Taxation and the Earnings of Husbands and Wives

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Abstract

This paper examines the response of husbands' and wives' earnings to a tax reform in which husbands' and wives' tax rates changed independently, allowing me to examine the effect of both spouses' incentives on each spouse's behavior. I compare the results to those of more simplified econometric models that are used in the typical setting in which such independent variation is not available. Using administrative panel data on approximately 11% of the married Swedish population, I analyze the impact of the large Swedish tax reform of 1990-1. I find that in response to a compensated fall in one spouse's tax rate, that spouse's earned income rises, and the other spouse's earned income also rises. I test and reject a set of models in which the family maximizes a single utility function. A standard econometric specification, in which one spouse reacts to the other spouse's income as if it were unearned income, yields biased coefficient estimates. Uncompensated elasticities of earned income with respect to the fraction of income kept after taxes are over-estimated by a factor of more than three, and income effects are of the wrong sign. A second common specification, in which overall family income is related to the family's tax rate and income, also yields substantially over-estimated own compensated and uncompensated elasticities. Standard econometric approaches may substantially mis-estimate earnings responses to taxation.

I. Introduction

Standard investigations of the impact of taxation on taxable income typically relate the family's overall taxable income to a measure of the family's tax rate.[2] In a parallel literature on the effect of tax rates on labor supply, it is standard to relate a spouse's labor supply decision to his or her own tax rate.[3] It has been typical to assume that an individual's labor supply responds to the income of his or her spouse as it would respond to unearned income, following a long tradition beginning with Mincer (1962). In this paper, I relax these restrictions by examining how independent variation in both spouses' tax rates impacts each spouse's earnings decision. A richer econometric model allowing for such independent variation shows that the simplifications inherent in the standard approaches may lead to strongly biased results.

Swedish tax reforms in the early 1990s represent a particularly promising setting for studying these issues, for three primary reasons. First, Sweden has individual taxation, meaning that an individual's marginal tax rate on earned income depends only on his or her own income. When the Swedish tax schedule changes, husbands and wives face different changes in their marginal tax rates, and the relative size of these changes differs across households, allowing me to identify the response of one spouse's income to the other spouse's incentives.[4] In the U.S., by contrast, married couples are almost always taxed jointly on the sum of their incomes, implying that husbands and wives face the same marginal tax rate. Second, I use the Longitudinal Individual Data for Sweden (LINDA), which contain information on the separate income of each spouse, unlike the IRS-Michigan-NBER Tax Panel on the U.S., which measures married couples' taxable income at the family level and does not allow investigation of how each spouse's income responds to incentives. The LINDA data are a panel of detailed administrative data on the labor force activity, government program participation, demographic characteristics, and other relevant features of approximately 11% of the Swedish population, which allows me to estimate parameters precisely, including cross responses. Third, from 1989 to 1991, the top marginal income tax rate in Sweden decreased from 76% to 51%, with substantial but smaller decreases in other tax brackets. This represents an opportunity to examine labor supply responses to large exogenous changes in incentives.[5]

With a specification allowing for cross responses, I estimate a rich set of parameters, including own and cross income and substitution effects for both husbands and wives. Standard econometric models, in which one's own income or hours worked is assumed to respond to spousal income as it responds to unearned income, cannot reflect the possibility that the spouse's tax rate could have both income and substitution effects on one's earnings. The literature examining the response of families' taxable income to the marginal tax rates they face leaves open the question of how

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[2]This large literature includes Feldstein (1995), Gruber and Saez (2002), Kopczuk (2005), Auten and Carroll (1999), Goolsbee (1999), and Saez (2003). See Slemrod, Saez, and Giertz (2009) for a review.

[3]Examples include Hausman (1981), Eissa 1995, and Blundell, Duncan, and Meghir (1998).

[4]I use "own response," "own elasticity," or "own effect" to refer to the reaction to one's own tax rate or income, and "cross response," "cross elasticity," or "cross effect" to refer to the reaction to the tax rate or income of one's spouse.

[5]Chetty (2010) argues that large reforms give much more precise parameter estimates, and Chetty, Friedman, Pistaferri, and Olsen (2010) argue that large reforms may give estimates closer to long-run labor supply elasticities. Indeed, Chetty (2010) argues that because my paper examines a large reform in Sweden, I perform much more precise parameter estimates than other papers on income responses to taxation.

husbands' and wives' decisions separately contribute to families' aggregate responses, and implicitly assumes that the family can be treated as if it reacted to one (family) unearned income.

The results show that husbands and wives react to each other's marginal tax rates and unearned incomes, as well as to their own. My central estimates show compensated elasticities of individuals' earned income with respect to their own net-of-tax share of .25 and .49 for husbands and wives, respectively.[6] (The net-of-tax share is defined as one minus the marginal tax rate.) It is noteworthy that the female earned income elasticity is higher than the elasticity for men, even in a country known for its relative gender equality and high female labor force participation rate. Compensated cross elasticities are .048 and .051, respectively, implying that in response to a compensated decrease in one spouse's tax rate, both spouses' earned incomes rise. Elasticities of earned income with respect to own unearned income are large (-.074 and -.056 for husbands and wives, respectively) and precisely estimated. I estimate elasticities of own earned income with respect to spouses' unearned income of -.0041 for husbands and -.018 for wives. When the dependent variable is a measure of taxable labor income, calculated by subtracting tax deductions from labor income, the elasticities are similar.

I find that standard econometric models, which make various simplifications, may yield very different results. I first assume that one spouse's earned income responds to the other spouse's income as it reacts to unearned income. This yields an estimate of the income effect that is large and of the wrong sign. When a husband's marginal tax rate falls, he works more, and the estimates imply that his wife works more, as well. This induces a spurious positive correlation between the change in the measure of the husband's unearned income (which includes his wife's income) and the change in the husband's own earnings. Thus, the estimated coefficient on the husband's unearned income, which represents the income effect on his earnings, is overly positive.[7] For both husbands and wives, this specification also produces an estimate of the uncompensated earnings elasticity that is biased upward by a factor of more than three, as well as an over-estimate of the compensated elasticity. A standard assumption from the parallel literature on the elasticity of taxable income is that the family's overall earnings reacts to the net-of-tax share and overall family unearned income. This specification likewise produces divergent results, with the compensated and uncompensated own elasticity substantially over-estimated and the uncompensated cross elasticity substantially under-estimated. Other specifications frequently run in the literature, including specifications omitting unearned income, also produce substantially biased results. Because these lessons are methodological–reflecting whether standard approaches produce correct results–I argue that the results are relevant to our understanding of these methods in contexts both inside and outside Sweden.

Since I estimate own and cross uncompensated and compensated effects, I am able to perform two separate tests of a unitary model of family taxpaying decisions. The unitary model is defined by the feature that the family can be characterized as maximizing a single utility function. I reject a unitary model based on violations of the "income pooling condition," which implies in this context that a married individual's pre-tax earnings should react equally to an increase in that

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[6]Chetty (2009) discusses why examining the response of earned income is a promising alternative to examining taxable income.

[7]Analogous reasoning implies that the estimated coefficient on the wife's unearned income should be overly positive.

individual's unearned income as it reacts to an increase in the unearned income of his or her spouse.[8] The unitary model also predicts that the Slutsky matrix should be symmetric: the compensated response of the husband's pre-tax earnings to the net-of-tax rate of the wife is predicted to be equal to the compensated response of the wife's pre-tax earnings to the net-of-tax rate of the husband. I cannot reject Slutsky symmetry at conventional significance levels.

The paper proceeds as follows. Section II discusses the empirical specification. Section III describes the policy environment and other relevant features of the Swedish economy in the period under consideration. Section IV describes the data. Section V presents the empirical results and relates them to a unitary model of family taxpaying decisions. Section VI concludes.

II. Empirical Model

A. Basic Framework

In the framework described in Appendix I, the earnings of a given spouse may depend on his or her own net-of-tax share and unearned income, and on the net-of-tax share and unearned income of his or her spouse. For my empirical model, I relate the logs of the variables, which will yield coefficient estimates interpretable as elasticities and follows the specification in Gruber and Saez (2002). It is illuminating to follow a specification that has been estimated in previous literature, as the results under alternative specifications can then be compared in a straightforward way to what has been estimated in previous work. The log of a spouse's earned income, $\ln(E_{it}^s)$, is specified as a function of the log of that individual's net-of-tax share (i.e. the log of one minus that individual's marginal tax rate), $\ln(1 - \tau_{it}^s)$, the log of the other spouse's net-of-tax share, $\ln(1 - \tau_{it}^{-s})$, the log of the individual's own income, $\ln(Y_{it}^s)$, and the log of the other spouse's income, $\ln(Y_{it}^{-s})$. Here the superscript $s \in \{h, w\}$ represents the individual in question, whereas $-s$ denotes that individual's spouse, and h and w refer to the husband and wife, respectively. i indexes couples, and t represents the time period.

To remove individual-level fixed effects that may be correlated with the tax and income variables of interest, the model will be estimated in first differences, again following Gruber and Saez (2002):

$$
\begin{aligned}
\Delta \ln(E_{it}^h) = & \; \beta_0^h + \beta_1^h \Delta \ln(1 - \tau_{it}^h) + \beta_2^h \Delta \ln(1 - \tau_{it}^w) + \beta_3^h \Delta \ln(Y_{it}^h) + \beta_4^h \Delta \ln(Y_{it}^w) \\
& + X_{iT}^h \beta_h^h + X_{iT}^w \beta_w^h + \vartheta_t^h + \varepsilon_{it}^h
\end{aligned}
\tag{1}
$$

$$
\begin{aligned}
\Delta \ln(E_{it}^w) = & \; \beta_0^w + \beta_1^w \Delta \ln(1 - \tau_{it}^w) + \beta_2^w \Delta \ln(1 - \tau_{it}^h) + \beta_3^w \Delta \ln(Y_{it}^w) + \beta_4^w \Delta \ln(Y_{it}^h) \\
& + X_{iT}^w \beta_w^w + X_{iT}^h \beta_h^w + \vartheta_t^w + \varepsilon_{it}^w
\end{aligned}
\tag{2}
$$

where $\Delta \ln(Z_t)$ represents the change from $t-1$ to t in the log of Z. (I use "base year" to indicate $t-1$, the initial year in each pair of years over which the first difference is taken, and "final year" to refer to t, the last year in each pair of years over which the first difference is taken.) The subscript

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[8]More generally, the income pooling condition states that a married individual's consumption of any good should react equally to an increase in that individual's unearned income as it reacts to an increase in the unearned income of his or her spouse. See Lundberg, Pollak, and Wales (1997) for an alternative test of income pooling in a developed country.

t still appears in the empirical model since multiple first differences will be used. Time dummies ϑ_t^s control for economy-wide earned income growth specific to each period over which the first difference is taken. ε_{it}^h and ε_{it}^w are error terms. X_{iT}^h and X_{iT}^w represent other variables—age, age squared, education, region, number of children, industry, occupation, and sometimes interactions of the covariates—that control for other factors that could influence changes in earned income. The control variables bear the subscript T, which refers to an initial period prior to the earliest observation of t.

