresponds to 1991. The marginal effects are displayed on the vertical axis and the horizontal shows annual hours of work.

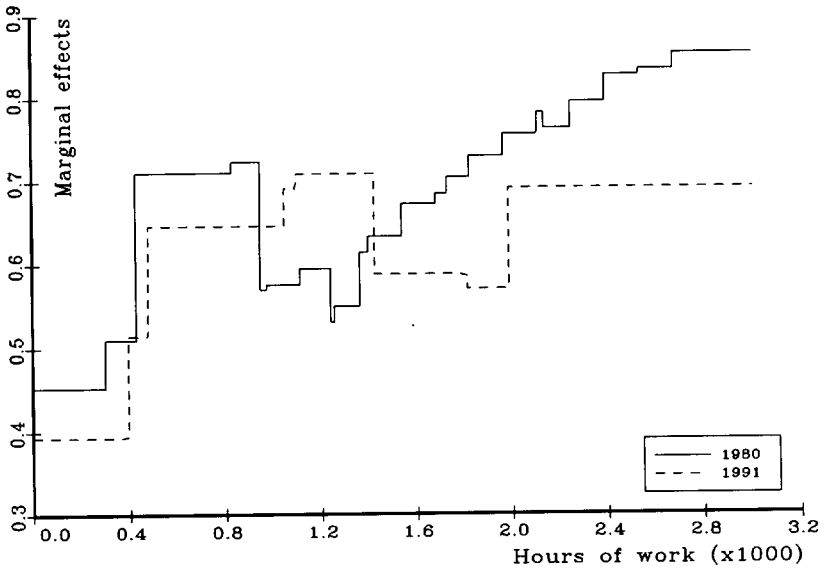

Figure 1. Aggregate marginal effects of income tax schedule, transfer system, VAT and payroll taxes 1980 and 1991 faced by an average individual.

As indicated in the figure, the differences between the marginal effects at plausible hours are not as substantial as might be expected. The aggregate marginal effect at 2,000 hours is roughly 75% in 1980 compared to 70% in 1991. However, the difference is larger at higher hours of work where the effects in the 1980 system approach 90% and the effects in 1991 stay around 70%. For moderate and low hours the differences depends on the individual's capital income, housing status etc.

In 1980, a negative capital income was deductible from labor income. Hence a capital deficit would shift the marginal effects rightwards in figure 1. In 1991, a deficit just creates a segment of zero marginal tax on labor income in the interval where the negative tax liability of capital exceed the tax liability of the other income sources. There

will be no marginal effects from capital taxation beyond the point where the tax liability of labor income and other sources equals the negative tax liability of capital.

Figure 2 illustrates the budget sets corresponding to the marginal effects presented above. The vertical axis shows the consumption (in thousands of SEK) and the horizontal annual hours of work.

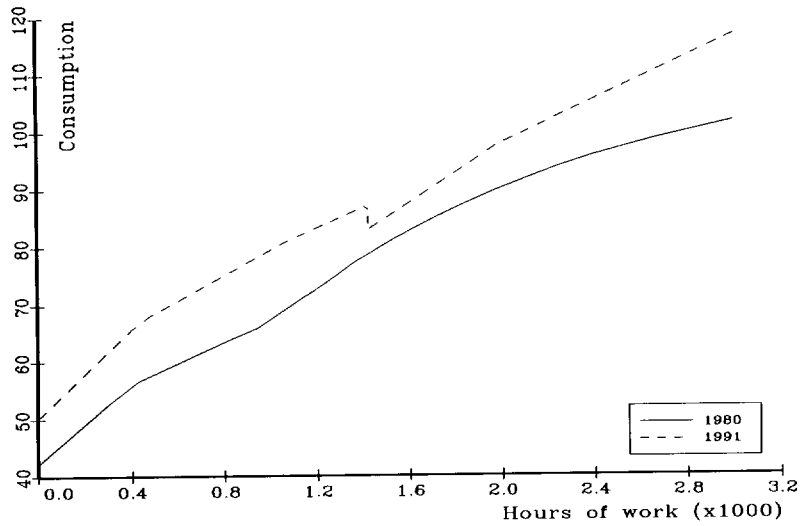

Figure 2. Budget set generated by the income tax schedule, transfer system, VAT and payroll taxes 1980 and 1991 faced by an average individual.

The figure indicates that an average individual has higher consumption possibilities in the 1991 than in the 1980 system. The vertical intercept of the budget set, i.e. the nonlabor income, can be separated into three components; the net income of the spouse, the transfers to the household at zero hours of work of head and a residual non-earned after tax income from capital and implicit rents. In 1980 the average individual received SEK 14,055 in transfers at zero hours of work, the corresponding figure for 1991 is SEK 19,327. Further, the average net income of the spouse equaled SEK 26,280 in 1980 and SEK 30,052 in 1991. The residual net non-earned incomes equaled SEK 1,855 and SEK 803 , respectively.

3. Parametric versus nonparametric estimation

Parametric estimation methods impose further restrictions than those implied by economic theory. To overcome these restrictions nonparametric estimation methods have been developed and become increasingly popular during the last decade. The restrictions imposed by parametric methods are particularly severe when estimating labor supply

functions generated by piece wise linear budget constraints. As we will illustrate below, this is because in the context of decision making subject to a piece wise linear budget constraint it is hard to think of other data generating processes (DGP) than utility maximization with globally convex preferences.

Suppose hours of work, h, are generated by a linear budget constraint defined by the wage rate w and nonlabor income y. Suppose we specify the parametric form to be estimated as: $I = a + \alpha w + \beta y + \varepsilon$, where ε is a random term. Accounting for corner solutions we define $h = 0$ if $I < 0$, $h = I$ if $0 \leq I \leq \overline{H}$ and $h = \overline{H}$ if $I > \overline{H}$. This model is well defined and coherent for *any* values of a, α and β. Suppose instead that the budget constraint is piece wise linear and that we want to specify a coherent model which also encompasses the case with just one segment. The usual way to construct a coherent DGP when the budget constraint is piece wise linear is to assume utility maximization with globally convex preferences. However, the assumption of globally convex preferences implies that $\alpha > 0$ and $\beta < \alpha / \overline{H}$. That is, the parametric form given above coupled with the requirement that it should represent globally convex preferences imposes severe constraints. Given the analytical functional forms we presently know, the assumption of globally convex preferences severely limit the flexibility of the functions.

Blomquist and Newey (1997) develop a nonparametric method to estimate labor supply functions generated by nonlinear piece wise linear budget constraints. We briefly describe this method below. The method is based on the idea that labor supply can be viewed as a function of the entire budget set, so that one way to account non parametrically for a nonlinear budget set is to estimate a nonparametric regression where the variable in the regression is the budget set. In the special case of a linear budget constraint this estimator would be the same as nonparametric regression on wage and nonlabor income, since these two numbers characterize the budget set. The method would then be similar to the one used in Hausman and Newey (1995). Nonlinear budget sets will be characterized by more numbers than two, for example for piece wise linear budget sets by location of kink points and slopes in between. An important part of the

development of an estimation procedure is to find a way to characterize a nonlinear budget constraint with just a few numbers.

