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Horizontal Equity and Taxpayer Characteristics: Who Is Advantaged and Disadvantaged by the Federal Income Tax?

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Horizontal tax equity as defined by Musgrave (1959, p. 160) requires that "people in equal positions should be treated equally" by the tax system. As Feldstein (1976) notes, if all individuals have the same utility function, horizontal equity requires simply that taxpayers with the same consumption bundles (goods and leisure) be taxed equally. However, diversity of preferences complicates the matter. When tastes differ across households, Feldstein suggests the following principle of horizontal equity:

> If two individuals would be equally well off (have the same utility level) in the absence of taxation, they should also be equally well off if there is a tax.[1]

In other words, a tax should not change the utility order. This implies that horizontal equity cannot be evaluated by a simple ranking of consumption bundles, but that a utility ordering of households becomes necessary.

Since utility levels cannot be observed, Feldstein's proposal appears nonoperational at first glance. The present study proposes to remedy this deficiency by estimating household utility levels indirectly from household labor supply behavior. A subsample of data on households is drawn from the 1980 Panel Study of Income Dynamics to estimate labor supply functions for husbands and wives. Assuming an underlying Cobb-Douglas utility function, the estimated parameters of the labor supply functions are used to identify the parameters of the household indirect utility function. Utility levels are computed for each household and households are ranked according to their utility levels both before and after tax. The characteristics of households whose utility rank decreases after tax (disadvantaged households) are then compared with the characteristics of households whose utility rank increases or stays the same (households advantaged by the income tax). Those disadvantaged by the income tax tend to be two-earner professional families while those advantaged by the income tax tend to have more children, own their own homes, and to have one earner.

This study is related to an earlier study by Rosen (1978) in which Feldstein's utility definition of horizontal equity is used to evaluate the equity of the present tax structure. Assuming family utility functions of the constant elasticity of substitution (CES) form, and using 1967 National Longitudinal Sample data for mature women ages 30–44 years, Rosen estimated family utility function parameters. Preferences were allowed to differ by race and by

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the presence of preschool children. He then computed the Spearman rank correlation between utilities before and after tax and concluded that the ranking of utilities is not appreciably altered by the tax system. Several recent studies such as those by Atkinson (1980), Plotnick (1981), and King (1983) have likewise dealt with the problems of measuring the extent of horizontal inequity in the tax system.

The present study is also an attempt to explore the horizontal equity of the tax system but differs from earlier studies. Our concern is not with the extent of horizontal inequity but with the characteristics of families advantaged and disadvantaged by taxation. By observing their characteristics, we are able to point to aspects of the income tax that are inconsistent with horizontal equity. Like Rosen, we estimate the parameters of family utility functions, but we have a more representative and more recent sample.

In section I of this paper, the indirect utility model is described. Section II is a discussion of the estimation of utility levels of our sample of households. In section III, we identify those households advantaged and disadvantaged by the income tax. Section IV summarizes the results and their implications for future research.

I. THE INDIRECT UTILITY MODEL

In this study, we assume that family utility depends on family disposable (after-tax) income and the leisure time of the two spouses; specifically, family preferences are defined by the Cobb-Douglas utility functions:

$$U = a_1 \ln Y_d + a_2 \ln L_1 + a_3 \ln L_2 \tag{1}$$

where Y_d is family disposable income, L_1 and L_2 are the leisure hours of the husband and wife, and the a's are positive constants that sum to one.[2] We further assume that the family faces two constraints: (1) family disposable income must be equal to the sum of the husband's earnings, the wife's earnings, and the nonwork income of the family minus the family tax liability, and (2) hours worked plus hours of leisure cannot exceed the number of hours available. In particular, we assume:

$$Y_d = Y - T(Y - e) = w_1N_1 + w_2N_2 + I - T(Y - e) \tag{2a}$$

and

$$K = N_j + L_j \qquad j = 1, 2 \tag{2b}$$

where Y is family money income before tax, $T(Y - e)$ is the family income tax liability, e is total exemptions and deductions, w is the hourly wage, N is hours of market work, I is nonwork income (income from investments, for example), K is the fixed amount of time available, and the subscripts denote the husband and wife, respectively.

The income tax is a bracket tax on family taxable income, $Y - e$. The tax function is given by

$$T(Y - e) = t(Y - e - Y_{min}) + T(Y_{min}) \tag{3}$$

where t is the bracket tax rate for the bracket in which $Y - e$ is observed, Y_{min} is the minimum income in that tax bracket, and $T(Y_{min})$ is the tax payable on that minimum income.