The dependent variable, the change in the log of real earned income, may best reflect the welfare consequences of taxation among the variables commonly observed in tax datasets, as discussed in Chetty (2009).[9] The response of earned income is straightforward to examine because in the data, the definitions of several types of capital income changed from before the Tax Reform of 1991 to after. In some regressions, I also examine how a measure of taxable labor income, formed by subtracting a set of deductions from earned income, responds to the net-of-tax share.[10] It is worth noting that in the framework in Appendix I, the relevant independent variable is the net-of-tax share, rather than the net-of-tax wage.

Since the log of zero is undefined, I add 1 to earnings before logging it, so that the dependent variable is defined even if an individual does not participate in the labor market. The dependent variable for spouse s in couple i is therefore $\ln[(1 + E_{it}^s)/(1 + E_{it-1}^s)]$, and the notation in (1) and (2) can be considered shorthand for this expression. The results are generally insensitive to other choices, such as adding .1 or 10 to earnings before taking the log. In order to address the concern that logging the dependent variable could have an affect on the results particularly at low incomes, in one specification, I exclude from the regressions those who exited the labor force. Because the prediction of Slutsky symmetry of the unitary model of family responses to taxation (discussed in Appendix I) only holds when both spouses participate in the labor market, I exclude couples from my main regressions in those pairs of years in which at least one member of the couple does not participate in the labor market in the base year. The measure of income used as an independent variable is "virtual income," which represents the intersection of the individual's extended budget segment in consumption-effort space with the Y-axis. The construction of virtual income is discussed at greater length in Appendix II.[11]

In the main regressions, I consider two sets of one-year differences, which are pooled in the regressions: one from 1989-1990, and the other from 1990-1991. These are the years of the tax reform. This strategy will identify a short-term effect of the changes in the tax schedule.[12] The main source of exogenous variation is that in TR91, marginal tax rates were reduced much more for those at the top of the income distribution than for those at the bottom. This generates very large exogenous variation across households and time in the net-of-tax shares of husbands relative

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[9] I also follow the suggestion of Chetty (2009) and explore the response of measures of non-wage compensation to the tax rate.

[10] Feldstein (1999) develops a measure of the deadweight loss of taxation in terms of the elasticity of taxable labor income with respect to the net-of-tax share, but the empirical literature has focused on the elasticity of taxable income (including capital income) with respect to the net-of-tax share. By investigating the elasticity of taxable labor income, I estimate a parameter that more closely corresponds to Feldstein's (1999) model.

[11] Burtless and Hausman (1978) explain virtual income and why it is the appropriate income measure for estimating income effects in the presence of a nonlinear budget set.

[12] Gruber and Saez (2002) find relatively similar elasticities at 1-year, 2-year, and 3-year intervals.

to their wives. For example, suppose that in Couple 1, the wife is in the lowest tax bracket, and the husband is in the highest tax bracket (both before and after the reform). In Couple 2, both the husband and wife are in the highest tax bracket (both before and after the reform). Those in the highest tax bracket receive a large cut in their marginal tax rate, whereas those in the lowest bracket receive a small cut. Therefore, due to the tax reform, the net-of-tax share of the husband relative to that of the wife increases in Couple 1 but stays constant in Couple 2. Thus, I can effectively relate the changes over time in the relative earnings of the husbands and wives in the two couples, to the changes over time and couples in their relative net-of-tax shares (and to the changes in virtual incomes associated with these tax changes and any simultaneous changes in capital taxation).[13]

B. Instruments

The actual marginal tax rate that an individual faces is potentially endogenous. For example, if an individual responds to an increase in his or her own marginal tax rate by decreasing his or her earned income, and marginal tax rates are progressive, then an OLS estimate of the effect of the net-of-tax share on earned income will be biased downward. Thus, it is typical to instrument for the net-of-tax share with a so-called "simulated instrument." This instrument is constructed by calculating the change in the net-of-tax share that would have occured if the individual had maintained the behavior he or she exhibited in the initial period (Gruber and Saez 2002). The intuitive notion that underlies this procedure is that the change in the tax schedule is exogenous to individuals' initial behavior, so the value of this instrument will not be affected by the endogenous response to the new tax schedule.

In particular, the instrument is constructed by projecting final year taxable income to be base year taxable income for spouse s in couple i, Z_{it-1}^s, multiplied by the growth of mean taxable income per taxpayer in the sample, $(1+g)$. Letting $\hat{Z}_{it}^s$ be projected taxable income, I set $\hat{Z}_{it}^s = (1+g)Z_{it-1}^s$. Suppose that the net-of-tax share (as a function of taxable income) before the tax change is given by $T_{t-1}()$ and the net-of-tax share after the tax change is given by $T_t()$. I use $T_t(\hat{Z}_{it}^s) - T_{t-1}(Z_{it-1}^s)$ to instrument for $T_t(Z_{it}^s) - T_{t-1}(Z_{it-1}^s)$. In the regressions relating to the extensive margin, the average after-tax share is instrumented analogously. Because virtual income for spouse s in couple i in year t, $Y_{it}^{s,v}()$, varies according to which budget segment the individual locates on, it is a function of actual taxable income.[14] Thus, virtual income is also potentially endogenous. I construct a simulated instrument for the actual change in virtual income, by predicting the change in virtual income that would have occurred, if the individual had projected taxable income $\hat{Z}_{it}^s$ in the final period. In other words, I use $Y_{it}^{s,v}(\hat{Z}_{it}^s) - Y_{it-1}^{s,v}(Z_{it-1}^s)$ as an instrument for $Y_{it}^{s,v}(Z_{it}^s) - Y_{it-1}^{s,v}(Z_{it-1}^s)$.[15]

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[13]My regressions in fact allow for more flexibility than a specification that literally related the relative earnings of the spouses to their relative net-of-tax shares, because I run separate regressions for husbands and wives and enter each spouse's net-of-tax share separately in each regression.

[14]$Y_{it}^{s,v}()$ is subscripted by i because it also depends on capital income and government transfers, which vary by individual.

[15]Since each spouse's tax rate on capital income was potentially different prior to the reform (because each spouse's capital income was taxed separately), this created an incentive for couples to avoid taxes by allocating capital income to the lower-taxed spouse. However, this does not affect my estimates because I instrument for the actual change in virtual income using the change that would have been expected on the basis of the different

C. Controlling for the Evolution of the Income Distribution

In their regressions relating taxable income to the net-of-tax share and an income effect, Gruber and Saez (2002) control for a ten-piece spline in the log of base year real income. Since the size of the tax change is correlated with income, it may be difficult empirically to tease apart variation in base-year income from variation in the change in marginal tax rates. Indeed, Gruber and Saez (2002) write that using rich controls for base-year income "may destroy identification. This problem is especially acute when the size of the tax rate change is directly correlated with the income level as in the TRA of 1986...In practice, rich controls for base year income make it very difficult to separately identify income and substitution effects with only one tax change." (pp. 11-12). Because I examine only one tax reform, over-controlling for base year income is a major cause for concern. Given the correlation between base year income and the change in the marginal tax rate, the regression results may be highly sensitive to mis-specification, for example of the functional form with which base year income enters.

To address this issue, I calibrate the evolution of the income distribution using a period in which no major tax change occurs, and I assume that absent the tax change, the income distribution would have evolved similarly during the period of the change. I then relate the remaining variation in earned income to exogenous variation in the marginal tax rate, controlling for a rich set of covariates that can capture effects unique to the period of the tax change. I begin this procedure by performing the following regression during a period in which the change in the tax schedule is negligible:

$$
\begin{aligned}
\Delta \ln(E_{it}^w) \;=\; & \xi_0^w + f[\ln(E_{it-1}^w)]\xi_{E,w}^w + f[\ln(E_{it-1}^h)]\xi_{E,h}^w + f[\ln(Z_{it-1}^w)]\xi_{Z,w}^w \\
& + f[\ln(Z_{it-1}^h)]\xi_{Z,h}^w + X_{iT}^w \xi_w^w + X_{iT}^h \xi_h^w + v_{it}^w
\end{aligned} \tag{3}
$$

Here f is a ten-piece spline in lagged log real income. I use ten-piece splines in one's own lagged log real earned income, one's spouse's lagged log real earned income, one's own lagged log real taxable income, and one's spouse's lagged log real taxable income. I include a ten-piece spline in lagged log real taxable income because in the main regressions of interest, changes in log real earned income will be related to changes in marginal tax rates. Marginal tax rates are computed based on taxable income, so controlling for lagged log real taxable income addresses possible mean reversion relating to taxable income. The knots of the spline are placed at deciles of the income distribution. $\xi_{E,h}^h$, $\xi_{E,w}^h$, $\xi_{Z,h}^h$, $\xi_{Z,w}^h$, $\xi_{E,w}^w$, $\xi_{E,h}^w$, $\xi_{Z,w}^w$, and $\xi_{Z,h}^w$ represent vectors of coefficients on these splines. The analogous regressions are performed for the husband.

These regressions yield an estimated set of coefficients $\hat{\xi}_{E,h}^h$, $\hat{\xi}_{E,w}^h$, $\hat{\xi}_{Z,h}^h$, $\hat{\xi}_{Z,w}^h$, $\hat{\xi}_{E,w}^w$, $\hat{\xi}_{E,h}^w$, $\hat{\xi}_{Z,w}^w$, and $\hat{\xi}_{Z,h}^w$, which collectively calibrate how income evolves in the absence of a tax change. In the later period that spans the tax change, I use these estimated coefficients to partial out the predicted effect of base year income, thus creating residual changes in the log of real earned income, $\tilde{\Delta} \ln(E_{it}^w)$

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components of pre-reform virtual income. The estimation procedure therefore effectively throws away any variation coming from individuals' endogenous responses to the new tax schedule, and therefore throws away any variation relating to re-allocation of capital income. It is also worth noting that capital income has been taxed at a flat rate of 30% since the 1991 reform, thus eliminating any incentive for couples to re-allocate their assets to the lower-taxed spouse.

and $\tilde{\Delta}\ln(E_{it}^h)$, for the wife and the husband:

$$
\begin{aligned}
\tilde{\Delta}\ln(E_{it}^w) \;=\;& \Delta\ln(E_{it}^w) - f[\ln(E_{it-1}^w)]\hat{\xi}_{E,w}^w - f[\ln(E_{it-1}^h)]\hat{\xi}_{E,h}^w \\
& - f[\ln(Z_{it-1}^w)]\hat{\xi}_{Z,w}^w - f[\ln(Z_{it-1}^h)]\hat{\xi}_{Z,h}^w
\end{aligned} \tag{4}
$$

Analogous residuals are calculated for husbands. These residuals represent the remaining variation in the change in earned income, with the predicted effect of lagged income removed. I now modify equations (1) and (2), relating the residuals to the independent variables:

$$
\begin{aligned}
\tilde{\Delta}\ln(E_{it}^w) \;=\;& \beta_0^w + \beta_1^w \Delta\ln(1-\tau_{it}^w) + \beta_2^w \Delta\ln(1-\tau_{it}^h) \\
& + \beta_3^w \Delta\ln(Y_{it}^w) + \beta_4^w \Delta\ln(Y_{it}^h) + X_{iT}^w \beta_w^w + X_{iT}^h \beta_h^w + \vartheta_t^w + \varepsilon_{it}^w
\end{aligned} \tag{5}
$$

The analogous regression is performed for husbands. I instrument for tax rates and virtual incomes using the simulated instruments described earlier.