Estimation procedure

Suppose the budget constraint consists of three linear segments as illustrated in figure 3. We denote the slopes of the linear segments by w_i, $i = 1,2,3$ and the intercepts of the extended linear segments by $y_i, i = 1,2,3$. The slopes are the net wage rates and the intercepts are the "virtual incomes". The two kink points are denoted ℓ_1 and ℓ_2.

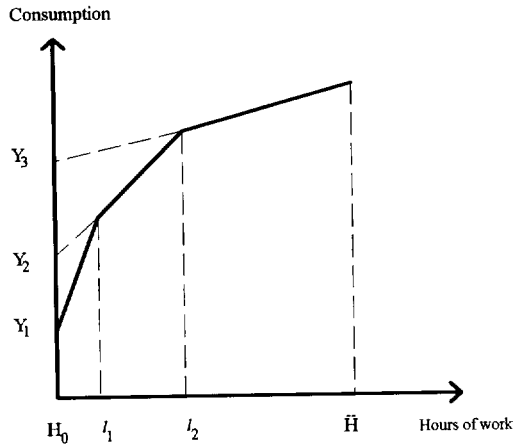

Figure 3. Three segment budget set.

If hours of work are generated by a budget constraint as the one illustrated in figure 3, then expected hours of work are given by a function $E(h^*) = f(w_1, w_2, w_3, y_1, y_2 . y_3)$. That is, there are 6 regressors in this nonparametric regression. The Swedish tax-transfer system from the early eighties generated budget constraints that consisted of 27 segments. To represent such a budget constraint would require 54 regressors. Without some simplifications to reduce the dimensionality of the problem nonparametric estimation would be unfeasible. We use two methods to reduce the dimensionality of the estimation problem. The first step in our estimation procedure is to approximate the budget constraints with continuos budget constraints consisting of three piece wise linear segments. In this way we reduce the dimensionality of the estimation problem to a manageable size. We also use some separability assumptions to reduce the dimensionality of the estimation problem. To approximate the budget constraints we use a least squares procedure.

The least squares approximation method

Take a set of points h_i, $i = 1,...,K$. Let $C(h_i)$ denote consumption on the true budget constraint and $\hat{C}(h_i)$ consumption on the approximating budget constraint. The criterion to choose the approximating budget constraint is *min* $\Sigma[C(h_i) - \hat{C}(h_i)]^2$. The approximation depends on how the h_i are chosen. Our criterion for choosing the h_i is how well the approximating budget constraints can explain actual data.[7]

Series estimator

The second step in the estimation procedure is to apply a series estimator to the wage rates, virtual incomes and kink points of the approximating budget constraints. It should be noted that the kink points can be written as simple nonlinear functions of the wage rates and virtual incomes, so the estimating functions are really only functions of wage rates and virtual incomes. To make use of the nonparametric flexibility of series estimators it is important to let the data determine what terms that should be included. In that way the nonparametric feature of the estimator becomes active. Here we will use cross-validation to chose both the number of terms and to compare different sequences of terms to include. The cross-validation criteria is defined as:

$$CV = 1 - \frac{\sum \left(h_i - \hat{g}_{-i}(x_i)\right)^2}{\sum (h_i - \bar{h})^2} \qquad (1)$$

where $\hat{g}_{-i}(\,)$ denotes the estimated function with observation i excluded. The upper bound of this measure is one. There is no lower bound.

Data source

To predict the effect of the tax reform we use the nonparametric labor supply function presented in Blomquist and Newey (1997). Three waves of the Swedish "Level of living" survey was used for the estimation. The data pertain to the years 1973, 1980 and 1990. The surveys were performed in 1974, 1981 and 1991. The 1974 and 1981 data sources

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[7] Blomquist and Newey (1997) contains a more detailed description of the approximation procedure.

are briefly described in Blomquist (1983) and Blomquist and Hansson-Brusewitz (1990) respectively. The 1990 data is described in Blomquist and Newey (1997).

In the estimation only data for married or cohabiting men in ages 20-60 are used. Farmers, pensioners, students, those with more than 5 weeks of sickleave, those who were liable for military service and self employed are excluded. This leaves us with 777 observations for 1973, 864 for 1980 and 680 for 1990.

The tax systems for 1973 and 1980 are described in Blomquist (1983) and Blomquist and Hansson-Brusewitz (1990). The tax system for 1990 is described in appendix A of Blomquist and Newey (1997). Housing allowances have over time become increasingly important. For 1980 and 1990 we have therefore included the effect of housing allowances on the budget constraints. The housing allowances increase the marginal tax rates in certain intervals and also create nonconvexities.[8]

The fact that data from three points in time are pooled has the obvious advantage that the number of observations increase. Another important advantage is that there is a variation in budget sets that is not possible with data from just one point in time. The tax systems were quite different in the three time periods which generates a large variation in the shapes of budget sets.

Blomquist and Newey (1997) derive an exact form for expected hours of work for a particular data generating process where the random preference variable is uniformly distributed. In this expression for expected hours of work the following two variables are important; $dy = \ell_1(y_1 - y_2) + \ell_2(y_2 - y_3)$ and $dw = \ell_1(w_1 - w_2) + \ell_2(w_2 - w_3)$. It turns out that in actual estimation where the cross validation measure is used to chose

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[8] The asymptotic properties of the estimator are presented in Blomquist and Newey (1997). These properties are derived under the assumption that budget sets are convex. According to Blomquist and Newey the general properties are similar for nonconvex budget sets. Blomquist and Newey present estimates for labor supply functions estimated on original nonconvex budget sets and functions estimated on budget sets that were convexified. The results were very similar. One reason for this might be that the nonconvexities usually appear at low hours of , i.e. a place in the budget constraint where individuals' choices are rarely located.

estimating function these two variables are important. The estimated nonparametric function is given in table 1.[9]

Table 1. Nonparametric estimates using pooled data.

Variables		
Const.	2.064	(49.85)
dy	-0.00210	(-4.37)
dw	-0.00145	(-1.16)
y_3	-0.0036	(-3.95)
w_3	0.00964	(6.61)
y_3^2	1.98×10^{-5}	(3.40)
wage elasticity	0.075	(6.61)
income elasticity	-0.038	(-4.31)
Cross validation	0.0373	

Note: t-values in parentheses. The delta method was used to calculate the t-values for the elasticities.

