Volume Title: Behavioral Simulation Methods in Tax Policy Analysis

Volume Author/Editor: Martin Feldstein, ed.

Volume Publisher: University of Chicago Press

Volume ISBN: 0-226-24084-3

Volume URL: http://www.nber.org/books/feld83-2

Publication Date: 1983

Chapter Title: Alternative Tax Treatments of the Family: Simulation Methodology and Results

Chapter Author: Daniel R. Feenberg, Harvey S. Rosen

Chapter URL: http://www.nber.org/chapters/c7704

Chapter pages in book: (p. 7 - 46)

1 Alternative Tax Treatments of the Family: Simulation Methodology and Results

Daniel R. Feenberg and Harvey S. Rosen

> It is hard to grapple with an existing social order, but harder still to have to posit one that does not exist.
>
> Hugo von Hofmannsthal

1.1 Introduction

The choice of a unit of taxation is a fundamental one in any tax system. In most cases, this boils down to whether the tax schedule will be applied to the income of the individual or that of the family. Since the personal income tax was introduced into the United States in 1913, the selection of the taxable unit has been a source of controversy.[1] The choice has fluctuated over time, and even now there is no strong societal consensus.

Currently, single and married people face different tax schedules, with the tax liability of married individuals being based upon the couple's joint income.[2] Consequently, tax burdens change with marital status, although one cannot predict a priori whether tax liabilities will increase or decrease when an individual marries. The answer depends in part upon the closeness of the incomes of the spouses. The general tendency is that the closer

Daniel R. Feenberg is a postdoctoral research economist at the National Bureau of Economic Research. Harvey S. Rosen is with the Department of Economics, Princeton University, and the National Bureau of Economic Research.

This work was supported in part by a grant from the National Science Foundation. The authors are indebted to Donald Fullerton, Christopher Sims, and members of the NBER's research program in taxation and project in tax simulation for useful suggestions. Any opinions expressed are those of the authors and not those of the institutions with which they are affiliated.

1. The pros and cons of various choices are discussed by Rosen (1977), Brazer (1980), and Munnell (1980).
2. The family was established by statute as the principal unit of taxation in 1948. The system of separate schedules for singles and marrieds was introduced in 1969.

the incomes, the more likely that tax liabilities will increase (Munnell 1980).

This state of affairs has been criticized for a number of reasons. Some observers, noting that the tax system often provides financial disincentives for marriage, have argued that the current regime encourages immorality (*Washington Post* 1979). Economists have tended to focus on possible inefficiencies induced when tax liability is based upon family income ("joint filing"). As Boskin and Sheshinski (1979) note, since the labor supply elasticities of husbands and wives differ, economic efficiency would be enhanced if their earned incomes were taxed at different rates. Yet under a system of joint filing, spouses face the same marginal tax rate on the last dollar. A closely related criticism is that the current tax regime tends to discourage married women from entering the marketplace. This is because under joint filing, the wife's marginal tax rate is a function of the husband's earnings.[3]

In the light of these and other criticisms, a number of suggestions have been made to reform the tax treatment of the family. None of these proposals has been accompanied by careful estimates of their effects on income distribution, revenue collections, and labor supply. The purpose of the present paper is to provide this information.

The vehicle for our analysis is the TAXSIM file of the National Bureau of Economic Research.[4] TAXSIM contains virtually all the information from a sample of 2,339 tax returns filed in 1974.[5] (The returns, however, are "aged" so that all magnitudes reported are in 1979 levels.)[6] The file includes information on the taxable earnings of both spouses, interest, dividends, capital gains, rents, etc. Our basic plan is to simulate the effects of alternative tax regimes by computing for each the associated tax liabilities. In this way, one can determine the gainers and losers as the tax system is modified.

An important complication arises because much economic behavior depends upon the tax system, so that *pretax* values of (say) earnings may be a function of the tax regime. More specifically, a number of econometric studies have indicated that although husbands' hours of work are independent of the tax system, the labor force behavior of married

3. This argument implicitly assumes that a husband's labor supply is not sensitive to tax rate changes generated by his wife's earnings.

4. TAXSIM is described in detail in Feldstein and Frisch (1977). In the version used here, neither state and local nor social security taxes are taken into account.

5. The file is a stratified sample from the Treasury Tax Model; it includes one return in eighty for returns showing no wife's labor income and one return in twenty with positive wife's labor income. The Tax Model is itself stratified with weights ranging from one to several thousand.

6. In order to bring all figures to 1979 levels we increase all dollar amounts by the proportional change in taxable income from 1974 to 1979, and to increase the number of returns according to the growth of population.

women is quite responsive to the net wage (see e.g. Rosen 1976 or Hall 1973).[7] Thus, ignoring the labor supply response of married women is likely to lead to biased estimates of the effects of tax reform proposals. Our simulations explicitly incorporate endogenous work decisions for wives.

Unfortunately, even a complete set of variables relating to a household's tax situation does not include all of the information needed to predict the effects of taxes on labor supply. For example, standard theoretical considerations suggest that an important determinant of labor supply is the wage rate, but since it is not entered on the tax return, the wage is absent from TAXSIM. Section 1.2 of this paper consists of a careful discussion of the statistical issues surrounding the problem of imputing such missing data. The reader who lacks interest in this methodological question may wish to skip to section 1.3, which explains the behavioral assumptions built into the simulations. Section 1.4 contains the results. The alternative tax regimes considered run the gamut from eliminating joint filing altogether, to retaining joint filing but granting tax subsidies to secondary workers. A concluding section includes some caveats and suggestions for future research.

1.2 Methodological Issues

A behavioral simulation requires data on individuals' tax situations and on their economic and demographic characteristics. The tax information is required to make careful predictions of the revenue implications of alternative tax regimes. The economic and demographic information is needed to estimate the impact of tax changes upon economic behavior.

The fundamental methodological problems of this study are consequences of the fact that no publicly available data set has all this information. The sources typically used by economists to estimate behavioral equations have virtually no federal income tax data (see e.g. Institute for Social Research 1974). On the other hand, data sets that are rich in tax information tend to tell us little else about the members of the sample. For example, because individuals do not report wage rates and hours of work on their federal income tax returns, TAXSIM has no information on these crucial magnitudes. Clearly, then, one must bring together information from (at least) two different data sources in order to perform tax simulations with endogenous labor supply responses.

A popular technique for combining information is statistical matching.[8] The first step in this procedure is to isolate a set of variables that is common to both data sets. Then a search is made to determine which

7. The evidence is reviewed more carefully in section 1.3 below.

8. It has been used, for example, to create the Brookings MERGE file. See Pechman and Okner (1974).

observations of each data set are "close" on the basis of these variables.[9] The close observations are pooled in order to form a "synthetic" observation, which is then treated as if it were generated by a single behavioral unit.

In addition to suffering from statistical problems,[10] the matching procedure is enormously expensive in computer time for data sets of even moderate size. In this section we develop an imputation procedure that we think dominates matching on both statistical and cost grounds. We begin by discussing the general problem of predicting tax revenue collections in a simulation model with endogenous behavior. This turns out to provide a useful framework for generating a rigorous data imputation technique, which is done in the second part of this section. In the third part, the procedure is applied to the problem of estimating missing wage data.

1.2.1 Predicting Tax Revenues

Let y be a vector of variables endogenous to the tax system. Included are items such as taxable income, which depends directly upon provisions of the tax code, as well as variables like pretax earnings, which depend upon the tax system only to the extent that the latter influences economic behavior. Let x be a vector of exogenous variables such as age and wealth. If the tax code at a given time is represented by the parameter B, then we can think of the tax system as a function $t(x,y,B)$ which determines the amount of taxes owed by an individual given both the relevant exogenous and endogenous variables. Our problem is to determine how revenues change when there is a change from the current tax regime, denoted B', to some new tax regime, B''.

Call the joint distribution of the exogenous and endogenous variables in the population $f(x,y|B')$. Then total tax revenue under the current regime B' is

$$T(B') = N\int_x\int_y t(x,y,B')f(x,y|B')dy\ dx\ , \tag{2.1}$$

where N is the total number of taxpaying units.

The analytic integration implied by (2.1) cannot in practice be performed. An obvious alternative to (2.1) is its discrete analogue,

$$\hat{T}(B') = \sum_{i=1}^{I} t(x_i,y_i,B')P_i\ , \tag{2.2}$$

where y_i and x_i ($i = 1, \ldots, I$) are I sample observations from the universe of N taxpaying units and P_i is the sample weight of the ith observation. (In the absence of deliberate stratification, $P_i = N/I$ for all i.)

Under the tax regime B'' tax revenues are

9. Criteria for doing the matching are discussed by Kadane (1978) and Barr and Turner (1978).

10. These are explained by Sims (1978).

(2.3) $$T(B'') = N\int_x\int_y t(x,y,B'')f(x,y|B'')dy\ dx\ .$$

Unfortunately, even knowledge of $f(x,y|B')$ does not in general give us $f(x,y|B'')$, the joint distribution of x and y under the new regime. Only with the restrictive assumption that y is inelastic with respect to the change in tax regimes can we estimate new tax revenues as

(2.4) $$\hat{T}(B'') = \sum_{i=1}^{I} t(x,y,B'')P_i\ .$$

For changes in tax regimes of the sort being analyzed in this paper, the exogeneity assumption is untenable.

In order to predict taxes under B'', the first step is to specify a behavioral relation that gives y as some function of x, the tax code, and an error term independent of x:

(2.5a) $$y_i' = y(x_i,B') + u_i'\ ,$$

(2.5b) $$y_i'' = y(x_i,B'') + u_i''\ ,$$

where u_i' is the random error for the ith individual under regime B' and u_i'' is defined analogously. (The errors have means of zero.) Note that independence between u_i' and u_i'' is *not* assumed; indeed, one expects that typically they will conceal a substantial individual "fixed effect" and hence be correlated.