The procedure described in this section is conceptually similar to a "triple difference" strategy, in which the differences across couples over time are contrasted between a period of no policy change and a period of a policy change. The assumption is that the influence of all of the factors that are unique to the period spanning the tax change can be removed with the controls. I control extensively for occupation, industry, region, education, and several other demographic variables. The evidence is consistent with the contention that this procedure removes the true effect of lagged income and business cycle effects, since adding more extensive controls makes little difference to the estimated coefficients of interest.[16]

D. Implications of the Unitary Model for the Parameter Estimates

Appendix I discusses a unitary model of family taxpaying decisions. The unitary model of family decision-making is defined by the feature that the family's behavior can be characterized as maximizing a single utility function. This yields two central predictions.[17] First, income pooling: the husband's (wife's) earnings should react equally to a change in his (her) own unearned income as to a change in his wife's (her husband's) unearned income. This condition holds because the family does not distinguish between the unearned income of the husband and the unearned income of the wife in making its labor effort and consumption decisions; rather, the household acts as a single agent that pools its unearned income and reacts to it the same whether its source is the husband or wife. Second, Slutsky symmetry: The compensated response of the husband's earnings to the wife's net-of-tax rate should be equal to the compensated response of the wife's earnings to the husband's net-of-tax wage. Standard consumer demand theory implies this condition. The family has a single utility function, so the Slutsky matrix for the consumption of goods, including

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[16] My procedure also bears a conceptual resemblance to the empirical strategy of Lindsey (1987). Lindsey predicts how much taxable income should exist in each part of the income distribution, absent the tax change. The difference between the actual amount of taxable income in each part of the distribution and the predicted amount is then attributed to the effect of taxation. My procedure performs a similar comparison, but differs from the Lindsey strategy by employing panel data, rather than repeated cross sections.

[17] Blundell and MaCurdy (1999) present a unitary model in which families trade off consumption and the hours worked of both the husband and wife. This model includes the two predictions discussed presently and several other less often tested conditions.

the effort of the husband and wife, must be symmetric about the diagonal. Since the empirical model is specified in terms of elasticities, I transform the coefficient estimates to relate them to the predictions of the unitary model. For individuals at the sample means of income, income pooling implies:

$$\beta_3^h \bar{Y}^w = \beta_4^h \bar{Y}^h \tag{6}$$

and

$$\beta_3^w \bar{Y}^h = \beta_4^w \bar{Y}^w \tag{7}$$

where bars above the income variables represent their sample mean values.[18]

To test Slutsky symmetry, begin by recalling the Slutsky relation in the context of earned income:

$$\frac{\partial E^h}{\partial (1-\tau^w)}\big|_u = \frac{\partial E^h}{\partial (1-\tau^w)} - E^w \frac{\partial E^h}{\partial Y^w} \tag{8}$$

$$\frac{\partial E^w}{\partial (1-\tau^h)}\big|_u = \frac{\partial E^w}{\partial (1-\tau^h)} - E^h \frac{\partial E^w}{\partial Y^h} \tag{9}$$

After performing transformations to express the elasticity estimates as marginal effects, the following equality is implied by Slutsky symmetry, evaluated at the sample means of the variables:

$$\beta_2^h \frac{\bar{E}^h}{1-\bar{\tau}^w} - \bar{E}^w \beta_4^h \frac{\bar{E}^h}{\bar{Y}^w} = \beta_2^w \frac{\bar{E}^w}{1-\bar{\tau}^h} - \bar{E}^h \beta_4^w \frac{\bar{E}^w}{\bar{Y}^h} \tag{10}$$

III. The Tax Reform of 1991

The Tax Reform of 1991 changed income tax rates dramatically, as the top marginal tax rate fell from 76% to 51%.[19] TR91 revised several other aspects of the tax system, including the VAT and corporate taxes. The period considered in this paper includes two tax reductions, from 1989-1990 and 1990-1991, the latter of which was substantially larger. Table 1 shows the tax schedule for the national Swedish government, called the "state tax schedule," in 1989 and 1991. Marginal tax rates fell substantially for those at the top of the income distribution but fell little for those at the bottom. Before TR91, the state tax schedule was comprised of two different schedules, the basic schedule and the additional schedule. Basic taxable income differed from additional taxable income because a number of deductions could be taken on the basic schedule that could not be taken on the additional schedule. The total state marginal tax rate was calculated by summing the basic marginal tax rate and the additional marginal tax rate. Starting in 1991, the distinction between basic and additional taxable income was eliminated, and income was taxed according to a single state tax schedule.

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[18]In my tests, I use the sample mean values from 1989, before the tax change. I also test these predictions for individuals at other points in the income distribution and find similar results.

[19]A detailed description and analysis of TR91 can be found in Agell, Englund, and Södersten (1998). Many important features of the reform had been anticipated since 1987, when a commission began to plan the reform. Hansson (2007) also examines the Swedish Tax Reform of 1991, focusing on the response of individuals' earned income to taxation and assuming that one spouse reacts to the other's income as if it were unearned income. Holmlund and Söderstrom (2008) examine reforms following the 1991 reform.

Prior to 1991, Sweden had a global tax system, under which earned income and capital income were taxed at the same marginal tax rate, calculated on the basis of an individual's earned income, taxable government transfers, capital income, and deductions. Starting in 1991, Sweden changed to a dual tax system, under which the marginal tax rate on earned income is computed only based on earned income (and taxable government transfers and deductions), and capital income is taxed at the flat rate of 30%. These changes in the taxation of unearned income provide sizeable exogenous variation in after-tax unearned income, thus aiding in the identification of income effects.

The reform also broadened the tax base, to make up for the revenue lost due to the tax cuts. For example, before 1991, nominal interest expenses were fully deductible against typically high marginal income tax rates, whereas after the reform, they were deductible against the lower capital income tax rate of 30%. Due to such broadening of the base, deductions and exclusions fell as a share of total income. The reform was designed to be almost revenue-neutral. The Swedish Ministry of Finance (1991) projected that 89.1 billion Swedish Kronor (SEK) would be lost due to the tax cuts, and that SEK 8.2 billion would be lost due to increased spending planned for 1991. However, the projections indicated that SEK 95.1 billion would be recouped through the combination of base broadening (SEK 79.6 billion), dynamic gains from increased economic activity in response to the tax cuts (SEK 5.0 billion), and increases in other revenues such as corporate tax revenues (SEK 10.4 billion).

The total marginal tax rate is calculated as the sum of the local, municipal and state tax rates. The mean value of the sum of local and municipal rates is 31% (both before and after the reform), with a minimum of 27% and a maximum of 33% over all the years examined. It is possible to construct an alternative measure of the marginal tax rate that includes the phase-outs and phase-ins of the basic deduction and of various transfers (such as a housing-related transfer). Ultimately, how much individuals respond to such incentives is an empirical question, and the results are similar when other measures of the marginal tax rate are employed.

Some features of the Swedish macroeconomic environment are shown in Figure 1. The dashed line represents real percentage GDP growth per capita. Sweden entered a recession in late 1990, with real per capita GDP growth rates of 1.0%, -1.1%, -1.2%, and -2.0% in 1990, 1991, 1992, and 1993, respectively. The solid line shows the unemployment rate, which increased substantially during the recession.[20] To control for the influence of these macroeconomic factors, I control for a rich set of covariates, including dummies for 2-digit industry codes, 2-digit occupation codes, and other covariates interacted with year. Income effects could also have come not only from changes in capital income measured in the data, but also by the changes in wealth induced by the macroeconomic environment or by the capitalization of changes in the tax rules into asset prices. A particular source of concern is that housing prices in Sweden fell substantially around the time of the reform. When I include a measure of the imputed income from housing wealth in my measure of virtual income, I estimate similar income effects.

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[20]It is possible to argue that this macroeconomic turmoil could help me to uncover family labor supply responses. During a period of economic calm, couples may re-optimize their decisions infrequently, but in a period of turmoil, we may be able to observe these changes more readily and relate them to exogenous changes in tax policy. On the other hand, one could argue that in a weak labor market, families may not have labor supply choices available to them that they otherwise would have made. The overall impact on the parameter estimates is *a priori* unclear.

To understand the context in which the tax reform occurred, it is also worth noting various relevant features of the Swedish environment.[21] Completed fertility of the 1961 birth cohort is 2.03. The percentage of the population currently divorced in 2003 was 11.3%. 75.6% of Swedish women aged 15-64 participated in the labor market in 2002, and the male labor force participation rate was 79.4%. Swedish GDP per capita in 1990 was $27,240. Finally, a relatively large fraction of couples in Sweden cohabitate rather than formally marrying, and the percentage married was only 45.2% in 2003. The sample of married Swedes is thus selected in certain ways, but it is *a priori* unclear whether and how this should affect the parameter estimates.

IV. The LINDA Data

I use the Longitudinal Individual Dataset for Sweden (LINDA), described in detail in Edin and Fredriksson (2000). Based on the administrative records of the Swedish government, these data follow individuals and their families longitudinally. I examine yearly data from 1988 to 1991, inclusive. The data contain approximately 3.35% of the Swedish population, in addition to family members of these individuals. A random sample of 20% of the immigrants to Sweden and their families is also included. Prior to restricting the sample, the full data consist of approximately 950,000 sampled individuals per year, comprising approximately 11% of the Swedish population. After weighting by sample weights to correct for the over-sampling of immigrants, the full sample is cross-sectionally representative of the married Swedish population in any given year.

Gender, age, region of residence, occupation, industry, number of children, educational attainment, and other covariates are included in the data. In the regressions, the values of all of these control variables are taken from 1988. Most of these covariates are not available in the U.S. administrative data on tax returns, including the IRS-Michigan-NBER tax panel. My measure of earned income includes only wages paid from employers to employees (and excludes goverment transfers). I construct taxable labor income by subtracting certain deductions from earned income. During the period under consideration, the data do not contain a measure of hours worked. Further details about the data are contained in Appendix II.

I include in my main sample married individuals who are between 18 and 65 years old (inclusive), whose earned income in the base period is greater than zero, and whose spouses share all of these characteristics. 178,366 individuals fit these criteria, consisting of 89,183 husbands and the same number of wives. Summary statistics are shown in Table 2. The mean income in the sample is SEK 174,932 for husbands, as opposed to SEK 103,459 for wives.[22] Since men tend to have higher earnings and marginal tax rates are progressive, the mean net-of-tax share of husbands (.45) is somewhat lower than that of wives (.57). Since virtual income increases as the marginal tax rate increases (*ceteris paribus*), and since men have larger capital income than women, it makes sense that husbands have substantially higher virtual income on average (SEK 75,477 for husbands, as opposed to SEK 13,863 for wives).

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[21] The statistics in this paragraph are drawn from Blau, Ferber, and Winkler (2005) and Stevenson and Wolfers (2007).

[22] In 2007 U.S. dollars, these amounts are equivalent to $46,634 in mean earnings for husbands and $27,580 for wives.

Couples display positive assortative mating. In 1989, their earned incomes have a modest positive correlation of .22, and the correlation of their net-of-tax shares is .36. Pooling the changes from 1989 to 1990 and from 1990 to 1991, the correlation between the changes in their earned incomes is .13, the correlation between the changes in their simulated net-of-tax shares is .27, and the correlation between the changes in their actual net-of-tax shares is .26. Appendix Table A1 shows the number of couples who experienced each type of tax change. A cell displays the number of couples in which the husband and wife received a given combination of simulated percent changes in their net-of-tax shares. For a given simulated change in one spouse's net-of-tax share, there is substantial heterogeneity in the other spouse's simulated change.