We also use two parametrically estimated functions. Both are versions of the random preference model described in, for example, Blomquist and Hansson-Brusewitz (1990). To perform this estimation we have convexified the budget constraints for data from 1980 and 1990. There is, of course, a wide choice of what parametric functions to estimate. A labor supply function linear in the wage rate and nonlabor income have been used extensively in previous labor supply studies. It can therefore be of interest to estimate this parametric form. As discussed in section 3, the linear labor supply function is very restrictive. We therefore also estimate a more fexible form advocated by Blundell et al. (1991). This function is linear in the logarithm of the wage rate and the ratio of

[9] Several different sequences of terms to include in the series estimator were tried. We have chosen not to include time effects in the labor supply function. Adding time effects would give a better fit to the data in a mechanical sense. However, it would not increase our understanding of labor supply behavior and it would not increase the predictive power of the labor supply functions when we calculate the effect of a tax reform.

nonlabor income and the wage rate. We show the estimated functions in eqs. (2a) and (2b) with the t-values given in parenthesis beneath each coefficient.[10,11]

$$\underset{}{h = 1.914 + 0.0157w - 8.65*10^{-4}y - 9.96*10^{-3}AGE - 3.46*10^{-3}NC} \quad (2a)$$
$$\underset{(62.09)}{} \quad \underset{(8.96)}{} \quad \underset{(-5.95)}{} \quad \underset{(-0.53)}{} \quad \underset{(-0.44)}{}$$
$$\ln L = -225.43 \qquad \underset{(42.12)}{\sigma_\eta = 0.270} \qquad \underset{(11.81)}{\sigma_\varepsilon = 0.105} \qquad E_w = 0.123 \qquad E_y = -0.022$$

$$\underset{}{h = 1.432 + 0.2605lnw - 9.092*10^{-3}y/w - 1.089*10^{-2}AGE - 1.037*10^{-3}NC} \quad (2b)$$
$$\underset{(27.10)}{} \quad \underset{(14.64)}{} \quad \underset{(-2.59)}{} \quad \underset{(-0.68)}{} \quad \underset{(-0.16)}{}$$
$$\ln L = -218.40 \qquad \underset{(40.16)}{\sigma_\eta = 0.280} \qquad \underset{(8.10)}{\sigma_\varepsilon = 0.093} \qquad E_w = 0.137 \qquad E_y = -0.014$$

The wage and income elasticities are evaluated at the mean of the net wage rates and virtual incomes from the segments where individuals observed hours of work are located.[12] Of course, the wage and income elasticities are summary measures of how the estimated functions predict how changes in a linear budget constraint affect hours of work. None of the budget constraints used for the estimation are linear and we actually never observe linear budget constraints. It is therefore of larger interest to see how the predictions differ between the parametric and nonparametric labor supply functions for discrete changes in nonlinear budget constraints.

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[10] The variance-covariance matrix for the estimated parameter vector is calculated as the inverse of the Hessian of the log-likelihood function evaluated at the estimated parameter vector. We have had to resort to numerically calculated derivatives. It is our experience that the variance-covariance matrix obtained by numerical derivatives give less reliable results than when analytic derivatives are used.

[11] Net wage rates and virtual income are expressed in the 1980 price level for all years. The wage and income elasticities are evaluated at the average net wage rate and virtual income. The net wage rate and virtual income being calculated for the segment where observed hours are located.

[12] Ackum-Agell and Meghir (1995), using another data source and an instrumental variables estimation technique, present wage elasticities that are quite similar to those presented here.

4. Effects on labor supply and tax revenue

4.1 Decomposition of tax reform

The Swedish tax reform consists of many different parts. If the policy makers would like to do further changes in the tax system it would be of value to know the effect of the various components of the tax reform. Which changes in the past has stimulated labor supply most. What changes work in the opposite direction? What changes increase tax revenue? What changes decrease tax revenue? As far as we know this is the first study that makes a detailed decomposition of the tax reform.

The decomposition can be made in several different ways. One way would be to follow the exact chronological order in which the reform has taken place. However, if we follow this route we intertwine decreases in marginal tax rates, base broadening and restrictions in rules for deductions. We believe this will blur the picture. Instead we have chosen to use the following sequence.

i) Change the marginal taxes from the 1980 to the 1991 level taking account of changes in the personal exemption rules.
ii) Change the value added and payroll taxes from the 1980 to the 1991 levels.
iii) Change the capital income tax rules and the rules for taxation of homes.
iv) Change the housing allowance and child allowance rules.

We calculate the effect of a reform, given the previous changes. This implies that the picture of the effect of the various parts of the reform that we obtain depends on the sequence in which we introduce the various parts of the reform.

The changes in the housing and child allowance systems were designed so as to correct for unwanted distributional effects of other changes in the tax system, so it is natural to place this part of the reform last in the sequence. The decrease in marginal taxes was one of the cornerstones in the tax reform and many perhaps regard this as the quintessence of tax reform. One can regard some of the other changes in the tax system being of interest and politically feasible only after or in combination with decreased marginal taxes.

4.2 Labor supply effects

We will use the distribution of gross wage rates and nonlabor incomes in the 1980 data set as the basis for our calculations. For each observation in the 1980 data set we use the gross wage rate and nonlabor income in combination with the appropriate tax and transfer system to construct a budget set. This budget constraint is then approximated by the least squares procedure described above. Finally we use the nonparametrically estimated labor supply function to calculate the expected hours of work. Since the nonparametric function concerns expectation of hours of work, we need to perform the calculation one time for each observed budget set (individual), leaving us with 864 observations. We assume that the spouse do not adjust her labor supply due to the tax reforms, i.e. we take the gross capital and labor income of the spouse as exogenous.[13] However, we do allow the husband to react to the changes in the post tax income of the spouse, i.e. we recalculate the net income of the spouse under each separate tax regime.

Figure 4 illustrates a crude picture of the labor supply effects of the decomposed reforms presented previously. The vertical axis displays the predicted expected hours, the horizontal axis shows the introduced reform. Moving from left to right on the reform axis we start with the 1980 base case, followed by the reformed marginal tax rates of 1991, then we introduce the VAT and the payroll taxes of 1991, and so on. The diamond symbols correspond to the means of predicted hours in the samples (asymptotic standard errors of means in parenthesis) [14], the whiskers on the vertical lines indicate the upper

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[13] Aronsson and Palme (1998) estimate a parametric houshold model and use the estimated model to calculate the effect of tax reform. They find that the effect of the swedish tax reform on married women's labor supply is quite small. This is because their labor supply is affected by two cancelling effects. The tax reform increase female net wage rates, which increase their labor supply. However, this is counteracted by a negative cross-effect from the increase in husbands net wage rates. Aronsson and Palme also find that the cross-effect from women's wage rates to husbands hors of work is quite small. The results of Aronsson and Palme therefor suggest that the fact that we can not incorporate changes in women's hours of work might not be too serious.

[14] Let β be a vector of OLS estimates, Ω the estimated variance-covariance matrix of the β's and X a matrix of explanatory variables (including a constant in the first column). Then the variance of the estimated mean is $e'X\Omega X'e/N^2$, where e is a vector of ones (Nx1).

endpoints of the 10'th and 90'th percentiles of the predicted distributions of hours. In other words, 80% of the predicted sample is contained within the vertical lines, where the diamonds represent the sample means.

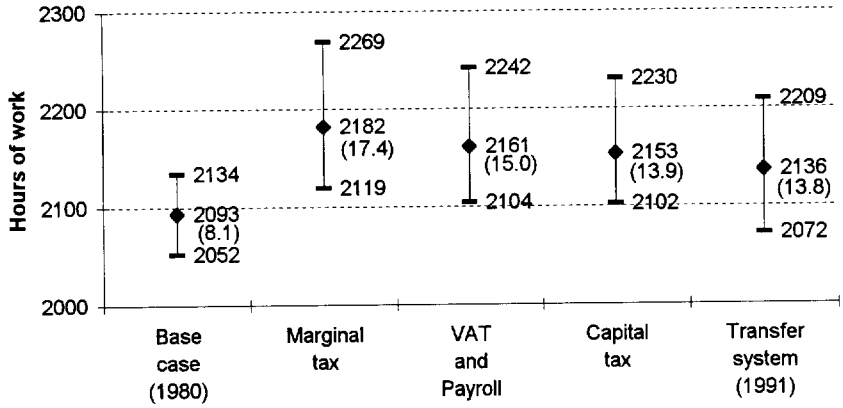

Figure 4. Nonparametric predictions of hours of work by decomposed reform.