If we substitute equation (2.5b) into (2.3), we find

(2.6) $$T(B'') = N\int_x\int_y\left[\int_{u_i''}t(x,y(x,B'') + u_i'',B'')\phi(u_i'')du_i\right] \times f(x,y|B')dy\ dx\ ,$$

where $\phi(u_i'')$ is the density of u_i''. The discrete analogue to (2.6) is

(2.7) $$\hat{T}(B'') = N\sum_{i=1}^{I}\left[\int_{u_i''}t(x_i,y(x_i,B'') + u_i'',B'')\phi(u'')du_i''\right]P_i\ .$$

If the distribution of u_i'' is known,[11] then (2.7) consists entirely of observables. It turns out, however, that both defining $\phi(u_i'')$ and integrating over u_i'' can be avoided by taking advantage of a simple trick. Define

(2.8) $$\hat{y}_i'' = y(x_i,B'') + (y_i' - y(x_i,B'))\ .$$

In words, $\hat{y}_i''$ is the expected value of y under the B'' regime plus the error term associated with regime B'. If, as might reasonably be expected, u_i' and u_i'' are highly correlated, then $\hat{y}_i''$ should be a better estimator of y_i'' than $y(x_i,B'')$, because the latter ignores the error in the behavioral equation. More precisely, $\hat{y}_i''$ and y_i'' have identical distributions under the assumption that u_i' is drawn from the same distribution as u_i'', a fairly mild condition. These considerations suggest the following estimator:

11. For example, u_i'' might be the normal error from a regression, whose mean and variance are computed along with the regression coefficients.

$$\hat{T}(B'') = N \sum_{i=1}^{I} t(x_i, \hat{y}_i'')P_i \,, \tag{2.9}$$

which can also be written (using the definition of $\hat{y}_i''$) as

$$\hat{T}(B'') = N \sum_{i=1}^{I} t(x_i, y(x_i, B'') + u_i', B'')P_i \,. \tag{2.10}$$

Since y_i'' and $\hat{y}_i''$ have the same distribution, $\hat{T}(B'')$ is an unbiased estimator of total revenue.

It is useful to compare (2.10) with (2.7). In effect, the integral over u_i'' of (2.7) has been replaced in (2.10) by a sample mean from an identical distribution. (Of course, the sample mean is calculated with one observation, but it is nevertheless an unbiased estimator, and hence performs the same function as a mean calculated over several observations.)

$\hat{T}(B'')$ should be contrasted with an estimator which uses only the predicted value of y_i'' for each observation,

$$\tilde{T}(B'') = N \sum_{i=1}^{I} t(x_i, y(x_i, B''), B'')_i \,. \tag{2.11}$$

One expects that $\tilde{T}(B'')$ will be less satisfactory than $\hat{T}(B'')$ because in general the distribution of the expectation of a random variable differs from the distribution of the variable itself, if only in having a smaller variance. Only if the tax code and labor supply functions are linear will (2.11) be equivalent to (2.10).

To summarize: We have carefully developed a method for estimating tax revenues under alternative tax regimes. Similar procedures have been used before (see e.g. Feldstein and Taylor 1976), but with a more intuitive statistical justification. Of course, the discussion so far has ignored the possibility that some variables in the x or y vectors may be missing from the TAXSIM file. The theory we have developed in this section, however, turns out to provide a useful framework for thinking about data information problems.

1.2.2 Imputing Baseline Data: Theory

Most of the plausible theories of labor supply suggest that it is necessary to know something about individuals' wage rates and hours of work in order to predict how alternative tax regimes affect revenues. But federal tax returns include only the product of hours and the wage rate, that is, earnings. In this section we show how external information concerning the joint distribution of earnings and hours can be used in conjunction with tax return data to impute the missing variables.

For expositional purposes, we specialize the model developed in section 1.2.1 above. Let the vector y of endogenous variables have two elements, e (earnings) and m (total taxable income).[12] Let the vector x of

12. We ignore for the moment the fact that the household may have more than one earner.

exogenous variables consist of one element, w, the pretax wage rate. The tax calculator is then $t(e,m,w,B)$.

Although TAXSIM has e and m, it does not have w. A number of data sets have information on e and w, but not m. Because there is no data set which includes e, m, *and* w, $f(e,y,w|B')$ cannot be inferred straightforwardly. But if we are willing to make some additional assumptions, $f(\cdot)$ is estimable.

The key assumption is that m and w, *conditional* on e and B, are independent. This seems quite reasonable in that once we know earnings, knowledge of the wage probably contributes little to predicting taxable income. Of course, the independence assumption is not *necessarily* true. It might be the case, for example, that high nonlabor incomes are associated with high reservation wages, ceteris paribus. This would generate conditional dependence of m and w, even given e. In this context, it should also be noted that in actual application there are several variables common to both data sets. Increasing the number of variables upon which independence is conditioned makes the assumption even more reasonable.

Rewriting equation (2.1) for our special case, we have

$$T(B') = N\int_w\int_m\int_e t(e,m,w,B')f(e,m,w|B')de\ dm\ dw\ . \tag{2.12}$$

Taking advantage of the usual identities concerning the distributions of independent variables,[13] (2.12) can be rewritten as

$$T(B') = N\int_w\int_m\int_e t(e,m,w,B) \times \left[\int_w f(\cdot|B)dw \frac{\int_m f(\cdot|B)dm}{\int_m\int_w f(\cdot|B)dw\ dm}\right] de\ dm\ dw\ . \tag{2.13}$$

Now, $\int_w f(\cdot|B)dw$ is the distribution of earnings and taxable income, and is estimable from the TAXSIM file. $\int_m f(\cdot|B)dm$ is the distribution of wages and earnings, and may be estimated from any data set with information on both w and e. Finally,

$$\int_m\int_w f(\cdot|B)dw\ dm$$

is the distribution of earnings and may be estimated from either or both files. Therefore $T(B)$ is identified by the existing unmatched files.

There still remains, of course, the problem of estimating the relevant distribution functions. As noted above, it is impractical to find closed-form expressions for $f(\cdot|B)$ and its marginal distributions. Sims (1978) has suggested that e, m, and w space be partitioned into a large number of cells, and that the marginal cell counts be used as estimated of the three integrals over $f(\cdot|B)$. However, given that in our problem we are dealing

13. See, for example, DeGroot (1975, p. 119).

with a number of continuous variables, this approach does not seem operational.

We therefore propose the following alternative. Let $(e_i, m_i; i = 1, \ldots, I)$ be a set of I observations from TAXSIM. Then the discrete probability analogue to equation (2.13) is

$$\hat{T}(B') = \sum_{i=1}^{I} \left[\int_w t(e_i, m_i, w, B') \frac{\int_m f(\cdot|B')dm}{\int_m \int_w f(\cdot|B')dw\, dm} dw \right] P_i, \tag{2.14}$$

where the term enclosed in brackets is the expected value of taxes owed by the ith taxpayer, given the joint distribution of wage rates with the other variables. (Note that P_i plays the role that $\int_w f(\cdot|B')dw$ had in (2.13).)

The ratio
$$\frac{\int_m f(\cdot|B')dm}{\int_m \int_w f(\cdot|B')dm\, dw}$$

that appears in (2.14) is just the distribution of wage rates conditioned on earnings and B'. As noted above, it can be estimated from a number of available data sets. It appears, then, that the only stumbling block to evaluating (2.14) is integrating over w. A Monte Carlo approach seems promising here.[14] Essentially, this procedure involves the replacement of the integral over w with a sample mean.

We proceed more formally by defining

$$q_i(w) \equiv t(e_i, m_i, w, B') \frac{\int_m f(\cdot|B')dm}{\int_m \int_w f(\cdot|B')dw\, dm} P_i .$$

Then (2.14) can be rewritten

$$\hat{T}(B') = N \int_w \sum_{i=1}^{I} q_i(w)dw . \tag{2.15}$$

For *any* density function $g(w)$, (2.15) is

$$\hat{T}(B') = N \int_w \sum_{i=1}^{I} \frac{q_i(w)}{g(w)} g(w)dw . \tag{2.16}$$

Observe that *if* w is distributed as $g(w)$, then (2.16) is the expected value of $\Sigma_{i=1}^{I} (q_i(w)/g(w))$.

Suppose that we have available a device for producing random numbers with distribution $g(w)$. Let $\hat{w}_{ij}$ be the jth such random number generated for the ith individual. Then the basic Monte Carlo strategy suggests replacing integral (2.16) with

14. For a general discussion of Monte Carlo techniques, see Shreider (1966).

$$(2.17)\qquad \hat{\hat{T}}(B') = \frac{N}{J} \sum_{j=1}^{J} \sum_{i=1}^{I} \frac{q_i(\hat{w}_{ij})}{g(\hat{w}_{ij})},$$

where J is the number of random drawings.

Suppose now that we let $g(w)$ be the conditional distribution of wages given earnings. Then (2.17) becomes

$$(2.18)\qquad \hat{\hat{T}}(B') = \frac{N}{J} \sum_{j=1}^{J} \sum_{i=1}^{I} t(e_i, m_i, \hat{w}_{ij}, B') \times \frac{\int_m f(\cdot|B')dm}{g(w_{ij})\int_m \int_w f(\cdot|B')dw\, dm} P_i .$$

When the definition of $g(\cdot)$ is substituted into (2.18), it collapses

$$(2.18')\qquad \hat{\hat{T}}(B') = \frac{N}{J} \sum_{j=1}^{J} \sum_{i=1}^{I} t(e_i, m_i, E(\hat{w}_{ij}, B'))P_i .$$

To appreciate the meaning of (2.18′) it is useful to contrast it to the alternative expression

$$(2.19)\qquad S(B') = N \sum_{i=1}^{I} t(e_i, m_i, E(w_i|e_i, m_i))P_i ,$$

where $E(w_i|e_i, m_i)$ is the conditional expectation of w_i. To compute $\hat{\hat{T}}(B')$, we must take the average of J values drawn from the conditional distribution of w, while for $S(B')$, w is imputed using simply the conditional mean. To the extent that $t(\cdot)$ is nonlinear, $S(B')$ yields biased estimates.

The only remaining question is how to choose J, the number of random drawings from the distribution. A careful examination of this question would require optimally trading off the (substantial) computational costs of increasing J against the efficiency gains from doing so. Such an exercise is beyond the scope of this paper. We settle upon $J = 1$ as an inexpensive solution that has all the desirable statistical properties of (2.18′).

We have come by a rather indirect route, then, to a rigorous yet straightforward solution to the problem of imputing wage rates to the TAXSIM file. Using a separate data file, estimate a regression of the form $w = g(Z) + \epsilon$, where Z is a vector of variables in common between TAXSIM and the data set and ϵ is a random error. Then for the ith observation in TAXSIM, impute the wage as $g(Z_i) + \epsilon_i$, where ϵ_i is a random drawing from the distribution of ϵ.