V. Empirical Results

A. Preliminary Evidence

Figure 2 shows that during the period of the tax reform, larger gains in earned income occurred in the parts of the income distribution that also experienced larger tax cuts, relative to the period without the tax reform. I use the evolution of the income distribution from 1988 to 1989 to calibrate how the income distribution develops, as described in Section III.C.[23] Thus, my regressions effectively contrast the change in the income distribution from 1988 to 1989, to the changes from 1989 to 1990 and from 1990 to 1991, and relate these relative changes to those in marginal tax rates, controlling for other factors. Figure 2 graphically depicts these relationships.

On the x-axis of Figure 2 is real earned income in the base year (in SEK divided by 10,000). The squares represent the mean simulated change in the the log of the net-of-tax share from 1990 to 1991 in each 1990 income group within a 10,000-Kronor range, minus the mean simulated change in the log of the net-of-tax share from 1988 to 1989 in each 1988 income group.[24] The circles show the mean gain in the log of real earned income in each 1990 earned income group from 1990 to 1991, minus the mean gain in the log of real earned income in each 1988 earned income group from 1988 to 1989. Figure 2a shows the graph for husbands, and Figure 2b shows the graph for wives.[25] It is evident that there are much larger gains in log real earned income from 1990 to 1991 at the top of the income distribution, relative to the bottom of the income distribution, than from 1988 to 1989. For both husbands and wives, the line showing the gain in log real earned income and the line showing the simulated increase in the log net-of-tax share tend to grow quickly with base year real earned income until about SEK 170,000, after which both lines level off. It is notable that it is not simply the case that income growth and tax cuts are both higher at higher income levels, but also that both level off in the same income range.

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[23]I use the 1988-9 progression of the income distribution, rather than the progression over later years, since individuals may still have been reacting to the tax changes in the years following the reform.

[24]The simulated change in the net-of-tax share is not monotonically increasing in base year real earned income because the brackets before and after the tax change do not occur at exactly the same points in the income distribution, because the tax base changed from 1990 to 1991, and because the marginal tax rate is based on taxable income (rather than earned income).

[25]There are few women in the high income ranges—between SEK 180,000 and SEK 250,000, there are only 306 women on average in each 10,000-Kronor range—so it is unsurprising to find substantial volatility in mean earnings growth in this range.

In this context, it is worth noting that inequality is only weakly countercyclical in Sweden. Absent the tax reform, the estimates of Björklund (1991) imply that the deterioration in macroeconomic conditions from 1990 to 1991 would have led to a substantially smaller increase in inequality than the increase that was actually observed from 1990 to 1991. The available evidence also shows that inequality does not usually increase more in the first year of a recession than in subsequent recession years (which is apparent in the work of Kopczuk, Saez, and Song 2007 on the U.S.). Moreover, the pattern of large relative income gains at the top of the income distribution from 1990 to 1991 survives when partialing out the effects of characteristics such as industry, occupation, education, age, and interactions of these variables. This suggests that the large relative decreases in marginal tax rates at the top of the income distribution help to drive the large increase in inequality in 1991 relative to the surrounding years.

I anchor the evolution of the income distribution by regressing the change in the log of real earned income from 1988 to 1989 on a ten-piece spline in own and spousal 1988 log real earned income and 1988 log real taxable income, as well as control variables. The coefficients on the different pieces of the spline are significantly different from each other, indicating that rich controls for lagged income are warranted. In the main regressions, I instrument for four independent variables. The first-stage regressions show F-statistics ranging from just over 6,000 to nearly 10,000. The R-squared ranges from .47 to .56. When a given variable is the depedent variable, its predicted value enters highly significantly, with a coefficient between .8 and .9.

B. Basic Results

Table 3 shows the basic regression results. In columns 1 and 2, I perform regression (5) for the husband and wife. The controls include age, age squared, number of children below 8, as well as dummies for nine possible levels of education, 24 Swedish regions, and year. I estimate fairly low own uncompensated elasticities: .17 for husbands and .25 for wives. The estimates are precise, with standard errors of .021 and .026, respectively. I find substantial and precisely-estimated own income elasticities of -.074 for husbands and -.056 for wives, similar to those in Blomquist and Selin (2007). The negative sign is consistent with the presumption that leisure is a normal good. Consistent with the typical finding that women's labor supply is more elastic than men's, wives' own uncompensated elasticity is significantly higher than husbands' (p<.01).

Given these parameter estimates, it is possible to calculate compensated own and cross elasticities, using the Slutsky equation and the transformation from elasticities into effects at the sample means. These are shown in the bottom section of the table. The compensated own elasticity is .25 for husbands and .49 for wives (significantly different from each other, and from zero, at the 1% significance level). Compensated cross elasticities, .048 and .051 for husbands and wives, respectively, are also substantial. Both are significantly different from zero (p<.05). As one would expect, these are smaller than the compensated elasticities with respect to one's own net-of-tax share. Interestingly, husbands and wives have similar uncompensated cross elasticities and similar compensated cross elasticities. The uncompensated cross elasticities are not significantly different from zero at conventional levels. Cross income elasticities, -.0041 for husbands and -.018 for wives, are also substantial and significantly different from zero (p<.01).

It is theoretically ambiguous whether one's earnings should rise or fall when the spouse's tax rate rises. Parallel with the literature on labor supply, in which the leisure of husbands and

wives could be complementary or substitutable, the "effort" of one spouse (reflected in pre-tax earnings, as described in Appendix I) could be complementary or substitutable with that of the other. The results show complementarity: as the net-of-tax share of one's spouse rises, one's own earnings rise. A number of factors could lead to complementarity. If one's spouse takes more leisure time, it may be more enjoyable (provide higher marginal utility) to take more leisure time oneself. Complementarity is also consistent with several forms of social interactions, such as spouses imitating one another.

Columns 3 and 4 add further controls for the 2-digit occupation and the 2-digit industry of both the husband and wife, and interactions of all of the control variables with the year dummies. This controls still further for business cycle factors unique to each year of the tax change. These regressions show broadly similar estimates, with slightly smaller elasticities. The results are also similar when I add more interactions of these variables to the regression, such as interactions of occupation and industry with education, age, or region.

In Columns 5 and 6, taxable labor income is the dependent variable. The compensated own elasticity of taxable labor income with respect to the net-of-tax share is .22 for husbands and .35 for wives, and the compensated cross elasticities are .061 and .051, respectively. Interestingly, the elasticity estimates are similar to those in the regressions in which earned income is the dependent variable. This may relate to the fact that in Sweden, the deductions available both before and after the reform may not have been particularly elastic. For example, one of the major deductions was for costs associated with commuting to work, and these choices are typically found to be relatively inelastic with respect to price in the short run.

In Appendix Table A2, I take the sample from Table 3, but in order to focus more directly on the intensive margin, I exclude those individuals in couples in which at least one member does not participate in the labor market in the final period.[26] Since this involves selecting the sample on the basis of an outcome variable, the results should be interpreted with caution. Because I exclude labor market non-participants, I can allow the dependent variable to be the residuals of $\ln(E_t^s/E_{t-1}^s)$ (rather than the residuals of $\ln[(1 + E_t^s)/(1 + E_{t-1}^s)]$, as in Table 3). When either dependent variable is used, the results are nearly identical. The estimated coefficients are usually about half as large as the estimated coefficients in the comparable specification in Columns 1 and 2 of Table 3.

My results can be compared with the predictions of the unitary model of family earnings responses to taxation discussed above. The own income effect for husbands is significantly different from the cross income effect for husbands (p<.001), and the own income effect for wives is significantly different from the cross income effect for wives (p<.001). These inequalities represent a violation of the income pooling prediction of the unitary model, under which own and cross income effects should be equal. I cannot reject the unitary model's prediction of Slutsky symmetry—the equality in equation (10)—at conventional significance levels (p=.19). Income pooling is also violated, and Slutsky symmetry holds, when I consider the log-log specification in Table 3 and evaluate the implied effects at values of the independent and dependent variables other than the sample means.

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[26]The results are similar when I take the sample from Table 3 and instead exclude those individuals who do not participate in the labor market in the final period.

One potential concern is that families who received tax cuts of different magnitudes are systematically different from one another. Typically, the more a husband's income exceeds his wife's, the larger his tax cut will be relative to hers. If shocks to couples were correlated with how much husbands earned relative to their wives, then the coefficient estimates could be biased. To address this concern, I examine couples in which the usual positive correlation between spouses' relative incomes and their relative simulated changes in tax rates is reversed. Specifically, I examine couples in which the spouse that had the larger income prior to the tax cut received the smaller simulated tax cut. This occurred in 28% of the sample. There were two primary reasons this occurred. First, as shown in Table 1, there are certain income ranges in which those with higher incomes received smaller tax cuts. Second, the tax base shifted in TR91, implying that the size of one's tax cut depended not only on the size of one's income, but also on the composition of that income; those making income from sources that received lighter tax treatment in TR91 tended to get larger tax cuts. The results for the 28% of couples are very similar to those for the couples in which the higher-earning spouse received the larger tax cut. When I run the specification corresponding to Columns 1 and 2 of Table 3 on only the 28% subsample, my estimates are .14, .024, -.057, -.0038, .23, .019, -.054, and -.013 for the uncompensated own elasticity for husbands, the uncompensated cross elasticity for husbands, the own income effect for husbands, the cross income effect for husbands, the uncompensated own elasticity for wives, the uncompensated cross elasticity for wives, the own income effect for wives, and the cross income effect for wives, respectively. When I run the same regressions on the remaining 72% of couples, the point estimates are only slightly larger and all statistically indistinguishable from those in the 28% subsample: .18, .035, -.084, -.0046, .27, .026, -.066, and -.025, respectively. As a second check on the results, it is also possible to replace each spouse with a "placebo" spouse, who is chosen randomly from among all other married individuals of the same gender as the real spouse. I then run the same regressions as in the main regressions, but with the values of the independent variables of the true spouse replaced with the values for the placebo spouse. As expected, the results show no significant response to the placebo spouse's incentives.

Chetty (2009) suggests that the response of measures of non-wage compensation to taxation should be examined in addition to measures of wage compensation for determining the deadweight cost of taxation. Measures of non-wage compensation, such as the value of company car benefits, show no significant response to taxation in my data. This is suggestive of the conclusion that changes in earned income represent changes in labor supply, either through changes in hours worked or changes in effort per hour worked that is reflected in the pre-tax wage, rather than changes in the form of compensation.

C. Comparison with Standard Empirical Specifications

Tables 4-6 show the results of frequently-estimated econometric specifications, which yield quite different results than those in Table 3. In Columns 1 and 2 of Table 4, I estimate a standard specification in which married individuals treat their spouses' income as unearned income. This specification imposes a restriction—the coefficient on one's own change in log real virtual income is restricted to be the same as the coefficient on the change in the log real income of one's spouse—and is therefore *a priori* undesirable. Own uncompensated elasticities are .57 and .78 for husbands and wives, respectively. These are much greater than the estimates of .17 and .25 in Columns 1 and 2 of Table 3. The income elasticities, .24 and .19 for husbands and wives, are very large and

of the wrong sign.[27]   The implied compensated own-elasticities are .46 and .62 for husbands and wives, respectively, which are also higher than the compensated elasticities in Table 3 (.25 and .49, respectively). Very similar biases occur in all of the estimates in Table 4 when the dependent variable is taxable labor income.