Maximization of (1) subject to (2a), (2b), and (3) yields the following work offer curves

for the husband and wife:

$$N_1 = (1 - a_2)K - a_2\left[\frac{I(1 - t) + te + tY_{min} - T(Y_{min})}{w_1(1 - t)}\right] - a_2K\frac{w_2}{w_1} \tag{4a}$$

$$N_2 = (1 - a_3)K - a_3\left[\frac{I(1 - t) + te + tY_{min} - T(Y_{min})}{w_2(1 - t)}\right] - a_3K\frac{w_1}{w_2} \tag{4b}$$

which relate hours of work to their wage, their spouse's wage, nonwork income, and the parameters of the tax system. The importance of the work offer curves is that they allow us to estimate the parameters of the utility function, a_1, a_2, and a_3.

Substituting (4a) and (4b) back into the utility function (1) gives the indirect utility function:

$$\begin{aligned} V = {} & \ln [w_1(1 - t)K + w_2(1 - t)K + I(1 - t) + te + tY_{min} - T(Y_{min})] \\ & - a_2 \ln w_1(1 - t) - a_3 \ln w_2(1 - t) + a_1 \ln a_1 \\ & + a_2 \ln a_2 + a_3 \ln a_3 \end{aligned} \tag{5}$$

which depends on the family's full income (its total income if both the husband and wife worked the total time available), the hourly wages of the husband and wife, the tax parameters, and the parameters of the utility function.[3] The only unknowns in this function are the parameters of the utility function which we estimate indirectly by estimating the work offer curves, (4a) and (4b), for a sample of husband-wife families. Given the estimates of the utility function parameters, we then compute utility levels for all households.

II. THE ESTIMATION

The sample of husband-wife families used in this study was drawn from the 1980 Michigan Survey of Income Dynamics. The data set contains information on income, wage, hours of work, and family demographic characteristics as well as tax information on total tax liability and marginal tax rate. A subset of 1,972 husband-wife families formed the basis for our study. Families on welfare, families in which the husband was less than 18 or more than 65 years of age, and families with negative nonwork income were excluded from the sample because we felt that behavior of these families would not be well described by the work-leisure choice model of our study.

To estimate the work-offer curves of husbands and wives we used restricted least squares. Our estimation model was of the form:

$$N_1 = \beta_0 + \beta_1\left[\frac{w_2(1 - t)K + I(1 - t) + te + tY_{min} - T(Y_{min})}{w_1(1 - t)}\right] + \epsilon_1 \tag{6a}$$

$$N_2 = \gamma_0 + \gamma_1\left[\frac{w_1(1 - t)K + I(1 - t) + te + tY_{min} - T(Y_{min})}{w_2(1 - t)}\right] + \epsilon_2 \tag{6b}$$

where $\beta_0 = (1 - a_2)K$, $\beta_1 = -a_2$, $\gamma_0 = (1 - a_3)K$, and $\gamma_1 = -a_3$, and the ϵ's are disturbance factors. Adding the restrictions that $(1 + \beta_1)K = \beta_0$ and $(1 + \gamma_1)K = \gamma_0$, where K is taken as 8,760 hours per year, allowed us to identify the parameters of the utility function.[4] To permit preferences to vary over the population, the work offer curves were estimated over four

subgroups of the sample based on race (black and nonblack) and education (12 years or less of school and more than 12 years of school).

Since, in the case of some families the wife was not employed and therefore had no observed wage, and since the wage is measured with error for wives who were employed, we used the Heckman (1980) method to obtain a consistent estimate of the potential wages of wives in our sample. Using the Heckman method, we first estimated (using probit analysis) the probability that a wife worked outside the home. Second, we estimated a wage equation through regression analysis, using the parameters of the probit estimation to adjust for bias in the estimation of the wage. The wage equation was then used to impute a wage to all wives in the sample.