The figure indicates that, given the distribution of gross wages and nonlabor incomes of 1980, the marginal tax reform considerably encourages labor supply, increasing the average hours of work from 2,093 to 2,182 (roughly 4.3%). All the other components of the reform reduce the average hours of work. The raise in indirect taxes lowers the average about 20 hours per year (≈-1%). The reform of capital and property taxation reduces the average about -0.4%, where the disincentive effects are most apparent for individuals associated with high hours of work (-0.7%). Finally, the 1991 transfer system lowers the labor supply with approximately -0.7%. In particular, the lower decile reduce their supply by approximately 30 hours per year (more than -1%).

Considering the distribution of hours of work the dispersion increased by the aggregate reform. In our sequence of reforms the marginal tax reform and the change of the transfer system increase the dispersion of hours. On the other hand, the introduction of increased indirect taxes and the 1991 system of capital taxation seems to tighten the distribution of hours.

The results from this section indicate that the marginal tax reform increases hours of work while the other components reduce average labor supply for married/cohabiting men. Considering the total reform the nonparametric model predicts the average labor

supply to increase by about 2.0% and that the distribution of hours becomes more dispersed.

Gross wage and labor supply effects

In the remainder of this section we will study how individuals with different characteristics respond to the reforms. The first characteristic is the gross hourly wage rate. There are several ways to analyze the incentive effects for different levels of the gross wage rate. We could study the effects for observations attached with different gross wage rate. In that case we would face problems to distinguish the wage effect from other, perhaps co-varying effects. A more appealing alternative is to study the, so called, mongrel labor supply function (see Blomquist and Hansson-Brusewitz (1990)). This function gives the relationship between the gross wage rate and hours of work, conditional on the tax system and other independent variables. In figure 5 we illustrate four mongrel curves generated for an average individual facing the various tax and transfer systems previously described. Note that the effects of the marginal tax reform and the raised indirect taxes are combined for presentational purposes. The vertical axis shows the post payroll wage rate and the horizontal axis shows hours of work. The solid lines illustrate the 1980 base case and the 1991 case, respectively. The long dashed line presents the mongrel function generated after the marginal tax rate reform (including the VAT and payroll reforms) and the short dashed present the mongrel function with the capital taxation of 1991 introduced.

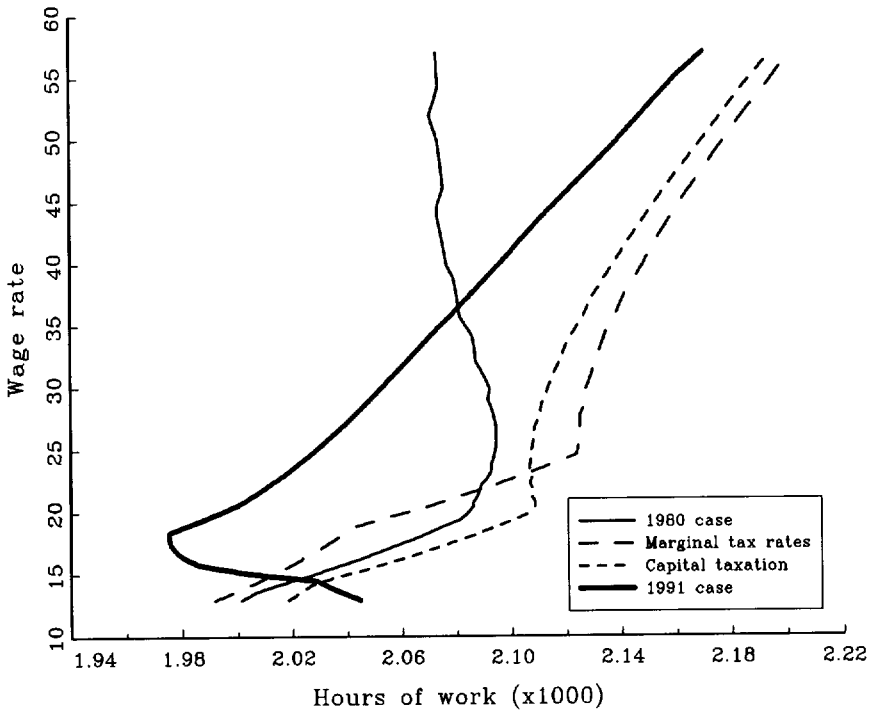

Figure 5. The mongrel supply functions, predicted by the nonparametric model[15]

First, considering the mongrel function generated by the 1980 system we observe that it is backward-bending for plausible wage rates (SEK 25 - 50), i.e. an increase in the pre tax wage rate decreases the expected hours of work. It should be emphasized that it is the tax and transfer systems that generate this shape of the mongrel function.

Changing the 1980 marginal tax rates to the 1991 rates, including the increased indirect taxation, stimulates labor supply for individuals with moderate or high wages. For very low wages (< SEK 20) the labor supply is predicted to decrease (of course, such low wages are rarely seen in reality). An explanation for this perhaps counter-intuitive result could be the following: The average individual studied in figure 5 reports a deficit in capital and, for sufficiently low wage rates, that individual might deduct all labor income and as a result face a zero marginal tax rate on labor income. However, since we include the increased indirect taxes in the marginal tax reform the individual

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[15] As we approximate the observed budget sets using the OLS-procedure we can only regard a discrete number of potential kink points. This procedure generates some discontinuities in the mongrel functions. In this figure we have smoothed the functions for presentational purposes.

actually face a higher marginal tax rate with the 1991 marginal tax rates including the increased indirect taxes compared to the 1980 base case. For more plausible wage rates the model predicts an increase of hours of work and a strong positive relationship between gross wage rate and hours of work. For the average wage rate in the sample (SEK 41 post payroll) the model predicts an increase of approximately 1.6% (cf. figure 4).

Introducing the 1991 capital and real estate tax rules, which separates the labor income from the other income sources, implies some interesting results. Recall that the 1991 construction eliminates the marginal effects on labor taxation caused by capital deficits, except in the interval where the negative capital tax liability exceeds the tax liability on labor income. Outside this interval the 1991 construction resembles a positive lump sum transfer to the individual without any marginal effects on labor income. For exceptionally low wages the interval where the marginal tax rate on labor income is zero might extend to plausible hours of work, implying that the individual faces a zero marginal tax rate in the 1991 tax system but a positive marginal rate under the 1980 tax rules. This is probably the reason why the figure indicates that hours of work increase for very low wages. However, for moderate and high wages the reconstruction generates a reduction in hours of work. This should be expected since a positive lump sum transfer reduce hours of work if leisure is a normal good.

Finally, the reform of the transfer system, that significantly increases the nonlabor income, reduces labor supply for all wage rates compared to the situation where the 1980 transfer system was prevailing (i.e. the short dashed *capital income* curve).