1.2.3 Imputing Baseline Data: Application to the Wife's Wage

We now apply our statistical theory to the problem of imputing wives' wages.[15] The first task is to select a suitable data set that includes the wage

15. Husbands' wages are not required for reasons given in section 1.3 below.

rate. The University of Michigan Panel Study of Income Dynamics (PSID) was chosen because it was the only data set we could locate which included both wage rate and annual income data for a sample from the general population. The much larger Current Population Survey (United States Department of Labor) asks for income in March and the wage rate in May; while these could in principle be matched, we did not attempt to do so. The National Longitudinal Survey (United States Department of Labor 1970) covers only specific age-groups. The major disadvantage of the PSID is the absence of any families with very large incomes. While these families are relatively rare in the population, they are an important source of tax revenue. It would have been useful to have a recent data set in which the rich are oversampled, but none exists.

The next step is to estimate with the PSID data a regression of the wife's wage on some function of those variables that are common to the PSID and TAXSIM. The set of common variables consists of: wife's earnings, husband's earnings, a dummy to indicate whether the wife is over sixty-five, and the number of exemptions. A regression of the wife's wage rate on a set of variables that includes her earnings may at first seem rather strange. After all, since earnings is just the product of wage rate and hours worked, it is an endogenous variable. This observation, although correct, is quite beside the point. The statistical theory developed in the preceding section dictates only that we describe the joint distribution of the wage rate and the common variables, *not* that we estimate a valid structural equation.

After some experimentation, we selected a function second-order in both husband's and wife's earnings. The results are presented in the column (1) of table 1-1. A glance at the table indicates that the standard errors of the earnings variables are somewhat large relative to the size of the coefficients. This is a consequence of multicollinearity among the five earnings variables and is not a cause for concern, because it does not render the predictions biased.

The possibility remains that even given the common variables, other factors significantly influence the wife's wage. In order to see whether this was the case, we augmented the list of regressors with the following variables from the PSID: wife's education, wife's labor market experience, wife's race, and wife's age.

As can be seen from the results given in column (2) of table 1.1, except for years of education none of the variables adds significantly to the explanatory power of the equation. Will, then, the fact that education is not available for the imputation process lead to an important bias in our calculations? We think that any such bias will be minimal. Education is, after all, not available in the tax model precisely because it is not required to calculate taxes. To the extent that education is correlated with some

Table 1.1 Wife's Wage Regressions

	(1)	(2)
Constant	1.883	−.2926
	(.1725)	(.3415)
Wife's earnings	.2007	.1840
	(.03188)	(.03174)
(Wife's earnings)^2	.01194	.009699
	(2.295×10^{-3})	(2.278×10^{-3})
Husband's earnings	.03551	.02049
	(.01400)	(.01399)
(Husband's earnings)^2	1.144×10^{-4}	7.0706×10^{-5}
	(2.787×10^{-4})	(2.7699×10^{-4})
Wife's earnings ×	1.734×10^{-5}	.001016
husband's earnings	(1.488×10^{-3})	(.001478)
Wife over 65*	.1389	−.1363
	(.3269)	(.3488)
Number of children	7.843×10^{-4}	.02593
	(.03203)	(.03226)
Wife's education	...	.1668
		(.02077)
Black*	...	−.09957
		(.1610)
Wife's age	...	.00786
		(.004138)
Wife's years of labor	...	.002968
market experience		(.003302)
S.E.E.	10.24	10.06
N	1808	1791

Note: Wage regressions are estimated from PSID. Earnings variables are measured in thousands of dollars. Variables in parentheses are standard errors.
*Dichotomous variables.

variable in TAXSIM that is not in the PSID, there will be some bias, but it is reasonable to expect such correlations to be small.

There turned out to be a problem with the first regression of table 1.1 that led us to reject it as a basis for our wage imputations: the residuals were not homoscedastic. It was therefore difficult to specify the distribution of the residuals, a step which is required in order to assign the random component of the imputed wage. To remedy this difficulty we estimated separate regressions for each of three earnings categories. (We did not investigate the possibility that the error variance might depend upon variables other than income.) These results, which are reported in table 1.2, provided a considerably more homogeneous set of residuals within groups, although not of an identifiable distribution. Therefore the random component of the wage imputation was found by making a random selection from the set of estimated residuals. The imputed wage,

Table 1.2 Wife's Wage Regressions by Earnings Class

	$0 < e < 2{,}500$	$2{,}500 < e < 7{,}500$	$7{,}500 < e$
Constant	1.939	2.5599	−3.743
	(.3485)	(.7340)	(1.695)
Wife's earnings	.8703	−.1721	1.055
	(.4363)	(.2937)	(.2542)
(Wife's earnings)^2	−.3306	.0502	−.01547
	(.1618)	(.02883)	(.01050)
Husband's earnings	.001795	.07768	.1943
	(.02599)	(.03021)	(.06958)
(Husband's earnings)^2	-2.482×10^{-4}	.001348	−.001079
	(3.886×10^{-4})	(3.7431×10^{-4})	(.001529)
Wife's earnings × husband's earnings	.03098	−.01612	−.009877
	(.01484)	(.005626)	(.006135)
Wife over 65	−.1699	.8497	−.5405
	(.4563)	(.4739)	(1.2119)
Number of children	−.02310	.06594	−.1034
	(.05126)	(.03865)	(.1073)
S.E.E.	10.69	7.95	13.03
N	703	810	295

Note: See footnotes to table 1.1.

then, is the sum of this residual and the conditional expected mean estimated from the appropriate equation from table 1.2.

Of course, for nonworking wives this procedure could not be implemented because of the absence of a wage variable to serve the dependent variable. Instead, a procedure was followed similar to that suggested by Hall (1973). We estimated for the sample of working wives a regression of the wage rate on husband's income, number of dependents, and an over sixty-five dummy variable, and used the results to impute wages to the nonworkers. As is well known, this procedure does not correct for the possible effects of selectivity bias (see e.g. Heckman 1980). Given our paucity of explanatory variables, it seemed to us pretentious to attempt this rather subtle correction. Moreover, Hausman (1980, pp. 47, 48) has pointed out that in cases like ours, the correction usually makes no practical difference anyway.

1.3 Behavioral Assumptions

We now turn to the question of how, given our figures on wages rates and hours of work, we can simulate the effects of various tax changes on work effort and the distribution of family income. In effect, our task is to specify the function $y(\cdot)$ of equation (2.5) that relates hours of work to exogenous variables and the tax code. The framework used is the stan-

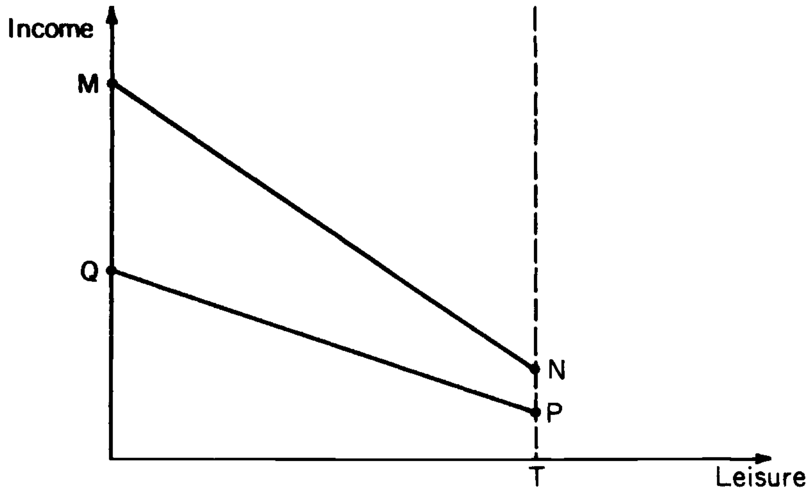

Fig. 1.1

dard microeconomic theory of the leisure-income choice.[16] The theory views the hours-of-work decision as an outcome when the individual maximizes a utility function subject to a budget constraint. This suggests an obvious way to organize our exposition: in section 1.3.1 we discuss the budget constraint generated by the personal income tax system, and in section 1.3.2 we explain how preferences are modeled.

1.3.1 The Budget Constraint

Consider first the budget constraint faced by an untaxed individual with a wage ω and unearned income I. The constraint can be represented graphically on a diagram with income plotted on the vertical axis and hours of leisure on the horizontal. In figure 1.1, if the individual's time endowment is $0T$ hours, then the budget constraint is a straight line MN with slope $-\omega$ and vertical intercept $I(=TN)$. Behind the linear budget constraint are the assumptions that the fixed costs associated with working are negligible and that the gross wage does not vary with hours of work. These assumptions are common to most studies of labor supply. Although the consequences of relaxing them have been discussed,[17] there is no agreement on whether they are important empirically. In this study we retain the conventional assumption that the pretax budget constraint can be represented as a straight line.

16. For a comprehensive discussion of the theory, the reader is referred to Heckman, Killingsworth, and MaCurdy (1979).

17. Hausman (1980) analyzes a model with fixed costs of work, and Rosen (1976) discusses a model in which full- and part-time workers receive different hourly wages.

Assume now that the individual is subject to a proportional tax on both earned and unearned income. Then the effective budget constraint facing the individual in figure 1.1 is *PQ*, with the tax rate being *NP*/*NT*. Note that even with such a simple tax system, one would have to know both the uncompensated elasticity of hours with respect to the wage and the income elasticity in order to predict the impact of taxes upon hours of work.

Of course, the United States tax system is progressive with respect to taxable income, not proportional. As an individual's income bracket changes, she generally faces a discrete increase in the marginal tax rate. This leads to a kinked budget constraint like *RSUVW* in figure 1.2. Observe that if the individual's optimum is along (say) segment *US*, then she behaves *exactly* as if optimizing along a linear budget constraint with the same slope as *US* but with intercept *TR*′. This fact, which has been observed by Hall (1973) and others, is extremely useful, because it allows us to characterize the individual's opportunities as a series of straight lines. The distance *TR*′ will be referred to as "effective" nonlabor income.