The data contained information on the family's marginal tax rate, t, and total income tax liability, $T(Y - e)$. This information was used to infer the other tax parameters by solving for the unknown tax parameters in equation (3). This gave us:

$$te + tY_{min} - T(Y_{min}) = tY - T(Y - e) \tag{7}$$

which we calculated for each household in the sample. In estimating our model, we disregarded nonlinearities in the tax function and used ordinary least squares to estimate our model.[5] Hausman (1981) and others have developed complicated estimation techniques for dealing with tax nonlinearities, but for simplicity, we chose to disregard this problem.[6]

Measurement of the other variables in the study was straightforward. Hours of work were measured annually, the husband's wage was computed by dividing earnings by hours worked, and nonwork income was computed as the residual of total family income and the earned income of the husband and wife.[7] Estimates of the wage equations for black and nonblack wives appear in Table 1. The columns headed LFP give the results of the probit estimation of the probability that the wife participates in the labor force. The wage equation shows that city size has a positive influence on the wife's wage while the wage increases with years worked but at a decreasing rate. The education level of the wife was entered as a series of dummy variables with 17 or more years the omitted category. The negative coefficients indicate that those with less than 17 years of education earn a lower wage and that generally, the lower the education level, the lower the wage. The insignificant coefficient on the probit lambda variables indicates that censorship was probably not an important problem in the estimation.

The wage function was used to impute a wage to each woman in the sample and the work offer curves were estimated using restricted least squares. The results of the estimation are in Table 2. The slopes, estimates of the utility function parameters, are all between zero and one as required by theory.

Table 3 shows the utility parameters implied by the regression slopes for the four population subgroups. The parameter a_1 reflects the family's utility weight on income and was estimated to be higher for those with more than 12 years of school. This is an expected result if families view education as an investment in higher future income. The parameters a_2 and a_3 are the family utility weights on the husband's and the wife's leisure, respectively. For nonblacks, our estimates showed little difference in these weights between husbands and wives but black families place a higher weight on the husband's than on the wife's leisure according to our estimates. The utility level was calculated on the basis of the estimated weights for each of the four subgroups and is shown in the table. Since the utility level has only a relative significance, it is shown as a ratio to the population mean utility level. The group with the highest utility level

TABLE 1
Estimates of the Wage Equations for Black and Nonblack Wives
(t ratios in parentheses)

Explanatory Variables	Nonblack		Black	
	LFP	Wage	LFP	Wage
Constant	2.821	8.585	3.684	7.159
	(10.221)	(13.540)	(5.218)	(6.465)
Nonwage income	−.484E-5	—	−.978E-5	—
	(−1.254)		(−.674)	
City size	−.0416	1.049	−.121	1.150
	(−.559)	(5.085)	(−.761)	(3.934)
Education				
0–5 years	−.747	−8.049	.718	−5.884
6–9 years	−.748	−6.156	−.509	−5.360
10 years	−.703	−5.186	−.625	−4.932
11 years	−.276	−4.843	−.727	−6.521
12–13 years	−.474	−4.935	−.542	−4.321
14 years	−.165	−3.887	−.356	−3.627
15 years	−.284	−3.285	−1.914	−5.551
16 years	−.118	−2.762	.492	−2.573
Years worked	.896	.133	.124	.065
	(5.149)	(3.043)	(3.875)	(1.061)
Years worked squared	−.000983	−.00215	−.00198	−.00173
	(−1.649)	(−1.448)	(−1.983)	(−0.852)
Husband's wage	−.0182	—	−.00582	—
	(−3.520)		(−.589)	
Children				
1–2 years	−.705	—	−.482	—
3–5 years	−.499	—	−.203	—
6–13 years	−.140	—	−.109	—
Age	−.0577	—	−.0858	—
	(11.448)		(−6.550)	
Home ownership	.178		.259	
	(1.785)		(1.608)	
Probit Lambda	—	−.191	—	.459
		(−.730)		(1.198)
R^2	—	.205	—	.208
−2 times log likelihood ratio	295.89	—	96.62	—
Sample size	1507	1014	465	353

is nonblacks with more than 12 years of education while the group with the lowest utility level is blacks with less than 12 years of education.

In the next section, we discuss the tax implications of these results.