Comparing the 1980 base case and the 1991 case the nonparametric model suggests that individuals with high gross wage rates increased their annual hours of work while individuals with low wage rates reduced their hours of work.

Family composition and labor supply effects

Since the reformed transfer program was designed to improve the economic conditions of households with many children, an alternative and interesting characterization is by

family composition. In figure 6 we illustrate how the average of hours of work vary by the number of children in the household. The solid diamonds represent the full sample, the circles the average in households without children, the horizontal bar one child, the cross two children and finally, the triangle represent three or more children in the household.

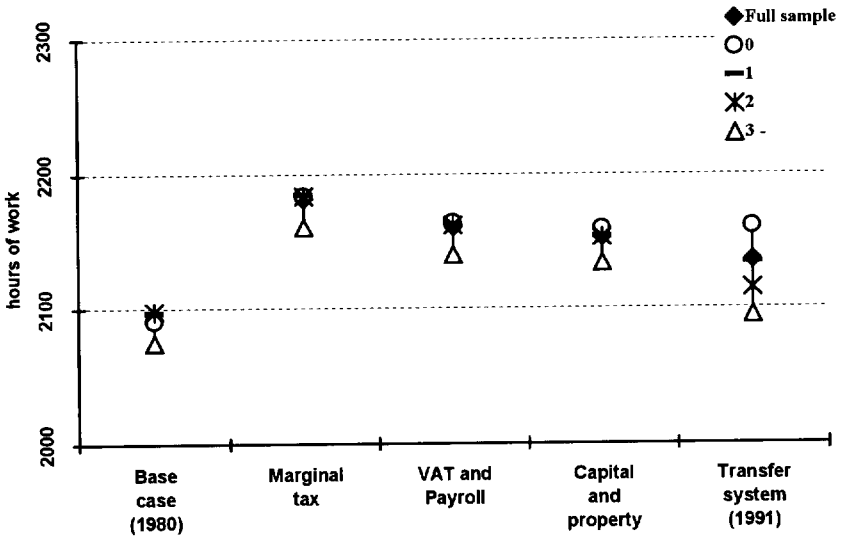

Figure 6. Nonparametric predictions of hours of work by decomposed reform and number of children. (Sample size: 0;330, 1;222, 2;240, 3;72)

The figure implies a remarkable relationship between the reform of the transfer system and the spread in the distribution of hours. For the 1980 regime of transfers, there is no divergence in hours of work between households with no or few children. Under the 1991 transfer system, however, the dispersion is quite large - individuals without any children works on average about 2,161 hours per year, while individuals with more than 2 children works about 2,095 hours. The figures also indicate that the number of children reduces hours of work in the 1991 regime.

In order to understand the source of the dispersion of hours of work under the 1991 regime we need to take a brief look at the budget sets faced by an average individual. Figure 7 illustrates budget sets faced by an average individual with zero and three children, respectively. The vertical axis shows the consumption possibilities and the horizontal axis shows hours of work.

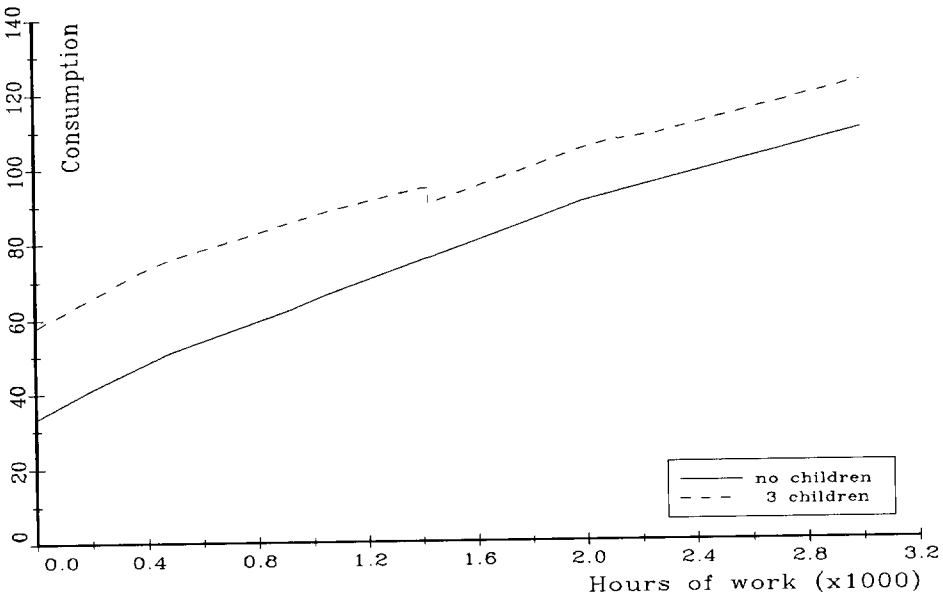

Figure 7. 1991 budget sets for an average individual with no and 3 children.

The most striking difference between the two budget sets is the intercepts. At zero hours of work the household with children receives almost SEK 27,000 in transfers per year including SEK 13,870 in income independent child allowance. The household with no children receives less than SEK 2,500 per year in housing allowance which is reduced to zero at plausible hours. On the other hand, the reduction rate of the housing allowance is 20% for households with children and only 10% for households without children. Consequently the former face a higher marginal effect than the latter in the intervals where the housing allowance is reduced. Even though there are differences in marginal effects we might conclude that it is the child allowance that generates the dispersion in hours of work. We want to emphasize that this dispersion is only due to the discrepancies in budget sets and not to differences in preferences.

4.3 Parametric predictions of labor supply

To illustrate some of the differences between parametric and nonparametric predictions we duplicate the analysis in the introduction of section 4.2 with the modification that we use parametric models to predict hours of work. The parameters are found in eqs. (2a) and (2b). Since this is a random preference model we need to draw several random numbers for each observation in order to calculate expected hours of

wok. The results presented in table 2 and figure 8 are based on the average of 100 simulations.

Table 2. Nonparametric and parametric predictions of hours of work

	Base case (1980)	Marginal tax	VAT and payroll	Capital and property	Transfer system (1991)
Non-parametric.					
10'th percentile	2052	2119	2104	2102	2072
Mean	2093	2182	2161	2153	2136
90'th percentile	2134	2269	2242	2230	2209
Parametric. Model 2a					
10'th percentile	2059	2174	2152	2148	2129
Mean	2120	2268	2238	2227	2220
90'th percentile	2182	2382	2340	2319	2317
Parametric. Model 2b					
10'th percentile	2051	2164	2142	2140	2123
Mean	2112	2240	2218	2209	2201
90'th percentile	2177	2322	2297	2287	2285

We see that both the parametric models predict a larger increase in hours of work than the nonparametric model. The predictions of model 2b are somewhat closer to the nonparametric predictions. To conserve on space we in the following only comment on the results of this model. In figure 8 we illustrate the predictions graphically. The vertical axis shows predicted hours of work and the horizontal axis displays the reforms (cf. figure 4). The endpoints represent the upper limits of the 10'th and 90'th percentlies, respectively, and the diamonds correspond the sample means. The crosses correspond to the nonparametric means presented in figure 4.