Included in the tax code are a complicated set of exemptions, deductions, and credits. Conceptually, it is not difficult to include their effects in the budget constraint—all that is required is that we be able to compute net income at any given number of hours of work. It should be noted, however, that some tax provisions, such as the earned income credit,

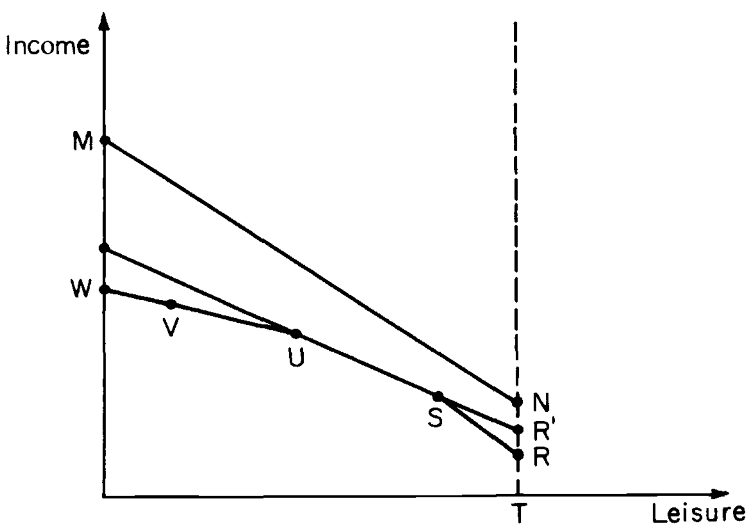

Fig. 1.2

actually lead to nonconvexities in the budget constraint. An important consequence of nonconvexities is that there may be several points at which indifference curves are tangent to the budget constraint. In theory, then, the utility function must be evaluated along each segment of the budget constraint in order to find a global maximum. The specification of a complete utility function—not just a labor supply curve—thus becomes a necessity.

1.3.2 The Utility Function

In order to model preferences we must select both a functional form and specific numerical values for its parameters. One possibility is to choose a reasonable functional form and then estimate the parameters ourselves. The most obvious problem with this approach is that in the TAXSIM model, there are simply not enough data to estimate a convincing labor supply function. As we have already noted, many of the important demographic and economic variables are absent.

Another option is for us to do the estimation using a more appropriate data base and then assign the parameter values to the members of the TAXSIM sample. After considerable thought, this option was rejected. The evidence indicates that the substantive results of labor supply studies are quite sensitive to functional specification and econometric technique.[18] It is therefore unlikely that anyone would have viewed our results as definitive.

Instead, we choose to cull from the literature "consensus" estimates of the wage and unearned income elasticities. Then, assuming some specific form for the utility function and taking advantage of duality theory, we work backward to find the implied utility function parameters. Instead of confining ourselves to one set of parameters, we use several in order to determine the impact upon our substantive results. We first discuss the functional form selected to characterize preferences and then explain how its parameter values are set.

Functional Form

The standard static theory of labor supply behavior starts with a family utility function which depends upon family income and the amounts of leisure time consumed by each spouse. The labor supply of each spouse depends upon the net wages of *both* spouses and effective unearned income. Using several fairly reasonable assumptions, however, one can specify a family utility function with only two arguments: wife's leisure and net family income. This simplification is permissible if the husband's labor supply is perfectly inelastic. In fact, many econometric studies of the labor supply behavior of married men have tended to show that both

18. See the excellent survey by Heckman et al.

wage[19] and income effects are small in absolute value.[20] We therefore adopt the simpler model as a reasonable first approximation of reality.

Now that we have decided upon the arguments for the utility function, we turn to the question of its functional form. In making a selection, two criteria are important: (i) it should be simple, both to limit computational costs and to facilitate intuitive understanding of the results; and (ii) it should be broadly consistent with econometric estimates of the labor supply.

Recently, Hausman (1980) suggested that one way to satisfy these criteria is to start with a labor function that fits the data fairly well and then take advantage of duality theory to find the underlying (indirect) utility function. More specifically, Hausman observes that the linear labor supply function has proved very useful in explaining labor supply behavior:

$$(3.1) \qquad H = a\omega + bA + s \ ,$$

where H is annual hours of work, ω is the net wage, A is effective income, and a, b, and s are parameters. Using Roy's identity, which relates various derivatives of the indirect utility function to H, Hausman shows that the indirect utility function $v(w,A)$ underlying (3.1) is

$$(3.2) \qquad v(w,A) = \left(A + \frac{a}{b}w - \frac{a}{b^2} + \frac{s}{b}\right)e^{b\omega} \ .$$

Given the ranges over which a particular individual's ω and A will vary in our simulations, equations (3.1) and (3.2) seem to be adequate approximations, and they are adopted for use in this paper. We assign each family a set of utility function parameters calculated so that current behavior is perfectly predicted by equation (3.1). Specifically, assume that the hours elasticity with respect to the wage for the ith family is η_i^w and the unearned income elasticity is η_i^A. Then a_i, b_i, and s_i are the solutions to the system:[21]

$$(3.3a) \qquad \eta_i^w = \frac{\omega_i}{H_i} a_i \ ,$$

$$(3.3b) \qquad \eta_i^A = \frac{\omega_i}{A_i} b_i \ ,$$

19. This includes own *and* cross wage effects. For households in which the wife is the primary earner, i.e. her earnings exceed the husband's, the wife's labor supply is assumed to be perfectly inelastic, as is the husband's.

20. See, for example, Heckman et al. (1979, pp. II.28, II.34). Hausman (1980) also finds a small wage effect but a fairly substantial income effect.

21. Clearly, this procedure cannot be implemented for nonworkers. For these individuals, the following ad hoc procedure is used: calculate the average H, w, and A members of the individual's AGI group who work between 0 and 100 hours per year. Substitute these means into system (3), and use the implied values of a, b, and s for the nonworkers.

(3.3c) $s_i = H_i - a_i\omega_i - b_iA_i$.

Up to this point we have discussed only the behavior of married couples. There are, of course, a substantial number of households headed by men and women without a spouse present. Not a great deal is known about the labor supply patterns of such people.[22] We assume in our simulations that the work behavior of these individuals is unaffected by the income tax. This assumption enables us to focus upon problems in the tax treatment of married couples. It also builds a conservative bias into our estimates of the aggregate behavioral response to change in the economic environment.

Elasticity Estimates

In order to solve equations (3.3), estimates of wage and unearned income elasticities for married women are required. The literature suggests fairly high values for the wage elasticity. The studies reviewed by Heckman, Killingsworth, and MaCurdy (1979) report values between 0.2 and 1.35 (pp. II.28, IV.3), and some investigators have proposed even larger estimates (see e.g. Bloch 1973 or Rosen 1976). There is virtually no guidance with respect to how the wage elasticity varies with income level. Indeed, because of the thinness of all statistical samples in very high income groups (i.e. family income greater than $35,000 in 1974), essentially *nothing* is known about the labor supply response of the women at the top end of the income scale.

Since we do not know with any confidence how η_i^ω varies with income, in a given simulation we simply assign all wives the same value. One set of simulations is performed with a value of 0.5 and another with 1.0. The results are contrasted to those which emerge when it is assumed that there is no behavioral response whatsoever to the tax system.

Turning now to the setting of values for η_i^A, we find that here also the literature provides less than firm guidance. This is due in part to the problems involved in correctly measuring unearned family income. (Difficulties arise from underreporting, estimating imputed incomes from durable goods, etc.) In addition, unearned income is usually treated as an exogenous variable in hours equations, although theoretical considerations suggest that in a life-cycle context, it is endogenous. Heckman, Killingsworth, and MaCurdy (1979) report that most investigators have found values of η_i^A between -0.002 and -0.2. We use a value of -0.1 in our simulations.

1.4 Results

In this section we simulate the effects of four alternative approaches to the tax treatment of the family: (*a*) an exemption from taxation of 25% of

22. Hausman (1980, p. 53) reports one study in which female heads of households have a substantial labor supply response and another in which the labor response is nil.

the first $10,000 of secondary workers' earnings, (*b*) a tax credit of 10% on the first $10,000 of secondary workers' earnings, (*c*) taxation of the husband and wife as single individuals, with the tax base of each being half of total family income ("income splitting"), (*d*) choice between (i) taxation of the husband and wife as single individuals, with the tax base of each spouse being his or her own earnings plus one-half of family unearned income, or (ii) the status quo.

Regimes *a* and *b* maintain the existing general framework for taxation of the family. They can be viewed as attempts to ameliorate what some observers consider to be an unduly high tax burden on secondary earners.[23] Regimes *c* and *d* represent more serious departures from the status quo. Under regime *c*, the tax unit is the individual, but tax liability is half of family income. In effect, then, all family income is split. Regime *d* represents a substantial attempt to make individuals rather than families the units of taxation, because only unearned income is split.

There are, of course, an essentially unlimited number of ways in which the tax treatment of the family could be changed. We think that these four are of considerable interest both for policy purposes and for demonstrating the capabilities of our simulation model.

Because there appears to be considerable concern about the impact of alternative tax regimes on wives' labor supplies, the simulations of this section focus only on the population of married couples. Appendix B contains results for simulations with married and single people together. In order to keep the number of tables manageable, we present in this appendix only results for the case where η^{ω}, the uncompensated supply elasticity for wives, is 1.0. Appendix C has results for the more conservative estimate of 0.5.

Each tax regime naturally induces a change in revenue collections. It is possible that in practice legislators might want to introduce additional adjustments to keep tax revenues constant. However, one cannot know what form these adjustments would take—changes in the rate schedules, deductions, and/or tax credits are all possibilities. Indeed, at recent congressional hearings, it was suggested that revenue shortfalls generated by changing the tax treatment of families be made up by a "windfall profits" tax on oil. In addition, there is no assurance that there would be a desire to maintain the tax collections associated with the status quo. Legislators might want to accompany the tax reform with a general increase or decrease in revenues. In the light of this ambiguity, we decided not to attempt here any revenue adjustments, although in future work we hope to develop some constant tax revenue estimates.