III. TAXPAYER CHARACTERISTICS

In Table 4, we rank households according to their indirect utility levels both before and after tax. Taxpaying households are then grouped according to whether their utility ranking increased or decreased after tax. As seen in Table 4, slightly more than half our sample (52%)

TABLE 2
Estimates of the Work Offer Curves

	Nonblack		Black	
	Slope	$\bar{R}^2$	Slope	$\bar{R}^2$
Education ≤12				
Husbands	−.249	.669	−.387	.918
	(−40.71)		(−64.04)	
Wives	−.241	.806	−.184	.644
	(−58.48)		(−25.64)	
Education >12				
Husbands	−.224	.588	−.384	.923
	(−31.27)		(−34.55)	
Wives	−.224	.793	−.141	.537
	(−51.26)		(−10.71)	
All				
Husbands	−.237	.630	−.387	.919
	(−50.68)		(−72.80)	
Wives	−.233	.799	−.172	.614
	(−77.49)		(−27.16)	

Notes: $\bar{R}^2$ is adjusted R^2. Numbers in parentheses are t-ratios.

experienced lower rankings after tax than before tax while slightly less than half (48%) went up in rank or stayed the same.[8]

What are the characteristics of those households whose utility ranks decreased after tax? First, they have, on average, higher annual incomes than do those whose utility ranks increased or stayed the same. This horizontal inequity arises, not because the income tax is progressive,[9] but because the income tax lowers the utility ranks of households which prefer income relative to those which prefer leisure. This would be true even if the tax were not progressive and results from the fact that leisure is not taxed under an income tax.[10]

Besides having higher incomes, the disadvantaged group is characterized by having 72% nonblack and 28% black households. By contrast, the advantaged group has a higher percent nonblack: 80% vs. only 20% black. These racial differences may be due to differences in preferences (the utility parameters of the nonblack and black households were estimated separately) or to differences in characteristics that allow households to exploit tax advantages (homeownership, for example).

Other characteristics of the disadvantaged group are that they have fewer children (.83

TABLE 3
Utility Parameters by Type of Family

Group	a_1	a_2	a_3	Utility Level	Sample Size
Nonblack, Education ≤12	.510	.249	.241	.971	822
Nonblack, Education >12	.522	.224	.224	1.199	685
Black, Education ≤12	.429	.387	.184	.727	365
Black, Education >12	.474	.385	.141	.866	100
All	.525	.260	.215	1.000	1972

TABLE 4
Characteristics of Taxpayer Groups When Rankings are by Utility Levels

	Households Ranked Lower After Tax Than Before Tax	Households Ranked the Same or Higher After Tax Than Before Tax
% of Households	52%	48%
Family Income	$30,880	$25,323
% Nonblack	72%	80%
Number of Children	.83	1.36
% Homeowners	73%	80%
% with Education >12	43%	36%
% Professional	37%	31%
% Mortgage Holders	59%	66%
% Two-Earner	84%	54%

compared to 1.36 for the advantaged group), are less likely to own homes (73% compared to 80% for the advantaged group), and are more educated (43% have 12 or more years of education compared to 36% for the advantaged group). Further, we find that the disadvantaged group has more professionals, fewer mortgage holders, and more two-earner families than does the advantaged group.

The information in Table 4 can be used to calculate the conditional probability of being in the advantaged or disadvantaged group given a certain household characteristic. These probabilities are shown in Table 5. As seen in the table, a household's chances of being in the disadvantaged group are higher if the household is black than if it is nonblack (.60 compared to .49). Further, renters are more likely than homeowners to be in the disadvantaged group as are those with more than 12 years of education. We also see, consistent with Table 4, that professionals, those without home mortgages, and two-earner families have higher probabilities of being disadvantaged by the income tax than do nonprofessionals, mortgage holders and one-earner families, respectively.

The existence of an advantaged and a disadvantaged group indicates that the income tax is

TABLE 5
Conditional Probability of Being Ranked Higher or Lower by Socioeconomic Characteristics

	Probability of Ranking Lower After Tax than Before Tax	Probability of Ranking Higher After Tax than Before Tax
Nonblack	.49	.51
Black	.60	.40
Renters	.59	.41
Homeowners	.50	.50
Education >12	.56	.44
Education ≤12	.49	.51
Professional	.56	.44
Nonprofessional	.50	.50
No mortgage	.57	.43
Mortgageholders	.49	.51
Two-earner families	.63	.37
One-earner families	.27	.73

not horizontally equitable when families are ranked by utility. It further suggests that there are provisions of the income tax that either over or undercompensate for the loss in utility associated with certain characteristics. For example, the exemptions for dependents recognize the need to support more persons on a given income. Likewise, the deductions for mortgage interest and property taxes recognize the financial obligations of homeowning. The fact that homeowners and large families tend to fall into the advantaged group in our study provides some evidence that the exemptions and deductions which favor these groups are overly generous.