If the leisure of husbands and the leisure of wives are complementary, then we would expect the standard specification to yield income elasticities that are more positive than the true income elasticities.[28]   Suppose, for example, that a wife receives a tax cut, leading her earned income to rise. Under complementarity, the tax cut for this wife also leads her husband to earn more. Thus, a rise in the husband's earned income is correlated with a rise in the wife's earned income. Under the standard specification, the change in the husband's earned income contributes to the change in the measure of the wife's unearned income. Thus, the wife's unearned income (which includes the husband's income in this specification) tends to rise when the wife's earned income rises, which contributes to a positive coefficient on the wife's unearned income. Given that income elasticities are overly positive, it also makes sense that uncompensated elasticities are over-estimated. *Ceteris paribus*, a rise in the net-of-tax share will decrease virtual income, since the intersection of the extended budget segment with the y-axis falls when the net-of-tax share rises. In the specification of Tables 3 and 4, the change in one's own log net-of-tax share is therefore negatively correlated with the change in one's log real virtual income.   Yet when spousal income is included along with own virtual income in the measure of unearned income, as in the standard specification, this negative correlation is dulled.   Thus, in the specification in Columns 1 and 2 of Table 4, the coefficient on the change in one's own log net-of-tax share picks up some of the variation that is actually attributable to the change in one's log real virtual income.

To explore the factors responsible for these results, Columns 3 and 4 run the traditional specification, but with own (instrumented) virtual income entered separately from (uninstrumented) spousal income. This replicates the specification in Columns 1 and 2, but without the restriction imposed that own virtual income is summed with spousal income in calculating the measure of own unearned income. The coefficient on spousal income is positive and large, whereas the coefficient on own virtual income is negative and large. This is consistent with the assertion that the positive correlation between the change in spousal income and the change in one's own income induces overly positive income effects in Columns 1 and 2. I reject the hypothesis that the coefficient on own virtual income is the same as the coefficient on spousal income (p<.001).[29] Uncompensated own elasticities and the coefficients on own log virtual income are similar to those in the specification in Table 3. As argued above, it appears that the own uncompensated elasticity is over-estimated in Columns 1 and 2 because when spousal income is included along with own virtual income in the measure of unearned income, the own uncompensated elasticity term picks up variation actually attributable to own virtual income.

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[27]In principle, it is possible that leisure is an inferior good, which would be consistent with the positive coefficient on the change in log real unearned income.   However, it appears implausible that leisure would be so strongly inferior, and the coefficient restriction associated with this specification makes it independently undesirable.

[28]In the presence of substitutable spousal leisure, the estimated income elasticities should be overly negative. Here I use "leisure" as shorthand to describe the absence of "effort" (as reflected in pre-tax earnings in the model in Appendix I).

[29]I also reject the hypothesis that these coefficients are equal when I run a specification in which each of these variables enters the regression linearly (rather than the logarithmic specification in Table 6).

To shed more light on the factors driving the results and evaluate to what extent other common specifications may be biased, Table 5 shows the results of omitting various key right-hand-side variables. Columns 1 and 2 omit spouse income and show that the coefficient on own NTS and own income are nearly unchanged. As expected due to the strong negative correlation of spouse virtual income and spouse NTS, the coefficient on spouse NTS is much more positive than in the Table 3 specification. Columns 3 and 4 omit the spouse terms entirely from the regressions. Interestingly, this makes little difference to the estimates of the own elasticities, presumably due to the relatively low correlation between changes in spouse tax rates shown in Appendix Table 1. Columns 5 and 6 include only own and spouse NTS as independent variables of interest. As expected due to the negative correlation of virtual income and NTS, the coefficients are substantially larger than in Table 3. The own NTS coefficients are smaller than in Table 4 Columns 1 and 2, presumably because the income effect was so over-estimated in the Table 4 specification. Columns 7 and 8 estimate the results with only own NTS as an independent variable, a familiar specification from much of the literature. As before, I find little difference in the elasticities from the specification in Columns 5 and 6 that also includes spouse NTS. Evidently ignoring the spouse in an empirical specification makes little difference, but constraining responses to own and spouse variables makes a large difference.

Table 6 investigates specifications often employed in the literature on the elasticity of taxable income. In particular, in this literature it is common to include a measure of overall family income as an independent variable (e.g. Gruber and Saez 2002), disallowing the possibility of separate effects of each spouse's income on earnings. In Columns 1 and 2, I investigate the consequences of this specification. The change in log family virtual income is the change in the log of husband virtual income plus wife virtual income, and this is instrumented using the predicted change. The own elasticities are much larger than in the basic specification, whereas the reaction to the spouse's net-of-tax share (NTS) is negative rather than positive. It makes sense that the uncompensated own NTS elasticity is over-estimated: the own NTS is negatively correlated with own virtual income, and the estimate of the effect of virtual income is less negative in this specification than the estimated effect of own virtual income in Table 3. The coefficient on own NTS therefore picks up some of the variation that is picked up by own virtual income in Table 3. Likewise, it makes sense that the effect of the spouse's NTS is overly negative: the effect of spouse's income is now estimated to be more negative than in Table 3 (since spouse's income and own income are lumped together), and since spouse's virtual income is highly negatively correlated with spouse's NTS, the coefficient on the latter is now more negative than in the Table 3 specification.

In the U.S., we typically have information on the sum of spouses' earnings, which is then related to the family's marginal tax rate and income. In the Swedish context, spouses have different marginal tax rates; because the family lacks one marginal tax rate, it does not make sense to relate overall family income to the family's marginal tax rate. To address this issue, it is possible to investigate the results in Sweden when the simulated changes in each spouse's marginal labor income tax rate are equal, as in the U.S. context. In Columns 3-5 of Table 6, I regress earnings on husband's net-of-tax share, husband income, and wife income, using husband's earnings, wife's earnings, and the sum of husband's and wife's earnings as the dependent variables. As expected, when the sum of husband and wife income is the dependent variable, the elasticity with respect to each independent variable is the sum of the elasticities for husbands and wives separately. The regressions with husband's and wife's income as the separate dependent variables are informative

because they allow us to disaggregate the overall elasticity into the separate contributing parts. When I regress earnings on the change in the NTS and the change in family income in Columns 6-8, I estimate similar uncompensated elasticities but a substantially higher income elasticity than in Columns 3-5. The higher income elasticity makes sense, since I sum together husband and wife income before taking the log; if smaller percentage changes in virtual income are associated with similar percentage changes in family earned income, the elasticity of family earned income with respect to virtual income is accordingly higher.

VI. Conclusions

This paper looks inside the family to uncover rich aspects of spouses' earnings responses to taxation. I argue that this may lead to new conclusions about the effects of labor income taxation that were obscured in earlier analyses that estimated more simplified econometric models. The results reveal that individuals respond substantially to their spouses' incentives, with sizeable compensated cross elasticities and cross income effects. It is noteworthy that the compensated earnings elasticity of married women is higher than that of married men, even in Sweden, which is often noted for its gender equality and high female labor force participation rate (see Alesina, Ichino, and Karabarbounis 2009). A customary specification, which treats spousal income as unearned income, produces income effects that are wrong-signed and large, and considerable bias results in the estimates of the uncompensated and compensated own elasticities. A specification that assumes that individuals respond to overall family taxable income–precluding the possibility that the response to each spouse's unearned income is different–may also lead to substantial biases. Relatedly, specifications that relate overall family earnings to the family's tax rate obscure the separate contribution of each spouse's earnings decision to overall family earnings.

While it has been recognized that these simplified specifications are not fully justified, it has not been recognized that these simplifications may lead to substantial biases in the resulting parameter estimates. The reasons for these substantial differences, relating to the simplifications inherent in the customary specifications, stand independent of features of the particular Swedish context in which I estimate the results. The more general lesson, applicable outside of the Swedish context, is that standard specifications simplify a richer family decision and may therefore lead us astray. The results suggest that at the least, we should place a high premium on gathering data in other contexts on the separate earnings of each spouse, and relating each spouse's earnings separately to measures of both spouses' incentives (including separate measures of the virtual income of each spouse).

These results have implications for models of family taxation. At a basic level, the paper uncovers a reaction to spousal incentives, suggesting that treating individuals without considering the incentives of their spouses may be an unwarranted simplification. The unitary model of family labor income responses to taxation is rejected by the income pooling test, with own income effects much larger than cross income effects, but I cannot reject Slutsky symmetry. Taken together, these results suggest that family models in which income pooling is violated by a large margin, but Slutsky symmetry almost holds–such as when bargaining power depends on the family distribution of income but not on the tax rate (Bourguignon, Chiappori, and Lechene 2004)–should be explored

further. Feldstein (1999) derives a measure of the deadweight cost of taxing labor income under the assumption of a unitary decision-maker. Likewise, the literature on the optimal taxation of the family has typically assumed a unitary decision-maker (Boskin and Sheshinski 1983; Kleven, Kreiner, and Saez 2009; Kaplow 2008). Further work on taxpaying decisions by non-unitary families would be valuable.

The results are also noteworthy insofar as they may reflect an impact of taxation on labor supply. Earned income is sometimes thought to reflect a broader measure of labor supply than hours worked does (Feldstein 1995, 1999). For example, effort per hour worked should influence earned income by increasing the marginal product and thus the hourly wage. Measures of hours worked are also subject to substantial measurement error. While earned income will also reflect changes in the form of compensation—for example, taxation might affect the mix of compensation between fringe benefits and wage compensation—it is not clear whether earned income or hours worked is a "better" measure of labor supply overall, since earned income has two major advantages over hours worked. The results also show no response of non-wage compensation to the independent variables. To the extent that these results reflect changes in labor supply, they are important in relating to a long line of literature on family labor supply (e.g. Ashenfelter and Heckman 1974; Devereux 2004; Blau and Kahn 2007). This literature has often been limited by the difficulty of finding exogenous variation in the incentives of the spouse. Interpreted as labor supply responses, the estimates suggest that the leisure of one spouse is complementary with the leisure of another (e.g. Hunt 1998; Gustman and Steinmeier 2000; Hamermesh 2002). Indeed, it is possible to argue that compensated changes in the tax rate of one spouse are unlikely to cause a shift in the form of compensation of the other spouse, so that the effect on the spouse's earned income should reflect a change in the spouse's labor effort (not simply a change in the form of compensation). In this context, the results suggest that the customary labor supply specification, in which labor supply is related to wages or the net-of-tax wage, and one spouse's income is treated as the unearned income of the other spouse, can produce substantially biased estimates.

The ability to examine the effects of separate changes in each spouse's marginal tax rate has allowed me to go beyond the limitations of standard specifications. The difference in the resulting estimates is large, and the implications for understanding responses to labor income taxation could be far-reaching. Several European countries have individual taxation and have made available administrative micro-data on the income of each spouse. This suggests the possibility of future work in such contexts, which could add to the new picture of family earnings decisions emerging from this paper.