The current tax regime provides the benchmark to which the various tax reform proposals are compared. The key information is given in table 1.3. For each adjusted gross income (AGI) class, the table shows

23. See, for example, Munnell (1980).

Table 1.3 The Status Quo, 1979

AGI Class (× $1,000)	Number of Returns	Average AGI	Tax Liability	Marginal Tax Rate	Hours Worked per Year	Fraction of Married Women Earning over $1,000 per Year
<5	1,177,081	2,973	−49	−.03	235	.22
5–10	4,441,634	7,669	41	.15	481	.36
10–15	8,431,342	12,424	965	.17	568	.34
15–20	8,446,110	17,469	1,818	.26	613	.43
20–30	15,239,496	24,329	3,055	.26	829	.51
30–50	8,915,744	36,548	6,424	.34	1,037	.64
50–100	1,662,893	66,211	16,480	.41	658	.45
>100	66,002	178,427	68,729	.55	833	.17
Means	...	24,184	3,831	.241	732	.45
Totals	48,780,302	1.180×10^{12}	1.869×10^{11}	...	3.573×10^{10}	

Table 1.4 — Exemption of 25% of First $10,000 of Secondary Worker's Earnings

AGI Class (× $1,000)	Tax Liability (exogenous behavior)	Tax Liability ($\eta^{\omega} = 1.0$)	Marginal Tax Rate	Hours Worked per Year
<5	−49	−49	−.03	235
5–10	17	20	.14	488
10–15	919	920	.16	572
15–20	1,705	1,717	.23	637
20–30	2,776	2,817	.22	874
30–50	5,877	5,992	.29	1,100
50–100	15,922	16,114	.36	712
>100	68,539	68,647	.52	853
Means	3,594	3,637	.20	766
Totals	1.753×10^{11}	1.774×10^{11}	...	3.737×10^{10}

averages[24] of adjusted gross incomes, federal income tax liabilities, marginal tax rates, and hours of work per year supplied by wives, and their labor force participation rates. (Negative tax liabilities and marginal tax rates can arise because the 10% earned income credit is refundable.) As we expect, average and marginal tax rates tend to rise with AGI class. The number of hours worked tends to rise with income, but the relation is not strictly increasing. As other family income increases, there is an income effect which tends to decrease the number of hours that wives work.[25] However, there is also a tendency for the wife's pretax wage to be positively correlated with other family income, which encourages work in the market (assuming a positively sloped supply of hours schedule). One cannot say a priori which effect will dominate.

We now examine how each proposal would change the status quo.

1.4.1 Exemption of 25% of Secondary Worker's Earnings

Table 1.4 shows the effects of allowing the family to deduct 25% of the first $10,000 of the wife's earnings.[26] In order to allow comparability with table 1.3, the adjusted gross income classes are those associated with the status quo.

The exemption has a substantial impact on labor supply. As comparison of the last column with table 1.3 suggests, on average wives supply thirty-four more hours per year than they do under the current system.

24. Sample population weights are used to compute these and all other averages.

25. This is under the assumption that leisure is a normal good, which is consistent with both casual observation and econometric evidence.

26. This is similar in spirit to the Conable bill, H.R. 6822, which gives a 10% exemption to the first $20,000 of the lower earner's income but only if the couple is subject to the marriage penalty. See Sunley (1980).

The increases are most marked in the higher-income brackets. For example, in the \$50,000–\$100,000 AGI class, annual hours increase by slightly more than fifty. This is because the wives in the higher tax brackets experience the greatest increase in the net wage, ceteris paribus.

On average, tax collections from couples fall by about 5%. In the middle-income ranges there is a tendency for the percentages decrease in tax liability to increase with income. For the sake of comparison, we have noted in the second column of table 1.4 what the revenue predictions would have been had we postulated perfectly inelastic labor supplies for wives. The figures suggest that about one-fifth of the shortfall in tax revenues is restored as a consequence of the increased tax base associated with higher labor supply. Although this is a far cry from the claims of some that tax reductions on earned income will be self-financing, it is enough of a difference to demonstrate the importance of allowing for endogenous behavioral responses.

1.4.2 Tax Credit for 10% of Secondary Workers' Earnings

Under this regime, the family can deduct from its tax bill an amount equal to 10% of the secondary worker's earnings up to a maximum of \$10,000. The results are shown in table 1.5. The overall increase in labor supply induced by the credit is greater than that of the 25% exemption. However, this result does not hold for each AGI class. In the two highest groups, work effort is less than under the exemption. The main reason for this is that at the top of the income distribution, marginal tax rates are sufficiently high that one-fourth the marginal tax rate gives a greater work incentive than the 10% tax credit. The cost of generating the greater labor supply is a somewhat lower level of tax revenues.

Table 1.5 Tax Credit of 10% on First \$10,000 of Secondary Worker's Earnings

AGI Class (× \$1,000)	Tax Liability (exogenous behavior)	Tax Liability ($\eta^{\omega} = 1.0$)	Marginal Tax Rate	Hours Worked per Year
<5	−61	−61	−.046	243
5–10	−8	−7	.12	516
10–15	876	901	.15	612
15–20	1,649	1,679	.21	673
20–30	2,719	2,786	.23	911
30–50	5,940	6,030	.31	1,103
50–100	16,139	16,210	.38	690
>100	68,631	68,670	.52	840
Means	3,576	3,626	.22	793
Totals	1.744×10^{11}	1.768×10^{11}	...	3.867×10^{11}

Table 1.6 Splitting All Income

AGI Class (× $1,000)	Tax Liability (exogenous behavior)	Tax Liability ($\eta^{\omega} = 1.0$)	Marginal Tax Rate	Hours Worked per Year
<5	−54	−54	−.03	235
5–10	−338	−319	.00	575
10–15	312	290	.20	539
15–20	1,459	1,449	.25	619
20–30	2,714	2,799	.22	910
30–50	5,583	5,663	.29	1,066
50–100	13,875	14,202	.33	751
>100	62,192	62,195	.53	840
Means	3,210	3,258	.214	771
Totals	1.566×10^{11}	1.589×10^{11}	...	3.761×10^{10}

1.4.3 Complete Income Splitting

As we noted earlier, there is now considerable sentiment for the view that, at least for income tax purposes, married people should be treated as much as possible like single people. In this and the succeeding section, we consider the effects when both spouses face the tax schedule that is currently faced by single individuals. In this section, we assume that the tax base for each spouse is one-half of total family income, both earned and unearned. Although we characterize this as "income splitting," note that it differs from the conventional use of that term, because we not only divide income but apply a different rate schedule as well (i.e. the schedule that single persons currently face). In section 1.4.4 we assume that only unearned income is split.

The income splitting results are shown in table 1.6. As one would expect, tax revenues go down compared to the status quo—the shortfall for couples is about $28 billion. On the average, hours of work by secondary workers increase by about forty, but interestingly, for some income groups work effort actually falls. Despite the fact that income splitting generally leads to a substitution effect that increases labor supply, there is also an income effect which tends to reduce it. Apparently, the substitution effect dominates in the upper-income groups, while in some of the lower-income groups the income effect dominates. Even given very simple assumptions on the structure of preference, it is not safe to assume that labor supplies for different groups will change in the same direction.

Because the current tax system tends to benefit married couples with only one earner, it is of some interest to examine how the tax burdens of one- versus two-earner families[27] would change under this tax regime.

27. To make this distinction operational, we define a single earner as one in which the minimum of the earnings of the two spouses is less than $1,000.

The results are shown in table 1.7. Columns (2) and (3) show how income taxes change for two-earner families, and (6) and (7) give the same information for one-earner families. On average, tax liabilities for one-earner families fall by a slightly greater proportion than those for two-earner families. This somewhat surprising result occurs because the one-earner families benefit especially from the splitting of nonlabor income.

1.4.4 Optional Single Filing

This regime gives married couples two options. The first is for each spouse to file as an individual and face the same rate schedule as a single person. Each spouse's tax base is the sum of his or her earned income, plus one-half of unearned family income. Deductions and exemptions are allocated in proportion to income.[28] In principle, proponents of individual taxation would probably want to include in a given spouse's tax base only the income deriving from his or her property. This would be impractical, however, because (*a*) much property is jointly owned and (*b*) spouses might transfer property to each other in order to minimize the family tax burden. It seems to us that imposing equal division of unearned income is a reasonable way to proceed.[29]

The family's second option is to continue filing jointly as it does under the current regime. The simulation program computes the utility level associated with each option (using equation [3.2]). The family is assumed to choose whichever option maximizes utility.

The outcomes are shown in table 1.8. What is most striking about this regime is the increase in labor supply generated, an average increase of about eighty hours per year. At the same time, tax revenues from couples fall by more than 10% as approximately half the families take advantage of individual filing to lower their tax liabilities.

Again, it is of some interest to compare the effects of this tax regime on one- versus two-earner families. This can be done by consulting table 1.7. Columns (2) and (4) indicate that tax liabilities for two-earner families fall by about 13%; columns (6) and (8) suggest that tax liabilities for one-earner families fall by only 8%. Although one-earner families gain to some extent by the ability to split unearned income, the major advantages go to those couples who no longer have to pay the "marriage tax."

Another way to interpret table 1.7 is in terms of the proportionate reductions in tax burdens for one- versus two-earner families. Under regime *c*, 58% of the tax cut goes to one-earner families. Regime *d*, on the other hand, gives only 42% of the reduction to these families. One expects, then, that if confronted with the choice between complete

28. The Fenwick bill (H.R. 3609) would allocate each itemized deduction to the spouse who actually makes the payment. As Sunley (1980) points out, this would lead to great complications in tax planning.

29. In contrast, the Fenwick bill would allocate unearned income on the basis of ownership (see Sunley 1980).

Table 1.7 One- versus Two-Earner Families under Regimes *c* and *d*

	Two-Earner Families				One-Earner Families			
AGI Class (× $1,000)	Average AGI (1)	Status Quo Taxes (2)	Taxes: Regime *c* (3)	Taxes: Regime *d* (4)	Average AGI (5)	Status Quo Taxes (6)	Taxes: Regime *c* (7)	Taxes: Regime *d* (8)
<5	4,150	−269	−269	−269	2,649	12	5	12
5–10	8,079	224	−139	112	7,434	−64	−422	−69
10–15	12,039	799	117	548	12,627	1,051	380	997
15–20	17,646	1,798	1,347	1,449	17,333	1,834	1,528	1,673
20–30	24,531	3,230	3,008	2,764	24,116	2,872	2,580	2,743
30–50	35,555	6,121	5,422	5,447	38,300	6,959	6,087	6,685
50–100	62,154	14,714	12,999	12,602	69,525	17,924	15,186	14,668
>100	169,465	62,532	56,280	55,795	180,285	70,013	63,422	63,105
Means	24,928	3,744	3,229	3,226	23,533	3,908	3,284	3,579
Totals	5.678×10^{11}	8.527×10^{10}	7.355×10^{10}	7.349×10^{10}	6.119×10^{11}	1.016×10^{11}	8.539×10^{10}	9.305×10^{10}

Note: Regime *c* is complete income splitting. Regime *d* is optional single filing.