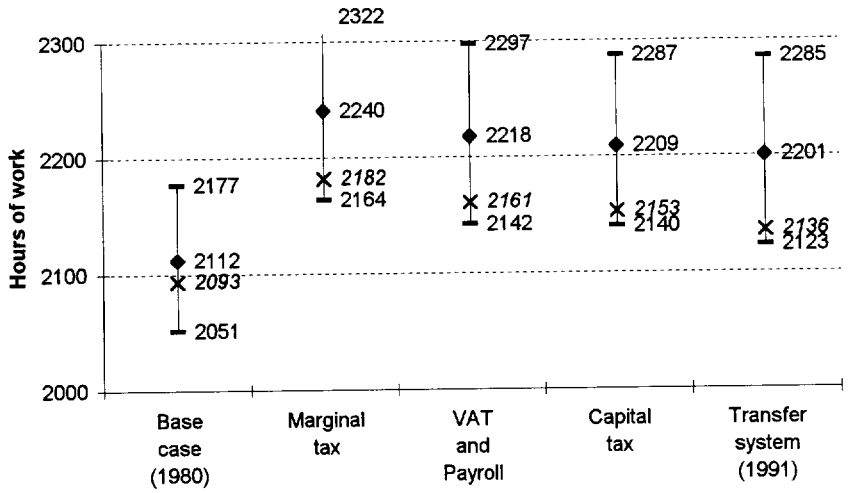

Figure 8. Parametric predictions of hours of work by decomposed reform

Comparing the predictions of the parametric and nonparametric models we conclude that the parametric model yields almost the same qualitative effects on hours of work although the magnitude of the variation is much larger in the parametric model. The percentage increase in average hours of work by introducing the 1991 marginal tax rates is approximately 6.1% compared to 4.2% predicted by the nonparametric model. The overall percentage increase is 4.2% by the parametric model and 2.0% by the nonparametric. Another notable difference is the distribution of hours of work, where the nonparametric model implies a tighter distribution for expected hours of work.

4.4 The effect of tax reform on tax revenue from husbands

In this subsection we discuss the effect of tax reform on government tax revenue from married/cohabiting men. However, since we use the transfer system with child and housing allowances to construct the budget sets of the husbands we also include these payments in the net tax revenue of the government. The average tax revenues from husbands are presented in table 3. Each row corresponds to a tax system with the reform specified in the first column introduced. The leftmost column gives the revenues from payroll taxes. The second column presents the revenues from income taxes, including income of capital and property. The third column presents the revenues from VAT (based on disposable income). The gross tax revenues are presented in column four. The fifth column shows the average transfers received by the households, where the negative

sign indicates that the transfers are paid by the government. Finally, the rightmost column presents the average net tax revenues, i.e. post transfer payments.

Table 3. Average tax revenue predicted by nonparametric model.

Reform	Payroll[1]	Income[1]	VAT[1]	Gross Rev[2]	Transfer[2]	Net Rev[2]
1980 Base case	30244 *45*	31868 *47*	5697 *8*	67810 *100*	-3595 *100*	64214 *100*
Marginal tax rate	31764 *51*	22747 *37*	7411 *12*	61924 *91*	-3550 *99*	58374 *91*
Indirect taxation	32871 *51*	21826 *34*	9317 *15*	64015 *94*	-3582 *100*	60433 *94*
Capital and property tax	32740 *50*	23261 *36*	9022 *14*	65024 *96*	-3581 *100*	61443 *96*
Transfer system	32468 *50*	23112 *36*	9273 *14*	64854 *96*	-5676 *158*	59178 *92*

[1] The *italics* correspond to the percentage contribution to gross tax revenue (i.e. pre transfer payments)
[2] The *italics* correspond to the percentage of tax revenue (transfers) of 1980

The net tax revenue column of table 3 indicates that the reform was under financed by approximately 8%. However, there are several reasons to be careful interpreting this result. Firstly, we account for the transfer payments to the households but we do not include the tax payments of the spouse. Secondly, as mentioned in the introduction, we only consider the reform associated with taxation of physical persons, leaving out the budget effects of the corporate taxation. Thirdly, due to lack of data we are unable to take full account for the complete base broadening, including fringe benefits as well as other important features, concerning capital taxation and indirect taxes. Hence, the figure is most probably an overstatement of the true deficit generated by the aggregate reform and should be viewed as an indication of the direction of the government budget effects.

As might be expected, the marginal tax reform alone reduced tax revenues by almost 10%, while the increased indirect taxation and change of structure of capital and property taxation increased tax revenues generating net effects of about -4% (pre transfer reform).

Another notable feature is the shares of contribution by income taxes versus indirect taxes. The table indicates that the tax revenue shares corresponding to the indirect taxes increased from 53% to 64% by the reform, i.e. the taxation shifted from income taxation towards indirect taxation. The average transfer payments to households increased substantially (about 60%) when the 1991 transfer system was introduced. Finally, it

might appear puzzling that the revenue from VAT actually increases in the last reform as the labor supply in fact decreases, however this is because the VAT is based on disposable income, where the increased transfers are included.

5. Income Distribution Effects

5.1 The distribution of husbands incomes

As mentioned in the introduction, one of the objectives of the reform was to decrease the excess burden caused by the tax system. However, the aim was to do this without any budget or distributional effects. In the previous section we indicated that the reform was underfinanced by approximately 8%. This section considers the effects on the distribution of husbands incomes. We use the Gini coefficient to measure inequality. In contrast to many other studies we also present standard deviations of the Gini coefficients.[16]

Table 4 presents the average gross income and other definitions of income based on the construction of the tax system. The gross income is defined as gross earned income (pre payroll taxes), plus capital income.[17] The other concepts are defined as post tax incomes as indicated in the column title. Since we assume that the gross wage is constant the individual gross income is just a linear function of individual hours of work. Hence, studying the gross income is approximately the same as studying hours of work, weighted by hourly gross wage rate. However, the subsequent definitions include the

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[16] Since the estimated parameters are stochastic variables, drawn from an unknown asymptotic distribution, the observed (predicted) hours of work (and consequently the predicted incomes) are also stochastic with an unknown asymptotic distribution. The distribution of the Gini coefficient might perhaps be derived by ordered statistics and delta methods but due to the depth of this problem we are satisfied by estimating the standard deviations by Monte Carlo simulations. Given the estimated parameter vector we make 1,000 draws from the estimated parameter distribution and calculate the Gini coefficient for each draw. From the resulting distribution we get the estimate of the standard deviation of the Gini coefficient.

[17] This definition of capital income does not include the implicit income from owner occupied homes.

nonlinear tax system, thus generating a different distribution as compared to hours of work.[18]

Table 4. Average income of husbands predicted by nonparametric model.