Appendix I. Predictions of a Unitary Model in the Context of Earned Income

The typical unitary model relates the net-of-tax wages of married couples to their hours worked, considering a trade-off between hours worked and the after-tax level of consumption. In this section, I consider a model that relates the net-of-tax share to pre-tax earnings, considering a trade-off between effort that is reflected in pre-tax earnings and the after-tax consumption that is bought with these earnings. In this framework, pre-tax earned income is taken to reflect effort. The Slutsky symmetry condition will still hold in the context of earned income: The first spouse's compensated response of earnings to the second spouse's net-of-tax share is equal to the second spouse's compensated response of earnings to the first spouse's net-of-tax share. This can be seen through the following reasoning. In the standard unitary framework, a family maximizes

$$U(C, L^h, L^w) \tag{11}$$

$$\text{s.t. } C = w^h(1 - \tau^h)(T^h - L^h) + w^w(1 - \tau^w)(T^w - L^w) + Y \tag{12}$$

or

$$\max U(w^h H^h + w^w H^w + Y, H^h, H^w) \tag{13}$$

over H^h and H^w, where $H^h = T^h - L^h$, $H^w = T^w - L^w$, and $Y = Y^h + Y^w$.

In the context of earned income, this family maximizes

$$U((1 - \tau^h)E^h + (1 - \tau^w)E^w + Y, E^h, E^w) \tag{14}$$

over E^h and E^w, where E^h and E^w represent the pre-tax earned income of the husband and the wife. (The variable E has been chosen to suggest not only earned income, but also to emphasize that pre-tax earned income is a composite measure of effort.) We can interpret U in this context as defined over consumption $(1 - \tau^h)E^h + (1 - \tau^w)E^w + Y$, and the effort of each spouse E^h and E^w.

It is clear that maximization of (14) over E^h and E^w is entirely analogous to maximization of (13) over H^h and H^w, and that both will yield Slutsky matrices that are symmetric, negative semidefinite, and homogenous of degree zero. This is because the Slutsky matrix is guaranteed to be symmetric as long as the utility function U represents a continuous, locally nonsatiated and strictly convex preference relation defined on any consumption set, and the Hicksian demand function is continuously differentiable (Mas-Collel, Whinston, and Green, Proposition 3.G.2). These assumptions can be made over any consumption set (including a consumption set that includes pre-tax earned income) and should hold at least as plausibly in the context of earned income as in the context of hours worked (when both spouses participate in the labor market, precluding corner solutions).

The utility function $U((1-\tau^h)E^h + (1-\tau^w)E^w + Y^h + Y^w, E^h, E^w)$ treats Y^h and Y^w symmetrically. It is therefore clear that when we solve for $\partial E^h/\partial Y^h$, $\partial E^h/\partial Y^w$, $\partial E^w/\partial Y^h$, and $\partial E^w/\partial Y^w$ using the first order conditions and the implicit function theorem, we must have $\partial E^h/\partial Y^h = \partial E^h/\partial Y^w$ and $\partial E^w/\partial Y^h = \partial E^w/\partial Y^w$.

Appendix II. Additional Data Description

Education dummies are dummies for nine categories measuring highest school attainment. Industry and occupation are defined at the 2-digit level. Occasional missing values of these covariates are represented by dummies indicating missing values. For the vast majority of households considered in the

regressions, both spouses' earnings are positive in both base periods (i.e. both 1989 and 1990). However, a number of households have positive earnings for both household members in the base period in one of these years but not in the other. Observations for these individuals are included in the regressions only when the income of both household members is positive in the base year; otherwise, the dependent variable is a missing value. 178,366 individuals are in households in which both spouses have positive earnings in at least one of the years examined.

In 1991, Sweden switched from a global tax system, under which the marginal tax rate on earned income depends on the sum of earned income, capital income, and taxable government transfers (minus deductions), to a dual tax system, under which the marginal tax rate on earned income is computed only based on earned income (and deductions and taxable government transfers), and capital income is taxed at a flat rate. This implies that the proper way to calculate virtual income is different in 1991 than it was before 1991. Prior to 1991, virtual income is calculated by computing the intersection of the individual's extended budget segment with the y-axis in taxable income-consumption space, and adding the value of untaxed transfers. Predicted virtual income in 1990 is calculated by inflating the value of taxable income in 1990 by the mean per-person growth in taxable income of individuals in the sample, calculating the virtual income associated with this predicted budget segment, and adding this amount to the predicted value of untaxed transfers (calculated by inflating 1989 untaxed transfers by the mean per-person growth in untaxed transfers from 1989 to 1990 of individuals in the sample).

In 1991, virtual income is computed by adding three quantities: the intersection with the y-axis of the individual's extended budget segment in pre-tax taxable labor income-consumption space, the after-tax value of capital income, and the value of untaxed government transfers. (Here taxable labor income is taken to include government transfers.) Because of the change in the tax base, in constructing the instrument for the marginal tax rate for 1991, I project 1991 taxable labor income by multiplying each individual's 1990 taxable labor income by the mean per-individual growth in taxable labor income of individuals in the sample from 1990 to 1991. I calculate predicted virtual income in 1991 by determining what virtual income would have been in 1991 if an individual had the projected taxable labor income in 1991, as well as the projected values of capital income and untaxed transfers (calculated by inflating the values of capital income and untaxed transfers from 1990 by the mean growth from 1990 to 1991 in the per capita values of these variables of individuals in the sample). Like all income variables, virtual income is always represented in real terms.

When it enters as a dependent variable in my regressions, I construct taxable labor income by subtracting deductions from earned income. The deductions in question do not include deductions for interest payments or capital losses. To form a consistent measure of deductions, I exclude those that were available only before or only after 1991. When I subtract deductions from earned income, the result is occasionally negative. (Because the sample excludes labor market non-participants, earned income minus deductions is negative for only .28% of the sample.) Since I examine the change in the log of real taxable labor income, and the log of zero or of a negative number is undefined, I set the values of real taxable labor income equal to 1 for these individuals in the years in which it is negative. The results are insensitive to this choice. Before 1991, certain deductions could be claimed only against the basic tax schedule. However, all of the deductions included in my measure of deductions prior to 1991 could be claimed against both the basic schedule and against the additional schedule. Thus, their marginal tax price was equal to the net-of-tax share associated with earned income, so a specification that relates my measure of taxable labor income to this net-of-tax share is appropriate.

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Figure 1. Macroeconomic Variables in Sweden, 1975-2000
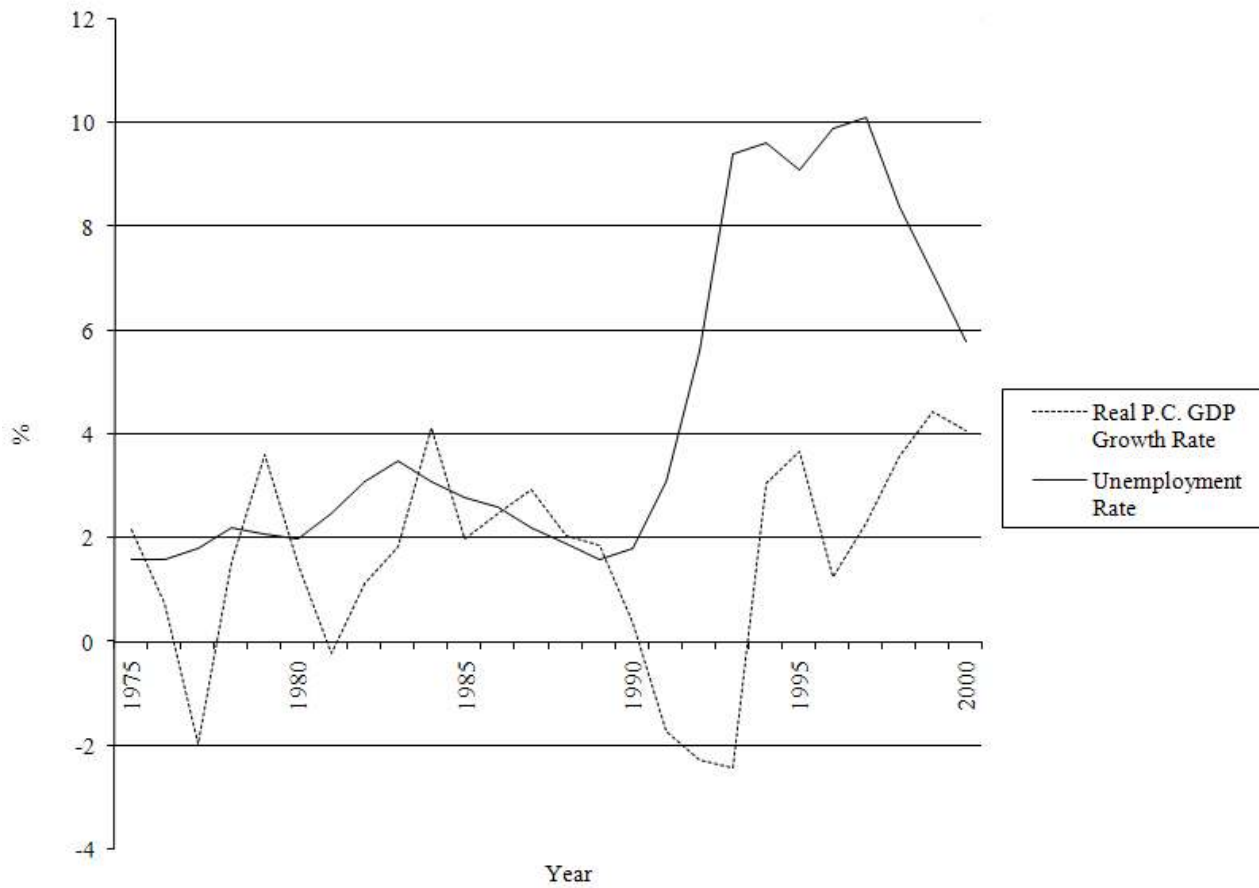
Source: U.S. Bureau of Labor Statistics, Foreign Labor Statistics. The dashed line shows the yearly growth rate of real GDP per capita in Sweden in each year from 1975 to 2000. The solid line shows the unemployment rate in Sweden in each year.