Conversely, families who fall into the disadvantaged group tend to have characteristics that result in a loss in utility that is undercompensated by the income tax. An example is the two-earner family which often finds its tax liabilities higher than similarly situated one-earner families. While the two-earner deduction in the income tax tends to equalize the situation for many families, that deduction was not in effect during the year of our data.

Whether one particular family is advantaged or disadvantaged by the income tax depends on the characteristics of that family. To the extent that black families are less likely to own their own homes and more likely to be two-earner families, they are likely to fall in the disadvantaged group. To the extent that professionals have high incomes, they too are likely to fall in the disadvantaged group. One might argue that since all families have the possibility of "buying into" the advantaged group (by buying a home or having more children), that prices will adjust and horizontal inequity will disappear. However, to the extent that non-economic considerations influence decisions, uncapitalized tax inequities will remain part of the income tax. Further, with a progressive tax system, inequities that are capitalized for the average family will not be fully capitalized for those in different tax brackets.[11]

IV. CONCLUSIONS

By ranking households by their pre- and post-tax utility levels, we find that certain households are advantaged and others disadvantaged by the federal personal income tax. Among those advantaged by the income tax are households with opportunities to reduce their tax liabilities via deductions and exemptions. Since the advantaged have, on average, more children, they have greater exemptions, and since they are more likely to own their own homes, they have more deductions. This suggests that the income tax provisions for homeowners (property tax and mortgage interest deductions) and large families may be inconsistent with the principle of horizontal equity. Also, the advantage that the one-earner family enjoyed in 1980 distorted the horizontal equity of the income tax. Whereas students of the income tax have long pointed out that the deduction of mortgage interest and the treatment of two-earner families violate horizontal equity,[11] it is interesting and important to note that the methodology used in this paper tends to confirm these views.

Our methodology does not allow us to identify the extent of the inequity, but does allow us to specify the characteristics of the advantaged and disadvantaged groups. Rosen's (1978) measure, on the other hand, allowed him to say something about the strength of the horizontal inequity (for a particular subsample of the population), but did not allow him to identify the characteristics of the unfairly treated group.

No conclusions regarding the overall equity of the income tax can be drawn from either Rosen's (1978) or our study. Both studies focussed on one aspect of equity, horizontal equity, and neglected the much more difficult area, vertical equity. Likewise, both studies take the household as the unit of analysis, even though utility is an individiual concept. Hence, the Cobb-Douglas utility function used in this study can be thought of as an approximation to the social welfare function of the family. The question of how individual utilities in the social welfare function should be weighted is ignored. This, and other issues raised above, provide interesting areas for future research.

NOTES

1. Feldstein (1976, p. 83).
2. The Cobb-Douglas utility function was selected for its convenient properties (linear work offer curves and a tractable indirect utility function) but has the undesirable feature of constraining the elasticity of substitution between arguments in the utility function to be one.
3. See Varian (1978, p. 94) for the derivation of the indirect utility function in the one person Cobb-Douglas case.
4. Total time available, K, was computed by multiplying 24 by 365. The choice of a time endowment is necessarily somewhat arbitrary.
5. Assuming the tax brackets are sufficiently wide that small changes in income do not cause changes in the tax brackets allows us to safely disregard nonlinearities in the tax function. This approach was followed by Wales and Woodland (1977).
6. Serious criticisms have been raised by Heckman (1983) arguing that Hausman has not empirically demonstrated the importance of the problem and that the application of the procedure requires that the exact location of the kink points be known to the econometrician.
7. No attempt was made to impute income from owner-occupied housing in this study because the data were not available.
8. Only 2% of the households had not changed in rank.
9. The progressivity of the income tax affects the vertical and not the horizontal equity of the income tax.
10. Consider two households, one with a strong preference for leisure and the other with a strong preference for income. The former will choose more leisure and have a lower income than will the latter. Assuming the two have equal utility levels before tax, an income tax will be horizontally inequitable because it discriminates against the household which prefers income and in favor of the household which prefers leisure. See Feldstein (1976, pp. 82–83).
11. This conclusion is based on the assumption of a family utility function with no adjustment for family size or home ownership. However, one could argue that families of different size or with different housing arrangements are not comparable for purposes of assessing horizontal equity. The limitations of sample size prevented us from taking this into account.
12. See, for example, Musgrave and Musgrave (1984, Chapter 17).

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