Reform	Gross inc[1]	Post Payroll[2]	Post Inc tax[2]	Post Trans[2]	Post VAT[2]
1980 Base case	103030 *100.0*	72786 *70.6*	40917 *39.7*	44513 *43.2*	38815 *37.7*
Marginal tax rate	108864 *105.7*	77099 *70.8*	54352 *49.9*	57901 *53.2*	50490 *46.4*
Indirect taxation	107585 *104.4*	74713 *69.4*	52887 *49.2*	56469 *52.5*	47152 *43.8*
Capital and property tax	107103 *104.0*	74362 *69.4*	51101 *47.7*	54683 *51.1*	45660 *42.6*
Transfer system	106105 *103.0*	73637 *69.4*	50524 *47.6*	56200 *53.0*	46927 *44.2*

[1] The *italics* correspond to the percentage of 1980 gross income
[2] The *italics* correspond to the remaining fraction of gross income

As can be seen from the table, the average gross income increased about 3%, while the average net income increased by more than 20%. The average tax rate decreased from an approximate level of 62% in 1980 to 56% in 1991.

We have calculated two sets of Gini coefficients, one assuming that no behavioral responses are present (i.e. individuals do not adjust to the new tax system), and the other taking the adjustments into account. A comparison of the coefficients might give an indication if the adjustment of hours of work increase or decrease the inequality of income distribution. Table 5 presents the Gini coefficients based on gross and net income. The column titled *"Fixed"* refers to income calculated as if the hours of work equals hours of work in the 1980 system and, consequently, the *"Adjusted"* title refers to adjusted labor supply.

[18] Henceforth, gross income denote the income before any taxes (incl. payroll taxes) has been paid, the net income corresponds to the income when all taxes (incl. VAT) has been paid. Concerning the average tax rate, the interpretation is actually the average of the proportional tax rate that generates the same net income.

Table 5. Gini coefficients of income of heads based on fixed and adjusted hours of work predicted by nonparametric model.

Reform	Gross income			Net income (post VAT)		
	Fixed	*Adjusted*		*Fixed*	*Adjusted*	
1980 Base case	0.1754	0.1754	*0.00221*	0.1113	0.1114	*0.00144*
Marginal tax rate	-	0.1908	*0.00264*	0.1495	0.1598	*0.00165*
Indirect taxation	-	0.1893	*0.00244*	0.1506	0.1604	*0.00157*
Capital and property tax	-	0.1902	*0.00240*	0.1536	0.1650	*0.00128*
Transfer system	-	0.1922	*0.00246*	0.1440	0.1551	*0.00132*

Note: Monte Carlo simulated standard errors in *italics*. Fixed results based on 100 simulations.

The results in table 5 indicate that we might underestimate the distributional effects if we do not take the labor supply incentive effects into account. The Gini coefficients are higher if we take labor supply into account. It is also clear that the reform failed to keep the income distribution unaffected; the Gini coefficient based on net income (post VAT) increased from 0.111 to 0.155. Introducing the 1991 rules of capital and property taxation increases the inequality. From the last row of the table we conclude that the introduction of the 1991 transfer system increased the dispersion of gross income, while the net income ended up being considerably more equally distributed. Although the transfer reform reduced the inequality of husbands incomes, it did not completely eliminate the redistributional effects from the reforms concerning the direct and indirect taxation.

5.2 The distribution of households incomes

An alternative to the previous analysis is to consider the distribution of incomes of households instead of husbands. However, since the households differ in size and composition we should take this into account by dividing the aggregate household income by some number of equivalent consumption units. We have chosen to represent the two adults in the household as 1.92 consumption units, reflecting the economies of scale. Each child adds another 0.66 consumption units to the household.[19] We then assign the calculated equivalent income to each household member. By this procedure

[19] This equivalence scale is used by the Ministry of Social Affairs (*Socialdepartementet*).

the aggregate equivalent income of the households is weighted by the size of each household. The Gini coefficients based on equivalent incomes are presented in table 6.

Table 6. Gini coefficients of equivalent income based on fixed and adjusted hours of work predicted by nonparametric model

Reform	Gross income			Net income		
	Fixed	*Adjusted*		*Fixed*	*Adjusted*	
1980 Base case	0.2514	0.2514	*0.00088*	0.2109	0.2109	*0.00038*
Marginal tax rate	-	0.2566	*0.00129*	0.2282	0.2306	*0.00076*
Indirect taxation	-	0.2559	*0.00122*	0.2284	0.2307	*0.00073*
Capital and property tax	-	0.2563	*0.00124*	0.2317	0.2343	*0.00074*
Transfer system	-	0.2602	*0.00145*	0.2114	0.2172	*0.00090*

Note: Monte Carlo simulated standard errors in *italics*. Fixed results based on 100 simulations.

From the analysis in section 5.1 we conclude that the reform was not distributionally neutral. The inequality, measured by the Gini coefficient, increased from 0.111 to 0.155 by the aggregate reform. However, the results in table 6 indicate that, using the equivalent income as the appropriate concept, the reform appears to be almost distributionally neutral. The Gini coefficient increased from 0.211 in 1980 case to 0.217 in 1991. The marginal tax rates, indirect taxation and capital and property taxation reforms all increase the inequality while the redesign of the transfer system considerably reduces the inequality. We also note that the Gini coefficients of the equivalent net income when the hours of work are held fixed are almost equal for the two extreme cases. This implies that if we ignore the incentive effects we might exaggerate the redistributional effects of the reform. The table also shows that the equivalent gross income is more unequally distributed in the 1991 system than in the 1980 system as a result of the dynamic effects.

Finally we present the predicted gross and net income as well as the tax revenues from the whole household, i.e. including the VAT, pay roll tax and income taxes paid by the spouse. The results are presented in table 7.

Table 7. Average income and tax payments of households predicted by nonparametric model

Reform	Gross income[1]	Net income[1]	Tax Payments[1]
1980 Base case	141269 *100*	60637 *100*	80632 *100*
Marginal tax rate	147103 *104*	76095 *125*	71007 *88*
Indirect taxation	145194 *103*	71304 *118*	73889 *92*
Capital and property tax	145341 *103*	70095 *116*	75246 *93*
Transfer system	143713 *102*	70800 *117*	72913 *90*

[1] The *italics* correspond to the percentage of 1980 gross income

6. Summary

In this paper we use a nonparametric labor supply function to study the effect of Swedish tax reform. We have decomposed the effect into parts. We find that the decrease in marginal tax rates that took place between 1980 and 1991 lead to an increase in average desired hours for married men of slightly more than 4.2%. The increase is considerably larger for high wage persons than for low wage persons. Adding the other parts of the tax reform cumulatively we find that the increase in VAT and the payroll tax on average decrease hours of work by around one percentage point. The change in the capital income and property tax reduce hours of work by another half percentage point. The change in the transfer system decreases hours of work by slightly less than one percentage point. The net effect of the reform is therefore an increase of average hours of work by slightly more than two percent. However, the change in hours of work differ depending on individuals' gross wage rates and family composition. Individuals with a gross wage rate of SEK 55 increased their hours of work by 3.8%, whereas individuals with a gross wage rate of SEK 30 decreased their hours of work by 1.6%. Weighting hours of work by their marginal product (gross wage rate) the increase in hours of work is therefore 2.7%. Whereas the 1980 tax system was such that hours of work did not vary with the number of children in the family, the 1991 tax system has the effect that

men with many children would work fewer hours than others. This can almost exclusively be attributed to the effect of the change in the transfer system.