Figure 2a. Changes in Earnings and Changes in Net-of-Tax Shares of Husbands, by Base Year Income Group
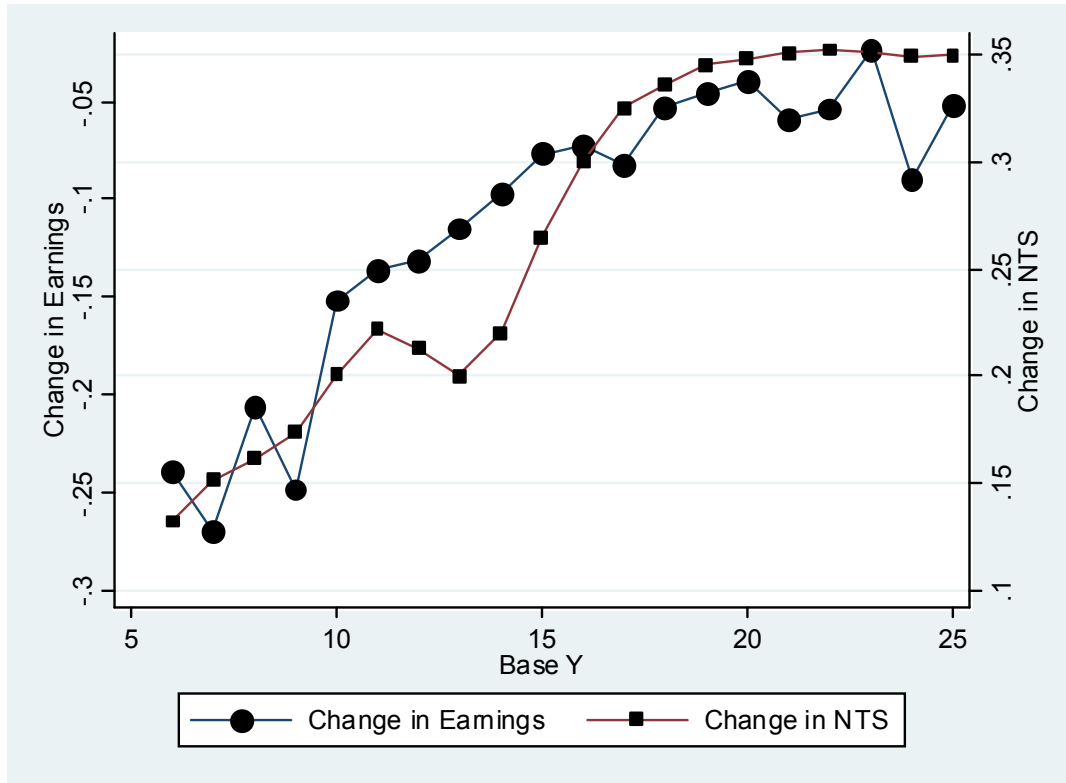
Notes: The figure shows that larger gains in real earned income took place in the same parts of the income distribution that experienced larger cuts in marginal tax rates, and that both rise until approximately the same point in the income distribution, at which point both lines level off. On the x-axis is real earned income (in Swedish Kronor) in the base year, divided by 10,000. The squares represent the mean simulated change in the log of the net-of-tax share (NTS) from 1990 to 1991 in each base-year income group (within a 10,000-Kronor range), minus the mean simulated change in the log of the net-of-tax share from 1988 to 1989 in each base-year income group. The mean simulated change in the log of the net-of-tax share is not monotonically increasing in base year real earned income because the brackets before and after the tax change do not occur at exactly the same points in the income distribution, because the tax base changed from 1990 to 1991, and because the marginal tax rate is based on taxable income (not earned income). The circles show the mean gain in the log of real earned income from 1990 to 1991 in each base year earned income group, minus the mean gain in the log of real earned income from 1988 to 1989 in each base year earned income group.

Figure 2b. Changes in Earnings and Changes in Net-of-Tax Shares of Wives, by Base Year Income Group
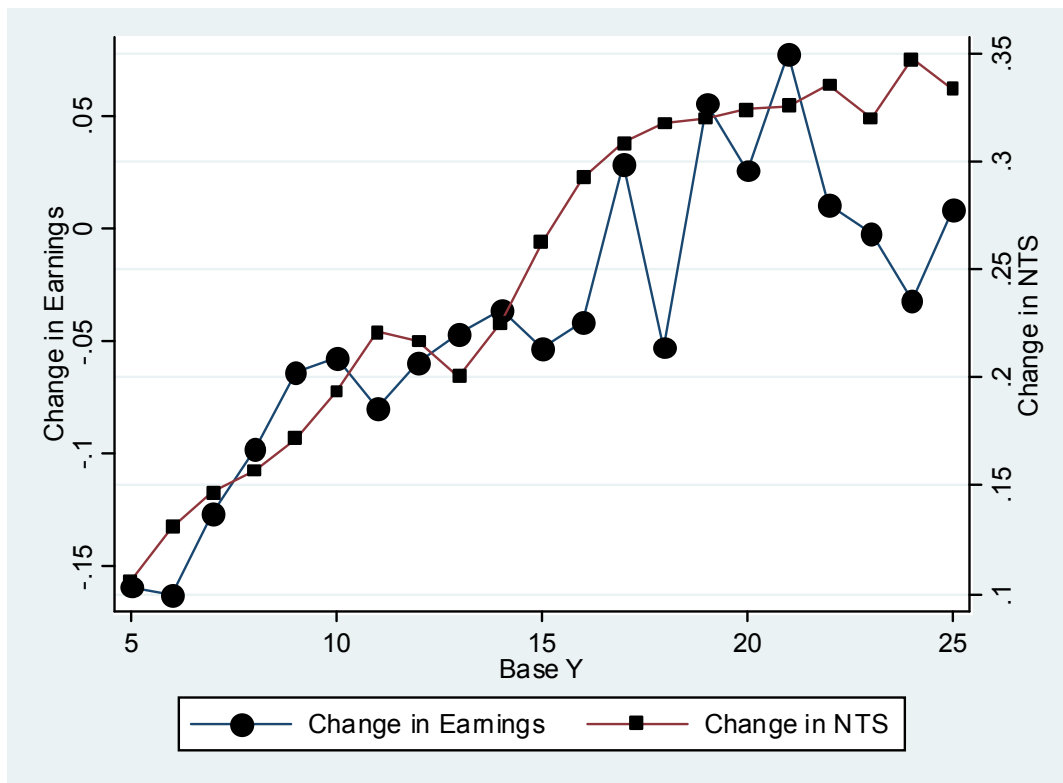
Notes: The figure shows that larger gains in real earned income took place in the same parts of the income distribution that experienced larger cuts in marginal tax rates, and that both rise until approximately the same point in the income distribution, at which point both lines level off. On the x-axis is real earned income (in Swedish Kronor (SEK)) in the base year, divided by 10,000. The squares represent the mean simulated change in the log of the net-of-tax share (NTS) from 1990 to 1991 in each base-year income group (within a 10,000-SEK range), minus the mean simulated change in the log of the net-of-tax share from 1988 to 1989 in each base-year income group. The mean simulated change in the log of the net-of-tax share is not monotonically increasing in base year real earned income because the brackets before and after the tax change do not occur at exactly the same points in the income distribution, because the tax base changed from 1990 to 1991, and because the marginal tax rate is based on taxable income (not earned income). The circles show the mean gain in the log of real earned income from 1990 to 1991 in each base year earned income group, minus the mean gain in the log of real earned income from 1988 to 1989 in each base year earned income group. It is unsurprising that in the higher income ranges, wives' mean income gains exhibit substantial volatility, since between SEK 180,000 and SEK 250,000, on average there are only 306 women in each 10,000-Kronor range.

Table 1. Marginal Tax Rates by Income and Year

1989 Schedule			1991 Schedule		
Bracket Start	Bracket End	MTR	Bracket Start	Bracket End	MTR
0	70,000	.36	0	149,284	.31
70,000	140,000	.51	149,284	—	.51
140,000	190,000	.65			
190,000	—	.76			

Source: Statistics Sweden. "MTR" refers to the marginal tax rate. The marginal tax rate is calculated by summing the Swedish state marginal tax rate with the average sum of local and municipal marginal tax rates (31% both before and after the reform). All amounts shown in the table are in real 1989 Swedish Kronor (SEK). In nominal terms, the end of the first bracket in 1991 was SEK 180,300. In 1989, an individual's tax liability was the sum of his or her liabilities on two different tax schedules, the basic tax schedule and the additional tax schedule. "Additional taxable income" refers to the measure of taxable income on the basis of which the liability on the additional tax schedule was calculated; "basic taxable income" refers to the measure of taxable income on the basis of which the liability on the basic tax schedule was calculated. Additional taxable income differed from basic taxable income because one could claim more deductions on the basic schedule than on the additional schedule. The additional schedule applied to individuals whose additional taxable income was above SEK 140,000. The tax schedule shown above for 1989 assumes that basic taxable income is equal to additional taxable income. The tax base also shifted in a number of ways from 1989 to 1991. For example, before 1991, the marginal tax rate on earned income was calculated as a function of both capital and labor income, whereas starting in 1991, capital income became irrelevant to the calculation of the marginal tax rate on earned income. "—" indicates that the bracket continues at all higher levels of income.

Table 2. Summary Statistics

	Husbands		Wives	
	Mean	SD	Mean	SD
Earnings	174,932	84,644	103,459	49,778
Taxable Labor Income	155,283	77,684	93,831	46,267
Age	44.0	9.16	41.29	9.11
Children < 18	1.40	1.18	1.40	1.18
Net-of-Tax Share	.45	.10	.57	.088
Virtual Income	75,477	20,092	13,863	13,561

Source: LINDA data. The sample contains 178,366 individuals, of whom 89,183 are husbands and 89,183 are wives.   The sample includes only married Swedes who are not self-employed, do not hold shares in a closely held corporation, are between 18 and 65 years old (inclusive), whose earnings are greater than zero in 1989 or 1990, and whose spouses share these characteristics.   The values of the variables are from 1988 and are expressed in 1988 SEK. The net-of-tax share is defined as one minus the marginal tax rate. Taxable labor income is calculated by subtracting certain deductions from earned income, as described in Appendix II.

Table 3. IV Regressions of the Change in Log Real Earnings or Log Real Taxable Labor Income on the Change in both Spouses' Log Net-of-Tax Shares and Log Real Virtual Incomes

	Earned Inc.				Taxable Labor Inc.	
	(1) H	(2) W	(3) H	(4) W	(5) H	(6) W
ΔOwn NTS	.17	.25	.15	.22	.17	.19
	(.02)***	(.03)***	(.02)***	(.03)***	(.02)***	(.03)***
ΔSpouse NTS	.03	.03	.03	.02	.05	.04
	(.03)	(.02)	(.03)	(.02)	(.03)	(.02)***
ΔOwn Income	-.07	-.06	-.06	-.04	-.05	-.05
	(.01)***	(.00)***	(.01)***	(.00)***	(.01)***	(.00)***
ΔSpouse Income	-.004	-.02	-.0007	-.01	-.004	-.02
	(.002)**	(.004)***	(.002)	(.00)***	(.002)*	(.002)***
Add'l. Controls?	No	No	Yes	Yes	Yes	Yes
N	89,183	89,183	89,183	89,183	89,183	89,183
Compensated Own Elasticity	.25	.49	.21	.38	.22	.37
	(.02)***	(.02)***	(.02)***	(.02)***	(.03)***	(.04)***
Compensated Cross Elasticity	.05	.05	.04	.04	.06	.06
	(.02)**	(.02)**	(.02)*	(.02)**	(.03)**	(.03)***

Notes: The dependent variable in Columns 1-4 is the residuals of $\ln[(1+E_t)/(1+E_{t-1})]$. E is earned income. The residuals are calculated by partialing out the predicted effect of lagged income, as described in the text. "ΔOwn NTS" is $\ln[(1-MTR_t)/(1-MTR_{t-1})]$, where MTR is one's own marginal tax rate. "ΔOwn Income" is $\ln[(1+VI_t)/(1+VI_{t-1})]$, where VI is one's own virtual income. "ΔSpouse NTS" and "ΔSpouse Income" are the analogs. The sample includes married Swedes who are not self-employed, do not hold shares in a closely held corporation, are between 18 and 65 years old (inclusive), whose earnings are positive in 1989 or 1990, and whose spouses share these characteristics. The years examined are 1989-90 and 1990-91. All regressions control for year dummies and the 1988 values of age, age squared, number of children, and dummies for education level and region. "Add'l. Controls" means that 2-digit industry and occupation dummies for both spouses and interactions of all of the controls with year dummies are included. "H" and "W" denote regressions for husbands and wives, respectively. "N" is the total number of individuals in the regressions. In Columns 5 and 6, the dependent variable is the residuals of taxable labor income. Standard errors clustered by individual are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 4. Comparison with Other Specifications: IV Regressions of Husbands' and Wives' Change in Log Real Earnings on the Instrumented Change in Own Log Net-of-Tax Share and the Instrumented Change in a measure of Log Real Unearned Income or the Instrumented Change in Spouse's Log Net-of-Tax Share