Table 1.8 Optional Single Filing

AGI Class (× \$1,000)	Tax Liability (exogenous behavior)	Tax Liability ($\eta^{\omega} = 1.0$)	Marginal Tax Rate	Hours Worked per Year
<5	−49	−49	−.03	235
5–10	−29	−3	.13	522
10–15	826	843	.15	592
15–20	1,554	1,576	.19	692
20–30	2,662	2,754	.22	932
30–50	5,708	5,895	.28	1,162
50–100	13,392	13,739	.29	829
>100	61,480	61,850	.47	872
Means	3,327	3,414	.206	815
Totals	1.623×10^{11}	1.665×10^{11}	...	3.978×10^{10}

income splitting and optional single filing, one-earner families would tend to support the former, ceteris paribus.

1.5 Concluding Remarks

In this paper we simulated the effects of alternative tax treatments of the family using a model which allows for the possibility of tax-induced changes in labor supply behavior. In order to do so, several methodological problems had to be solved. It was especially important to develop a statistical procedure for imputing values to missing variables. We hope that our "random imputation" technique will be useful to other investigators in a wide variety of applications.

Using the statistical methodology, we examined tax reform proposals that represented both minor and major departures from the current regime. These included various types of preferential treatment for the earnings of secondary workers as well as new rules governing the impact of marriage upon filing status. In a number of cases, we found that failure to allow for an endogenous labor supply response would have led to substantial errors in the revenue estimates. This was true even though the behavioral elasticities we postulated were rather modest in size.

We were often surprised about the directions and magnitudes of the behavioral responses to tax changes. Despite the very simple preference structure that we postulated, "back of the envelope" estimates about what would happen in a given simulation often turned out to be wrong. In a complicated tax structure with discretely changing marginal tax rates, income effects can induce unexpected responses.

In order to point out directions for future research, it is useful to consider some questions that a skeptical reader might raise.

1. *What about the labor supply response of husbands?* We have assumed that the labor supply of husbands is perfectly inelastic. As noted in section 1.3, this assumption is broadly consistent with the econometric literature. However, the possibility remains that for both sexes other dimensions of labor supply—human capital decisions, time of retirement, choice of occupation—might be affected by the tax system. Unfortunately, practically nothing is known about whether such effects exist.[30] As evidence on these issues begins to accumulate, presumably it can be incorporated into TAXSIM.

2. *What about life-cycle effects?* The foundation of this paper has been the standard static model of leisure-income choice. In theory, it would probably be better to examine labor supply decisions in a life-cycle context. To do so, however, would complicate the analysis immensely, as well as increase our data requirements—longitudinal data would be required. If a life-cycle analysis were successfully undertaken, it would allow us to account for changes in the demographic structure of the population, as well as to show how various tax policies affect individuals according to lifetime, rather than current, income classes. Although the lack of a life-cycle perspective clearly limits the usefulness of our results for analyzing very long run effects, a shorter horizon is probably more relevant for the current policy discussion.

3. *What about general equilibrium considerations?* Our simulations assume that pretax wages and interest rates remain constant despite the presence of some substantial changes in labor supply. It would clearly be desirable to make gross factor returns endogenous. Unfortunately, if we want detailed and careful information on tax burdens by income class, marital status, or virtually any other characteristic, a very large micro-data set is necessary. Setting up a useful general equilibrium model in this context currently appears infeasible. It should be noted that existing general equilibrium models of tax incidence assume a relatively small number of classes of individuals (see e.g. Fullerton, Shoven, and Whalley 1978).

4. *What about macroeconomic considerations?* The previous question concerned how much the gross wage might change if people desired to work more hours; here it is asked whether the hours could be absorbed by the economy at all. It is beyond the scope of this paper to develop a complete macroeconomic model of the employment effects associated with tax reform. We merely note that a case can be made that with proper monetary and fiscal policies, additional labor supply could be absorbed by the economy.[31] Similarly, we have made no attempt to assess how the macroeconomic feedbacks due to changing tax revenues might affect our substantive results.

30. See Rosen (1980).
31. See, for example, Feldstein (1972).

Thus, although we believe that the simulations in this paper are sufficiently careful to be considered seriously in the debate on tax policy, a good deal of work remains to be done.

Appendix A

About 70% of taxpayers in 1974 did not itemize their personal deductions (medical and dental expenses, interest payments, local taxes paid, etc.) but accepted instead the standard deduction. The standard deduction was then 15% of adjusted gross income with a minimum of $1,300 and a maximum of $2,000. Because some of the tax code changes we study would affect the decision to itemize deductions, it is important that this decision be endogenous to the model. Hence we must make an estimate of deductible expenses incurred by nonitemizers. The purpose of this appendix is to explain how deductible expenses were imputed to nonitemized returns.

Rather than use some extraneous data source, we have simply assumed that the distribution of deductible expenses follows a lognormal distribution (conditional on income) and that the parameters of this function may be inferred from the truncated sample. With these parameters known, random deviates with the correct conditional distribution may be used as proxies for the unknown expenses. If the distribution is correctly modeled and reflects the influence of all the variables on the tax return, then our estimates of tax rate (or any other functions of items on the tax return) will be unbiased.

This procedure ignores possible price effects of itemization on expenditure. This is permissible because we require only an estimate of deductible expenses at the prices associated with itemization rather than an estimate of actual deductible expenditures by nonitemizers.

The probability of a joint return showing itemized deductions depends strongly on income, ranging from less than 1% at incomes less than $5,000 to more than 99% at incomes over $1 million, but it does not seem to relate to any other available variables. For example, our regressions indicated that the number of dependents living at home, which might plausibly influence mortgage interest and medical bills, did not significantly influence either the decision to itemize or the amount of itemized deductions for those who did itemize. This result appeared in both ordinary least squares and Tobit equations.

The sample was divided into nine income categories. It was assumed that for each category except the first (AGI less than $5,000) a truncated lognormal distribution characterized the observed distribution of deductions. Two alternative means were used to recover the parameters of the untruncated distribution:

1. Where the point of truncation is known, Cohen (1951)[32] provides formulas for estimating the mean and variance of an underlying distribution from the first three moments of an observed truncated distribution. (Remarkably, these are in closed form.) If v_i is the ith moment of the observed distribution and c is the truncation point, then

$$u = c + (2v_1v_2 - v_3)/(2v_1^2 - v_2)$$

and

$$s = (v_1v_3 - v_2^2)/(2v_1 - v_2)$$

are the estimates of the mean and standard deviation of the underlying normal distribution. Estimates are presented in table 1.A.1, in the columns labeled "Cohen."

2. The second approach to estimate u and s as parameters of the regression

$$\ln D_j = u + \frac{1}{s}\,[F^{-1}(P_j)] + e\ ,$$

where D_j is the amount deducted by the jth household, $F^{-1}(\cdot)$ is the inverse of the cumulative normal distribution, and P_j is the observed sample probability that $D < D_j$. These results are given in table 1.A.1 under the headings "regression."

It is comforting to note that at least in the middle-income categories where there is a nearly even split between itemizing and not itemizing, there is reasonable agreement between the results generated by the two procedures. However, neither procedure produced (or was really expected to produce) reasonable results in the lowest-income category, and here the values of $u = 6.5$ and $s = 0.5$ were imposed.

With the parameters u and s in hand, the actual imputations are quite straightforward. Let c equal the log of the standard deduction. Then the probability of not itemizing is $F[(c - u)/s]$. Now let x be a random variable distributed uniformly on the interval [0,1]. Then $\{F^{-1}(x)s + u\}$ is a normal random deviate with mean u and standard deviation s, and $\{F^{-1}(xF[(c - u)/s]) + u\}$ is a random deviate from the truncated distribution below the point of truncation. The imputations are found, then, by having the computer generate values for x, and substituting values of u and s from table 1.A.1. It turned out that the imputations using the parameters from procedure 2 seemed more reasonable than those from Cohen's method, so the former were used.

32. The formula for the mean given here differs from that given in Cohen's paper because of a typographical error in that paper. This error is unfortunately perpetuated by Johnson and Kotz (1970).

Table 1.A.1 The Distribution of Deductible Expenses by Income Class

Income (× $1,000)	Estimated Mean (μ)		Estimated Standard Deviation(s)		Median Itemized Deductions*	Mean AGI
	Cohen	Regression	Cohen	Regression		
5	...	...	...	...	0	3,795
5–10	8.01	7.28	.167	.596	0	8,199
10–15	8.10	7.75	.34	.527	0	12,706
15–20	8.31	8.21	.2	.373	8.03	17,456
20–50	8.53	8.40	.133	.497	8.43	27,503
50–100	9.24	9.18	.602	.655	9.22	66,562
100–500	9.89	9.89	.804	.910	9.88	154,225
500–1,000	11.51	11.28	1.24	1.27	11.53	674,093
1,000	12.19	12.32	.616	1.38	12.27	1,952,799

*Median of log of itemized deductions for each income class, computed directly from the data. The value of zero is assigned for classes in which less than half the sample itemized deductions.

Appendix B

In the text, we report simulation results only for the subsample consisting of married couples. This is in order to focus attention on the impact of taxation on wives' labor supply. Of course, for revenue projection purposes, the entire sample is relevant, and these results are presented here. Table 1.A.2 has information for the current system. Table 1.A.3 shows how tax revenues vary by adjusted gross income class for each of the tax regimes described in section 1.4. We show revenues assuming both (*a*) no behavioral response and (*b*) wage and income elasticities of 1.0 and − 0.1, respectively, for married women.

Appendix C

We argued in the text that for married women's hours of work, values of 1.0 and − 0.1 are reasonable estimates of the wage and income elasticities, respectively. Nevertheless, it seems worthwhile to redo the simulations assuming a more conservative value of 0.5 for the wage elasticity. The results are reported in tables 1.A.4–1.A.7. There is an exact correspondence between these tables and tables 1.4–1.8 of the text. Both sets of tables look at the same tax regimes as they affect the subsample of married couples. The only difference is in the assumed value of the wage elasticity.