According to our calculations the tax reform was under financed. In practice the resulting deficit was financed by borrowing. This way to finance the deficit might affect individuals labor supply. We have not attempted to account for these potential effects on labor supply. The decrease in marginal tax rates would lead to increased hours of work, but not by so much as to keep tax revenue neutral. Our calculations indicate that the decrease in marginal tax rates would lower tax revenue by around 9%. However, the increase in VAT and the payroll tax would to some extent compensate for this. The changed rules for taxation of capital income and property also lead to increased tax revenue. Excluding the change in the transfer system the tax reform would be close to revenue neutral. However, the effect of the change in the transfer system is strong leading to an overall decrease in tax revenue by around 8%. Although our calculations might be calculated with error there is little doubt that the tax reform has contributed to the large budget deficit in Sweden that emerged in the early nineties. The tax reform also lead to a shift in the relative importance of tax bases. In 1980 the income tax generated around 47% of the tax revenue from the household sector. In 1991 this had been reduced to around 36%. The importance of the VAT and the payroll tax increased.

We study the effect on the income distribution using several definitions of the income unit. Looking at the distribution of household income corrected for the number of consumption units depending on a certain income we find that all parts of the tax reform contribute to increased inequality in gross incomes. Looking at net incomes the decrease in marginal tax rates and the change in the rules for capital income and property seems to have contributed to increased inequality. The increase in VAT and the payroll tax had no effect on inequality whereas the change in the transfer system equalized net incomes leaving inequality of net income virtually unchanged by the tax reform. Many earlier studies have not taken the change in labor supply into account when studying the effect on the income distribution. We find that it is important to take these behavioral

changes into account. The changes in hours of work tend to increase the inequality of annual incomes.

We have performed our calculations using both parametric and nonparametric labor supply functions. The parametric functions show a considerably larger change in hours. Predictions using the parametric function indicate an increase in average hours of work of 4.2% whereas the nonparametric indicate an increase of 2.0%. We conclude that using parametric methods might lead to biased predictions of the effect of the tax reform.

Appendix A. Description of the 1991 Swedish tax and transfer system

This appendix describes how the tax and transfer system of 1991 is implemented in the analysis. The 1980 system is described in Blomquist & Hansson-Brusewitz (1990). If not stated otherwise the figures are relating to the 1991 price level.

Income taxes

In order to simplify the following presentation we begin with some income definitions. The individual's (earned) *gross income* is defined as the sum of the income from different sources. The *assessed income* equals the gross income, minus deductions of various sorts that are related to the earning of the income. The *taxable income* defines the assessed income, minus the personal allowances. Finally, we define the *capital income* as the unearned income from interest, dividends etc., minus capital losses and interest payments.

Income related deductions are assumed to equal the standard deduction, i.e. 10% of earned income with a maximum deduction of 4000 SEK. The personal allowance is somewhat more complicated. The allowance equals 10304 SEK for assessed income below 1.86 and above 5.615 basic amounts.[1] For assessed income between 1.86 and 2.89 basic amounts the allowance escalates with 25% of the exceeding income. Finally, for assessed income between 3.04 and 5.615 basic amounts the allowance de-escalates with 10%. This construction creates a non-convexity in the tax schedule at 2.89 basic amounts. Neither the standard deduction nor the personal allowance is allowed to exceed the assessed income.

The earned and unearned incomes are taxed separately in the tax system The federal tax for earned income is 20% for taxable income exceeding 170000 SEK and the fiscal tax of approximately 30% was also levied on taxable income. Unearned income is taxed

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[1] The nominal amounts in the tax and transfer schedule are usually expressed as multiples of the basic amount. The basic amount is updated every year to eliminate the effects of the inflation. The basic amount equals 32'200 SEK in 1991.

at a proportional rate of 30%. If the unearned income was less than zero the taxed individual could claim a tax reduction equal to 30% of the deficit not exceeding 100000 SEK and 21% of the remaining. However, the tax reduction can not be larger than the tax liability. Table A.1 summarizes the tax schedule including the standard deduction and personal allowance in terms of marginal tax rates and the upper bounds of the assessed income brackets

Table A.1 Marginal tax rates within income brackets.

Gross income		Marginal tax
1991	1980[2]	rate[1]
14304	6299	0%
63892	28134	30%
97058	42738	22.5%
101888	44865	30%
184'349	81175	33%
184'803	81'375	55%
>184'803	>81'375	50%

[1] *The marginal tax rate includes a fiscal tax of 30%*
[2] *The intervals are deflated to the 1980 price level using a CPI of 2.271*

In addition to taxes on earned and unearned incomes, owner-occupied homes are taxed with 1.2% of the ratable value. The data set includes the 1980 guaranteed amount calculated as a fraction of the 1980 ratable value.[2] Since the ratable value in 1991 is significantly higher than the one in 1980 we need to account for this in our analysis. Lacking information about the new ratable value we use the fraction between the 1980 and 1991 purchase-price coefficients to estimate the 1991 ratable value. Furthermore, the tax rate varies with the age of the house but since we lack this information we assume that all houses are older than 5 years.

[2] The guaranteed amount is the tax base originating from owner-occupied houses, i.e. the additional taxable income that is imposed on the taxable incomes for owner-occupied homes.

Transfers

There are, in principle, two major transfers that affect the individuals in our sample, namely the child allowance and the housing allowance. The child allowance is independent of the household income and paid to any household with children. The allowance includes a basic transfer of 9'000 SEK per year and child with an extra transfer for additional children according to table A.2.

Table A.2 Extra transfers to households with many children.

Number of children	Additional transfers
3	4'500
4	13'500
5	18'000
6	40'500
7	54'000

In contrast to the child allowance the housing allowance dependends on the household income and is more complex in its construction. The allowance is constructed in two parts, one defining the maximum allowance to the household and the other defining a reduction of the allowance. The maximum amount is based on the housing costs, the family composition and the age of the head. Furthermore, the housing costs for owner-occupied homes are dependent on the regional location of the house. The relevant intervals of the housing costs are presented in table A.3.

Table A.3 Monthly housing costs brackets for households with children.

Family composition	Lower	Middle	Upper
One child	1'800	2'400	3'500
Two children	1'500	2'800	4'000
Three children	1'200	3'200	4'500

The transfer equals 75% of the costs in the lower bracket and 50% in the upper. Households with children receives an additional transfer of 1'000 SEK per month as

housing allowance. Households without children and with heads younger than 29 years receives at maximum 75% of the housing costs between 800 and 2'900 SEK per month. In households where the head is older the corresponding monthly transfer equals 30% of costs between 1'600 and 3'500 SEK.

When the maximum amount is calculated it is reduced if the household income exceeds a specified level. The household income is defined as the taxable income of both spouses, plus an additional amount equal to 20% of the household wealth exceeding 180'000 SEK. The breakpoints and reduction rates are presented in table A.4.

Table A.4 Breakpoints in annual household income and reduction rates of housing allowance

Household composition	Breakpoint	Reduction rate
with children	81'000	0.20
no children, age above 28	66'000	0.10
no children, age under 29	44'000	0.33

Usually the reduction is based on the household income 1989 but if the 1991 household earned income is less than 1989 earned income minus 15'000 SEK or more than 50'000 SEK above the same, the 1991 earned income (deflated by 1.13) is used instead of the 1989 earned income.

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