	(1) H	(2) W	(3) H	(4) W
ΔOwn NTS	.57	.78	.17	.24
	$(.02)^{***}$	$(.03)^{***}$	$(.02)^{***}$	$(.03)^{***}$
ΔVirtual Inc.	.24	.19		
$+\Delta$Spouse Inc.	$(.01)^{***}$	$(.01)^{***}$		
ΔVirtual Inc.			-.07	-.06
			$(.01)^{***}$	$(.00)^{***}$
ΔSpouse Inc.			.11	.12
			$(.01)^{***}$	$(.01)^{***}$
N	89,183	89,183	89,183	89,183

Notes: The dependent variable is the residuals of $\ln[(1+E_t)/(1+E_{t-1})]$, where E denotes earnings and the subscript denotes the year. The residuals are calculated by partialing out the predicted effect of lagged income on the true value of $\ln[(1+E_t)/(1+E_{t-1})]$, using the 1988-9 evolution of the income distribution to determine the coefficients, as described in the text. "ΔOwn NTS" is $\ln[(1-MTR_t)/(1-MTR_{t-1})]$, where MTR refers to one's own marginal tax rate and the subscript refers to the year. "ΔVirtual Inc.$+\Delta$Spouse Inc." refers to $\ln[(1+(VI+SI)_t)/(1+(VI+SI)_{t-1})]$, where VI is the individual's own virtual income and the subscript refers to the year, and SI is actual spousal income in the year in question. "ΔVirtual Inc." refers to $\ln[(1+VI_t)/(1+VI_{t-1})]$, and "$\Delta$Spouse Inc." is defined similarly. The sample includes only married Swedes who are not self-employed, do not hold shares in a closely held corporation, are between 18 and 65 years old (inclusive), whose earnings are greater than zero in 1989 or 1990, and whose spouses share these characteristics. The years included in the regressions are 1989-1990 and 1990-1991, when the tax changes occurred. These years are pooled in the regressions. All regressions control for year dummies and the 1988 values of age, age squared, number of children, dummies for nine education levels, and dummies for 24 regions. "H" refers to regressions for husbands, and "W" refers to regressions for wives. "N" refers to the total number of individuals included in the regressions, the vast majority of whom appear in both 1989-1990 and 1990-1991. Standard errors clustered by individual are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 5. Comparison with Other Specifications: IV Regressions of Husbands' and Wives' Change in Log Real Earnings on the Instrumented Change in Own Log Net-of-Tax Share, the Instrumented Change in Spouse's Log Net-of-Tax Share, and/or the Instrumented Change in Log Real Own Unearned Income

	(1) H	(2) W	(3) H	(4) W	(5) H	(6) W	(7) H	(8) W
ΔOwn NTS	.17	.24	.18	.25	.42	.71	.42	.71
	(.02)***	(.03)***	(.02)***	(.03)***	(.02)***	(.03)***	(.02)***	(.03)***
ΔSpouse NTS	.06	.08			.08	.08		
	(.03)***	(.02)***			(.03)***	(.02)***		
ΔOwn Income	-.07	-.06	-.07	-.06				
	(.01)***	(.00)***	(.01)***	(.00)***				
N	89,183	89,183	89,183	89,183	89,183	89,183	89,183	89,183

Notes: The dependent variable is the residuals of $\ln[(1+E_t)/(1+E_{t-1})]$. E is earned income. The residuals are calculated by partialing out the predicted effect of lagged income, as described in the text. "ΔOwn NTS" is $\ln[(1-MTR_t)/(1-MTR_{t-1})]$, where MTR is one's own marginal tax rate. "ΔOwn Income" is $\ln[(1+VI_t)/(1+VI_{t-1})]$, where VI is one's own virtual income. "ΔSpouse Income" is the analog. The sample includes married Swedes who are not self-employed, do not hold shares in a closely held corporation, are between 18 and 65 years old (inclusive), whose earnings are positive in 1989 or 1990, and whose spouses share these characteristics. The years examined are 1989-90 and 1990-91. All regressions control for year dummies and the 1988 values of age, age squared, number of children, and dummies for education level and region. "H" and "W" denote regressions for husbands and wives, respectively. "N" is the total number of individuals in the regressions. Standard errors clustered by individual are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 6. Comparison with Other Specifications: IV Regressions of Husbands' or Wives' Change in Log Real Earnings, or the Sum of Changes in Husbands' or Wives' in Log Real Earnings, on the Instrumented Change in Spouses' or Family Log Net-of-Tax Share, the Instrumented Change in Husband Log Real Unearned Income, the Instrumented Change in Wife Log Real Unearned Income, or the Instrumented Change in Log Real Family Unearned Income

	(1) H	(2) W	(3) H	(4) W	(5) Sum	(6) H	(7) W	(8) Sum
ΔOwn NTS	.30	.59						
	(.02)***	(.03)***						
ΔSpouse NTS	-.02	-.05						
	(.03)	(.02)***						
ΔFamily NTS			.25	.11	.36	.24	.12	.36
			(.07)***	(.06)**	(.10)***	(.07)***	(.06)**	(.10)***
ΔHusb Income			-.08	-.04	-.12			
			(.02)***	(.01)***	(.02)***			
ΔWife Income			-.02	-.05	-.07			
			(.02)	(.01)***	(.02)***			
ΔFam. Income	-.05	-.07				-.10	-.09	-.19
	(.01)***	(.01)***				(.01)***	(.01)***	(.01)***
N	89,183	89,183	23,759	23,759	23,759	23,759	23,759	23,759

Notes: "H" and "W" denote regressions for husbands and wives, respectively, in which the dependent variable is the residuals of $\ln[(1+E_t)/(1+E_{t-1})]$, where E denotes the unearned income of husbands or wives, respectively. In the columns labeled "Sum," the dependent variable is the change in the sum of the residuals of the log earned income of the husband and wife summed. Columns 1 and 2 are based on the full sample, and Columns 3-8 limit the sample to those observations in which have the same simulated changes in their NTS, which I call "ΔFamily NTS." The residuals are calculated by partialing out the predicted effect of lagged income, as described in the text. "ΔHusb NTS" is $\ln[(1-MTR_t)/(1-MTR_{t-1})]$, where MTR is one's own marginal tax rate. "ΔHusb Income" is $\ln[(1+VI_t)/(1+VI_{t-1})]$, where VI is one's own virtual income. "ΔWife NTS" and "ΔWife Income" are the analogs. "ΔFamily Income" refers to $\ln[(VI_{ht}+VI_{wt})/(VI_{ht-1}+VI_{wt-1})]$, where VI refers to virtual income. The sample includes married Swedes who are not self-employed, do not hold shares in a closely held corporation, are between 18 and 65 years old (inclusive), whose earnings are positive in 1989 or 1990, and whose spouses share these characteristics. The years examined are 1989-90 and 1990-91. All regressions control for year dummies and the 1988 values of age, age squared, number of children, and dummies for education level and region. "N" is the total number of individuals in the regressions. Standard errors clustered by individual are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Appendix Table A1. Number of Spouses with each Possible Combination of Simulated Percent Changes in Net-of-Tax Shares

		-23	-6	-2	8	26	29	33	38	77	81	82	156
							Changes for Wives						
	-23	0	2	1	71	1	8	34	0	0	0	0	0
	-6	0	89	0	906	0	199	1,470	0	0	28	9	3
	-2	1	2	10	245	1	13	164	0	0	3	3	2
	8	5	58	18	4,582	1	256	2,182	3	1	56	10	12
Changes	26	0	0	4	61	2	7	33	0	0	4	1	1
for	29	1	5	17	9,553	0	3,107	17,221	0	0	428	193	28
Husbands	33	2	249	2	9,066	1	1,508	13,592	1	0	213	84	23
	38	0	0	0	13	1	0	8	2	0	0	0	0
	77	0	1	0	4	0	0	0	0	0	0	0	0
	81	0	502	7	5,500	3	2,873	10,064	1	1	1,047	359	115
	82	0	2	0	205	0	33	332	0	0	18	57	4
	156	0	20	0	36	0	8	45	0	0	6	15	32

Notes: The number in each cell represents the number of couples in the sample in which the husband and wife had a given combination of simulated percent changes in their net-of-tax shares from 1989 to 1991. The heading of each column shows the simulated percent change in wives' net-of-tax share; the heading of each row shows the simulated percent change in husbands' net-of-tax share. The simulated percent change in the net-of-tax share is calculated as the percent change in the net-of-tax share that an individual would have experienced from 1989 to 1991 if his or her income had grown at the economy-wide growth rate of per-person income. The table shows 87,649 observations, which is 1,534 observations smaller than the sample size in the regressions in Table 3 (89,183). This is because some additional individuals enter the sample in 1990, because both of the members of their household have positive earnings in 1990, but not in 1989. There are 12 possible percentage changes in the net-of-tax share because in 1989, the total marginal tax rate was the sum of the marginal tax rate on the basic schedule and the marginal tax rate on the additional schedule, and two individuals with the same marginal tax rate on one of these schedules could have a different marginal tax rates on the other schedule. For simplicity, I have assumed that everyone faces the same total local and municipal tax rate of 31% (which is the mean sum of these tax rates both before and after the reform).

Appendix Table A2. Alternative Specification: IV Regressions of the Change in Log Real Earnings on the Instrumented Change in both Spouses' Net-of-Tax Shares and the Instrumented Change in both Spouses' Real Virtual Incomes

	(1) H	(2) W
ΔOwn NTS	.10	.13
	(.01)***	(.01)***
ΔSpouse NTS	.02	.02
	(.02)	(.01)
ΔOwn Income	-.04	-.03
	(.00)***	(.00)***
ΔSpouse Income	.0003	-.01
	(.00)	(.00)***
N	86,276	86,276

Notes: I include only observations on individuals in couples in which both members have positive earnings in both the base year and the final year. Since couples are selected on the basis of an outcome variable, the results should be interpreted with caution. The dependent variable is the residuals of $\ln(E_t/E_{t-1})$, where E is earned income. The residuals are calculated by partialing out the predicted effect of lagged income from $\ln(E_t/E_{t-1})$, as described in the text. "ΔOwn NTS" is $\ln[(1\text{-MTR}_t)/(1\text{-MTR}_{t-1})]$, where MTR is one's own marginal tax rate, and "ΔOwn Income" refers to $\ln[(1+\text{VI}_t)/(1+\text{VI}_{t-1})]$, where VI is one's own virtual income. "ΔSpouse NTS" and "ΔSpouse Income" are the analogs. The sample includes only married Swedes who are not self-employed, do not hold shares in a closely held corporation, are between 18 and 65 years old (inclusive), and whose spouses share these characteristics. The years examined are 1989-90 and 1990-91. All regressions control for year dummies and the 1988 values of age, age squared, number of children, dummies for nine education levels, and dummies for 24 regions. "H" refers to regressions for husbands, and "W" to those for wives. "N" is the total number of individuals included in the regressions. Standard errors clustered by individual are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.