For regimes *a* and *b*, the results barely differ from their counterparts in section 1.4. Because these regimes do not induce major changes in marginal tax rates, the particular value of the wage elasticity of supply is not of major importance. On the other hand, regimes *c* and *d* are much

Table 1.A.2 **The Status Quo, 1979 (marrieds and singles)**

AGI Class (× \$1,100)	Returns	Average AGI	Tax Liability	Marginal Tax Rate
<5	6,323,365	2,173	−18	−.01
5–10	13,520,001	7,595	379	.18
10–15	17,197,557	12,431	1,278	.21
15–20	11,502,705	17,420	1,983	.27
20–30	17,500,605	24,117	3,192	.27
30–50	9,899,335	36,829	6,719	.35
50–100	1,800,712	66,166	16,795	.42
>100	510,856	180,072	69,576	.55
Means	. . .	19,530	3,042	.235
Totals	78,255,136	1.528×10^{12}	2.380×10^{11}	

Table 1.A.3 **Tax Revenues under Alternative Tax Regimes (marrieds and singles)**

	Regime *a**		Regime *b**		Regime *c**		Regime *d**	
AGI Class (× $1,000)	Tax Liability (exogenous behavior)	Tax Liability $(\eta^{\omega} = 1.0)$	Tax Liability (exogenous behavior)	Tax Liability $(\eta^{\omega} = 1.0)$	Tax Liability (exogenous behavior)	Tax Liability $(\eta^{\omega} = 1.0)$	Tax Liability (exogenous behavior)	Tax Liability $(\eta^{\omega} = 1.0)$
<5	−18	−18	−18	−20	−19	−19	−18	−18
5–10	372	373	380	364	255	262	357	366
10–15	1,257	1,255	1,279	1,236	959	948	1,211	1,219
15–20	1,900	1,909	1,983	1,859	1,720	1,712	1,790	1,805
20–30	2,949	2,985	3,193	2,900	2,895	2,970	2,850	2,930
30–50	6,227	6,330	6,720	6,284	5,962	6,034	6,075	6,243
50–100	16,279	16,452	16,794	16,479	14,388	14,691	13,942	14,263
>100	69,403	69,502	69,576	69,487	63,613	63,617	62,964	63,301
Means	2,893	2,920	3,042	2,882	2,654	2,684	2,727	2,781
Totals	2.264×10^{11}	2.285×10^{11}	2.380×10^{11}	2.255×10^{11}	2.077×10^{11}	2.101×10^{11}	2.134×10^{11}	2.177×10^{11}

*Regime *a*: Exemption of 25% of first $10,000 of secondary worker's earnings. Regime *b*: Tax credit of 10% on the first 10% of secondary worker's earnings. Regime *c*: Complete income splitting. Regime *d*: Optional individual filing.

more effective at reducing tax rates, and the wage elasticity becomes more relevant.

By construction, the behavioral responses in this appendix are muted compared to their counterparts in section 1.4. However, it is striking that allowing for even a very mild behavioral response has significant effects on both tax revenues and hours of work.

Table 1.A.4 Exemption of 25% of First $10,000 of Secondary Worker's Earnings

AGI Class (× $1,000)	Tax Liability (exogenous behavior)	Tax Liability ($\eta^{\omega} = .5$)	Marginal Tax Rate	Hours Worked per Year
<5	−48	−48	−.03	235
5–10	17	20	.14	488
10–15	919	920	.16	572
15–20	1,705	1,717	.23	637
20–30	2,776	2,816	.22	875
30–50	5,877	5,992	.29	1,100
50–100	15,923	16,115	.36	712
>100	68,539	68,647	.52	853
Means	3,593	3,637	.220	766
Totals	1.753×10^{11}	1.774×10^{11}	...	3.737×10^{10}

Table 1.A.5 Tax Credit of 10% on First $10,000 of Secondary Worker's Earnings

AGI Class (× $1,000)	Tax Liability (exogenous behavior)	Tax Liability ($\eta^{\omega} = .5$)	Marginal Tax Rate	Hours Worked per Year
<5	−61	−61	−.046	239
5–10	−8	−3	.12	495
10–15	876	892	.14	591
15–20	1,649	1,664	.21	643
20–30	2,719	2,750	.22	869
30–50	5,941	5,989	.31	1,072
50–100	16,140	16,180	.37	675
>100	68,631	68,650	.52	837
Means	3,576	3,601	.22	762
Totals	1.744×10^{11}	1.756×10^{11}	...	3.72×10^{10}

Table 1.A.6 Splitting All Income

AGI Class (× \$1,000)	Tax Liability (exogenous behavior)	Tax Liability ($\eta^{\omega} = .5$)	Marginal Tax Rate	Hours Worked per Year
<5	−54	−54	−.03	235
5–10	−338	−333	−.01	528
10–15	312	295	.20	551
15–20	1,459	1,452	.25	614
20–30	2,714	2,759	.22	874
30–50	5,583	5,621	.29	1,051
50–100	13,876	14,038	.33	704
>100	62,191	62,191	.53	835
Means	3,210	3,233	.214	752
Totals	1.566×10^{11}	1.577×10^{11}	. . .	3.670×10^{10}

Table 1.A.7 Optional Single Filing

AGI Class (× \$1,000)	Tax Liability (exogenous behavior)	Tax Liability ($\eta^{\omega} = .5$)	Marginal Tax Rate	Hours Worked per Year
<5	−49	−49	−.03	235
5–10	−29	−13	.13	503
10–15	826	838	.15	585
15–20	1,555	1,568	.18	659
20–30	2,662	2,713	.22	884
30–50	5,708	5,805	.27	1,102
50–100	13,392	13,563	.28	753
>100	61,480	61,670	.47	852
Means	3,327	3,374	.202	778
Totals	1.623×10^{11}	1.646×10^{11}	. . .	3.796×10^{10}

References

Barr, B., and J. Turner. 1978. A new linear programming approach to microdata file merging. In United States Treasury Office of Tax Analysis, *1978 compendium of tax research*, pp. 131–50.

Bloch, F. 1973. The allocation of time to market and non-market work within a family unit. Stanford University: Institute for Mathematical Studies in the Social Sciences.

Boskin, M. J., and E. Sheshinski. 1979. Optimal tax treatment of the family: Married couples. NBER Working Paper no. 368.

Brazer, H. 1980. Income tax treatment of the family. In H. Aaron and M. Boskin, eds., *The economics of taxation.* Washington, D.C.: Brookings Institution.

Cohen, A. C. 1951. On estimating the mean and variance of singly truncated normal frequency distributions from the first three moments. *Annals of the Institute of Statistical Mathematics* 3, no. 1 (January): 37–44.

DeGroot, M. H. 1975. *Probability and statistics.* Reading, Massachusetts: Addison-Wesley.

Feldstein, M. S. 1972. Reducing unemployment to 2 percent. Washington, D.C.: Government Printing Office.

Feldstein, M. S., and D. Frisch. 1977. Corporate tax integration—estimated effects on capital accumulation. *National Tax Journal* 30, no. 1 (January): 37–51.

Feldstein, M. S., and A. K. Taylor. 1976. The income tax and charitable contributions. *Econometrica* 44: 1201–22.

Fullerton, D.; J. B. Shoven; and J. Whalley. 1978. General equilibrium analysis of U.S. taxation policy. In United States Treasury Office of Tax Analysis, *1978 compendium of tax research.*

Hall, R. E. 1973. Wages, income, and hours of work in the U.S. labor force. In E. Cain and H. Watts, eds., *Income maintenance and labor supply.* Chicago: Rand McNally.

Hausman, J. A. 1980. The effects of taxes on labor supply. Mimeo, MIT.

Heckman, J. 1980. Sample selection bias as a specification error. In J. Smith, ed., *Female labor supply*, pp. 206–48. Princeton: Princeton University Press.

Heckman, J.; M. Killingsworth; and T. McCurdy. 1979. Recent theoretical and empirical studies of labor supply: A partial survey. Mimeo, University of Chicago.

Institute for Social Research, Survey Research Center. 1974. *A panel study of income dynamics; procedures and tape codes, 1974 interviewing year; wave VII*, a supplement. Ann Arbor.

Johnson, N., and S. Kotz. 1970. *Continuous univariate distributions.* Boston: Houghton Mifflin.

Kadane, J. B. 1978. Some statistical problems in merging data files. In United States Treasury Office of Tax Analysis, *1978 compendium of tax research*, pp. 1201–22.

Munnell, A. 1980. The couple versus the individual under the federal personal income tax. In H. Aaron and M. Boskin, eds., *The economics of taxation.* Washington, D.C.: Brookings Institution.

Pechman, J. A., and B. Okner. 1974. *Who bears the tax burden?* Washington, D.C.: Brookings Institution.

Rosen, H. S. 1976. Taxes in a labor supply model with joint wage-hours determination. *Econometrica* 44, no. 3 (May): 485–507.

———. 1977. Is it time to abandon joint filing? *National Tax Journal* 30, no. 4 (December): 423–28.
———. 1980. What is labor supply and do taxes affect it? *American Economic Review*, papers and proceedings, 70, no. 2 (May): 171–76.
Shreider, Y. A. 1966. *The Monte Carlo method*. Pergamon Press.
Sims, C. 1978. Comment. In United States Treasury Office of Tax Analysis, *1978 compendium of tax research*, pp. 172–77.
Sunley, E. M. 1980. Statement before the House Ways and Means Committee on the tax treatment of married and single taxpayers. Mimeo, United States Treasury, April.
United States Department of Labor. 1970. *Dual careers*, vol. 1. Manpower Research Monograph, no. 21. Washington, D.C.
United States Department of Labor, Bureau of Labor Statistics. Various dates. Unpublished codebooks for Current Population Survey.
Washington Post. 1979. Sintax. 26 July.

Comment David A. Wise

Feenberg and Rosen have presented an approach to simulating the effects that changes in the tax code would have on tax revenue and women's labor supply. I say women's labor supply because the authors assume in this paper that husbands are not affected by the changes they analyze. Those aspects of their procedure that are interesting also provoke questions about the preferred procedure to use in making inferences like theirs, an issue to which I will return later. The authors have chosen to use as a base for their analysis a sample of tax returns. Thus they begin with good information on earnings. But they do not have information on the components of earnings: wage rates and hours worked. Their problem is to describe the budget constraint faced by the family, assuming that the husband's earnings are exogenous. To do this, they must predict the wife's wage rate and then use the tax code—or a hypothetical one—to "predict" the budget constraint faced by the family.

I shall first present a simple outline of the Feenberg-Rosen procedure and use it as a framework within which to make specific comments. I shall then make more general remarks and comment on the simulation results.

The procedure with respect to a family *i* may be described as follows:

1. Assume husband's earnings given.
2. Predict wife's wage rate

David A. Wise is Stambaugh Professor of Political Economy at the John F. Kennedy School of Government at Harvard University and a research associate at the National Bureau of Economic Research.

$$\hat{w}_i = f\begin{pmatrix}\text{variables common to} \\ \text{TAXSIM and PSID}\end{pmatrix} + \begin{pmatrix}\text{random draw from} \\ \text{empirical residual} \\ \text{distribution}\end{pmatrix}.$$

3. Predict wife's hours

$$\hat{H}_i = (\text{earnings from TAXSIM})_i \div \hat{w}_i \ .$$

4. Describe baseline family budget constraint using tax code and husband's earnings.
5. Assume parametric form of labor supply and associated utility functions

$$H = aw + bA + s, \quad v(w, A)$$
$$= (A + \frac{a}{b}w - \frac{a}{b^2} + \frac{s}{b})e^{bw} \ .$$

6. Assume "representative" wage and income elasticities η^w and η^A from the literature and choose values of a, b, s to satisfy

$$\eta^w = \frac{\hat{w}_i}{\hat{H}_i} a_i, \quad \eta^A = \frac{\hat{w}_i}{A_i} b_i, \quad s_i = \hat{H}_i - a_i\hat{w}_i - b_iA_i \ .$$

7. Predict baseline tax revenue t_i' using model and tax code.
8. Use actual tax revenue t_i^0 given in TAXSIM.
9. Define residual

$$u_i' = t_i' - t_i^0 \ .$$

10. Predict tax revenue t_i'' under new regime using model and "new" tax code.
11. Take tax revenue under new regime to be

$$\hat{t}_{i''} = t_i'' + u_i' \ .$$

12. Aggregate over i's.

To assume no response by husbands (step 1) seems to me to be defensible in an initial analysis of the problem. But given the relatively small behavioral impact on the simulation results, I am not confident that the effect of husbands' behavioral responses could ultimately be treated as a small part of the total. The income maintenance experiments, for example, identified a significant labor supply response by heads of families to changes in tax codes, especially changes in unearned income (to which the authors' results are not directed).

Steps 2 through 4 randomly assign a budget constraint to the family, with the randomness coming from the predicted wage rate in step 2. Step 2 is one of the interesting aspects of their procedure, although I found their long discussion of it unnecessary. The explicit treatment of the disturbance term is important because the tax-imposed budget constraint is nonlinear. Without the addition to the expected wage rate of a draw from the disturbance distribution, the range of budget constraints would be narrower than the empirically observed range and, concomitantly, high and low marginal tax rates would be underepresented.

Whether it is important to draw from the empirical residual distribution depends on its shape. If the distribution is nonsymmetric, it may be important; if not, simply using the estimated variance (from a regression package, for example) would probably do quite well.

Then the authors suppose that $\hat{H}_i$ results from optimizing a utility function of the form set forth in step 5.

A weak link in the authors' procedure I believe is the method they use to assign values to the parameters in the utility function. They choose estimated wage and income elasticities (η^w and η^A) from the literature and then used the relations in step 6 to determine the utility function (and labor supply function) parameters for the family. The problem with this process it seems to me is that the pieces are basically not compatible.

The utility function is one used by Hausman. But he allows b_i to be random across individuals and assumes a_i to be constant; his procedure estimates the parameter a_i and a mean and variance for b_i. With nonlinear budget constraints, elasticities are ill defined because they depend on which segment of the budget constraint one is on. Thus, under the assumptions to this point, there would be no single η^w and η^a. Nonetheless, Feenberg and Rosen choose values for them and using the previously estimated $\hat{w}$ and $\hat{H}$ assign to each individual both an a_i and a b_i; both become random across individuals. Also, Hausman's use of the functional form in step 5 assumes that w is the net wage and A is "as if" or "virtual" income. Elasticities from the literature are normally not consistent with these definitions. Thus the Feenberg-Rosen process seems to be trying to fit together pieces that are at odds with one another. It is hard to know how to interpret their results.

In addition, if one is going to use the functional form in step 5, then one should use parameter estimates for a_i and b_i that "fit" the data, given this functional form. An alternative to step 6 that may be more consistent with step 5 would be to use an estimate of a_i and a choice of b_i from its estimated distribution—based on estimates using this functional form—to assign a utility function to each person. This would be more appealing if the simulations were based on the data used for estimation. Here they are not.

The authors, of course, have no information on women who do not work. For this group, they assign the same utility function parameters that they assign to persons working 0 to 100 hours. I believe that this assumption is likely to be quite far from reality because much of the labor supply response to a tax change may come through its effect on participation. Because there are likely to be substantial fixed costs connected with working, persons who do not work may on average be quite different from those who work even a little. In particular, with the parameters assumed to be random across persons, those who do not work are concentrated among persons with parameter values at the tails of the distributions. On average, those who work a little are likely to have values that differ substantially from the tail average.

Having selected a budget constraint (steps 2 through 4) and having selected a utility function (steps 5 and 6), the authors in step 7 predict—on the basis of the budget constraint, the utility function, and the tax code—the baseline tax revenue, observed in the tax file. The difference between the observed and the predicted baseline revenue yields a residual u_i' (steps 8 and 9). The residual is due entirely to error in the prediction of the wife's earnings, since the husband's earnings are taken as given. The tax revenue under a new hypothesized regime (step 11) is taken to be the predicted revenue—based on the model and the new tax code—plus a term equal to the error u_i' in prediction of the baseline revenue. Although the authors take this to be an unbiased estimate, it is unbiased only if the entire residual is taken to represent a fixed effect with respect to alternative tax regimes. This may be a reasonable assumption to make as long as the time period is presumed to be unchanged. Otherwise, under a new regime in a different time period, the large transitory component of earnings would substantially reduce the correlation between the two residuals.

I have also a few general comments with respect to the procedure. The prediction of wage rates using the residual distribution (although not necessarily the empirical one) is certainly necessary in this context. But this is only an intermediate stage in the process; it does not represent a distribution over possible final outcomes—tax revenue in particular. It is bothersome because the error in this step interacts with the error in the choice of utility function parameters and in the prediction of tax revenue, but in an ill-defined way. This is particularly true with respect to the choice of utility function parameters, which seems unconvincing to me. It is troublesome because the pieces here do not fit together in a way that allows easy understanding of the effects of the assumptions on the outcome, a property that would be appealing in a simulation paper. The simulations themselves do not address the issue.

These problems of course arise from the need to splice together two data sources. Feenberg and Rosen must choose the parameters of a utility function, but are not able to select parameters that fit the data. Thus a general question that comes to mind is whether it is best to follow the authors' route or to base estimation and simulations on the same data source. The Feenberg-Rosen approach has the distinct advantage of

Table C1.1 Tabulation from Feenberg-Rosen Results

Regime			Status Quo	No Behavioral Response	With Behavioral Response
			(1)	(2)	(3)
(*a*)	25% exemption of 1st $10,000 of wife's earnings	$R: \eta = 1$	1.869	1.753 (−6.2% re 1)	1.774 (+18.1% re 1–2)
		$\eta = .5$			1.774
		$H: \eta = 1$	732		766
		$\eta = .5$			766
(*b*)	10% credit on 1st $10,000 of wife's earnings	$R: \eta = 1$	1.869	1.744 (−6.7% re 1)	1.768 (+1.6% re 1–2)
		$\eta = .5$			1.756
		$H: \eta = 1$	732		793
		$\eta = .5$			762
(*c*)	Income splitting	$R: \eta = 1$	1.869	1.566 (−16.2% re 1)	1.589 (+7.6% re 1–2)
		$\eta = .5$			1.577
		$H: \eta = 1$	732		771
		$\eta = .5$			752
(*d*)	Single individual taxation or status quo	$R: \eta = 1$	1.869	1.623 (−13.2% re 1)	1.665 (+17.1% re 1–2)
		$\eta = .5$			1.646
		$H: \eta = 1$	732		815
		$\eta = .5$			778

Source: Feenberg and Rosen's tables 1.3–1.8 and 1.A.4–1.A.7.

Notes: R = total tax revenue; H = wife's annual hours worked; η = life's wage elasticity; re = with respect to. The actual revenue figures are the amount shown times 10^{11}.

accurate baseline tax data. It is difficult to evaluate the estimation of labor supply response in the model, however. I suspect the possible error here could be very substantial. (This is especially troublesome since the simulated behavioral responses are relatively small and the reported simulations based on different wage elasticities lead to very similar results. Whether this reflects reality or only their model is unclear.)

An alternative approach is to fit a utility function (like that in step 5) to data on wage rates and hours worked—determining the budget constraint by the tax code—and then to simulate outcomes under a new code, based on that sample and the utility function parameters that fit it best. This is the procedure followed by Hausman, for example. This procedure has the advantage of internal consistency, and it is easy to check the effect of a different parameter assumption on the simulated outcomes. Its shortcoming is that such data that are available do not represent a random sample of tax files and it may not be straightforward to weight them so that they do. In addition, these data sets do not contain tax payments, so that accurate baseline tax revenue data are not available. More experimentation would help determine the ultimate accuracy of the two approaches.

Finally, I have a few comments on the simulation results themselves. From the Feenberg-Rosen results I have put together a summary tabulation (table C1.1). According to these results, of the four regimes simulated, if there were no behavioral response, tax revenue would be reduced by 6 to 16%. Of these amounts, from 2 to 18% is accounted for by the estimated labor supply response.

The change in wage elasticity from 1 to 0.5 has what to me is a surprisingly small effect on the results. It has *no* effect under regime *a*. Under regime *b* it reduces hours of work by 3.9%. The authors explain the result by arguing that their hypothetical regimes do not change marginal tax rates very much, but income splitting presumably would. However, under their regime *c*, the change in wage elasticity from 1 to 0.5 reduces simulated hours of work by only 2.5%.

Given the tenuous nature of the assumptions of the model, I would like to see many more simulations that would allow some evaluation of how sensitive the results are to the assumptions. I would also like to see some sensitivity analysis with respect to the assumed income elasticity. At least in the income maintenance experiments, the income effect of tax changes was in general more important than the wage effect.