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TAXES AND THE USER COST OF CAPITAL FOR OWNER-OCCUPIED HOUSING

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ABSTRACT

Owner-occupied housing is said to be favored in the tax code because mortgage interest and property taxes can be deducted in the computation of one's income tax base in spite of the fact that the returns from owner-occupied housing are not taxed. The special tax treatment reduces the user cost of capital for owner-occupied housing.

The issue treated in this paper is the measurement of the tax rate to be employed in the user cost calculations. It is argued that different tax rates are appropriate for the tenure choice and quantity-demanded decisions, and that these values depend on the detailed tax position of the household and the method of finance. Average 1977 tax rates for households in different income ranges are calculated using the NBER TAXSIM microeconomic data file on individual tax returns.

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Taxes and the User Cost of Capital for Owner-Occupied Housing

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Owner-occupied housing is said to be favored in the tax code because mortgage interest and property taxes can be deducted in the computation of one's income tax base in spite of the fact that the returns from owner-occupied housing are not taxed.[1] This favored tax treatment should generate a higher homeownership rate and greater demand for housing by owner-occupiers than would otherwise exist. Some recent attempts to measure these impacts include Rosen (1979), Rosen and Rosen (1980), King (1981) and Hendershott (1980). The method employed is to measure the real user cost of capital for owner-occupied housing and to relate both the tenure choice and per unit housing demand decisions to this and other variables.

The issue in this paper is the measurement of the personal income tax rate employed in the user cost calculations. Usually this tax rate (τ) is labeled the marginal tax rate of the household with little further discussion. In the most detailed analysis, Diamond (1980) has argued that τ depends intricately on the particular tax position of the household, including the household's nonhousing deductible expenses relative to its standard deduction. We contend not only that τ depends on the detailed tax position of the household but that different values of τ are relevant to the tenure-choice and quantity-demanded decisions of the same house-

[1] Even if interest were not deductible, owner-occupied housing is favored relative to investments that are taxed in that households do not pay taxes on the returns on their equity investment in the house.

hold. For the tenure-choice decision, the relevant tax variable is the average tax savings per dollar of expense due to being an owner rather than a renter of housing. For the quantity-demanded decision, the appropriate tax variable is the tax saving due to a marginal dollar of owner-occupied housing related expenses.

The present paper is divided into five sections. The first is devoted to the conceptual measurement of τ for the tenure-choice and quantity-demanded decisions. Section II describes the assumptions and precise methodology underlying the calculations of the tax rates and presents a variety of relevant household data by income class. In Section III, the NBER TAXSIM file (see Feldstein and Frisch, 1977) is employed to calculate the relevant τ's for households in different income ranges based upon tax returns filed for 1977, and these τ's are then compared with those employed in other studies. In Section IV, we speculate on the impact of abandoning the assumption of an exogenous tax law. Section V offers some concluding remarks.

I. Income Taxes and Housing Decisions

Consider a household with labor income Y and wealth W. This wealth can be invested at the interest rate i. Say that an income tax system exists in which rising marginal tax rates (t) are applied to additional income increments (A). If this household chooses to rent a housing unit valued at V, the household's income after taxes and housing expenses (Y_r^a) is:

$$(1)\quad Y_r^a = Y + iW - \left[\sum_{b=1}^{m} t_b A_b + t_n(Y+iW-NHE- \sum_{b=1}^{m} A_b)\right] -R,$$

where the expression in brackets is the total federal tax liability, t_b is the marginal tax rate applied to the A_b incremental segment of taxable income, t_n is the marginal tax rate on the last dollar of income, NHE represents non-housing related deductions, and R is the rental outlay on the house. If this same household owns a dwelling worth V, its income after taxes and housing expenses (Y_o^a) is

$$Y_o^a = Y+i[W-(1-\alpha)V] - (\tau_p+\alpha i)V - \left[\sum_{b=1}^{j} t_bA_b + t_k\left(Y+i[W-(1-\alpha)V]-[NHE+(\tau_p+\alpha i)V]-\sum_{b=1}^{j}A_b\right)\right] .$$

(2)

$$=Y+iW - (i+\tau_p)V - \left[\sum_{b=1}^{j} t_bA_b + t_k\left(Y+iW-(i+\tau_p)V - NHE - \sum_{b=1}^{j} A_b\right)\right],$$

where α is the debt-financed portion of the housing investment and τ_p is the property tax rate. It is assumed that the rate of return earned on nonhousing investment equals the mortgage rate; it follows that income after housing expenses but before taxes is reduced by interest payments on the entire value of the housing investment. Taxable income also declines by this amount (again, the bracketed term is the total federal tax liability) because debt charges are deductible from income and the implicit income earned on equity does not enter the taxable income base. Because taxable income is reduced relative to the renter case, $k \leq n$ and $t_k \geq t_n$ (given a progressive tax system).

Of course, households can choose the alternative of a standard deduction (STD). If STD>NHE for renters, then NHE should be replaced by STD in equation (1). For owners, NHE + $(\tau_p+\alpha i)V$ is replaced by STD if the latter exceeds the former. Note that the implicit interest on equity in the house is excluded from taxable income whether or not the household itemizes.

Formally, we can replace (1) and (2) with (1') and (2') as follows

(1') $$Y_r^a = Y + iW - \left[\sum_{b=1}^{m} t_b A_b + t_n\left(Y + iW - \max(NHE, STD) - \sum_{b=1}^{m} A_b\right)\right] - R$$

(2') $$Y_o^a = Y + iW - (i+\tau_p)V - \left[\sum_{b=1}^{j} t_b A_b + t_k\left(Y + i[W-(1-\alpha)V] - \max\left[NHE + (\tau_p + \alpha i)V, STD\right] - \sum_{b=1}^{j} A_b\right)\right].$$

These expressions are useful in the derivation of the appropriate tax rate to be employed in user cost calculations. Under some simplifying assumptions,[2] the rental price or user cost for the owner's housing is

(3) $$C = [(1-\tau)(i+\tau_p) - \pi + \delta]\, V,$$

where τ is the relevant personal income tax rate, δ is the depreciation (maintenance) rate and π is the expected rate of increase in the price of the house. The user cost is the product of the price and the sum of the real after-tax interest rate, the depreciation rate, and the net property tax rate. The issue in this paper is the measurement of τ.

First consider the owner's decision regarding how much housing to purchase. The relevant price is the opportunity cost of an incremental dollar of housing. Ignoring the expected capital gain and depreciation terms that have no tax implications,[3] we can calculate $\partial C/\partial V$ by finding $-\partial Y_o^a/\partial V$ from equation (2')

[2] These include: zero transactions costs, static expectations regarding future inflation, interest, and tax rates, and treatment of debt and equity as earning equal after-tax, risk-adjusted rates of return.

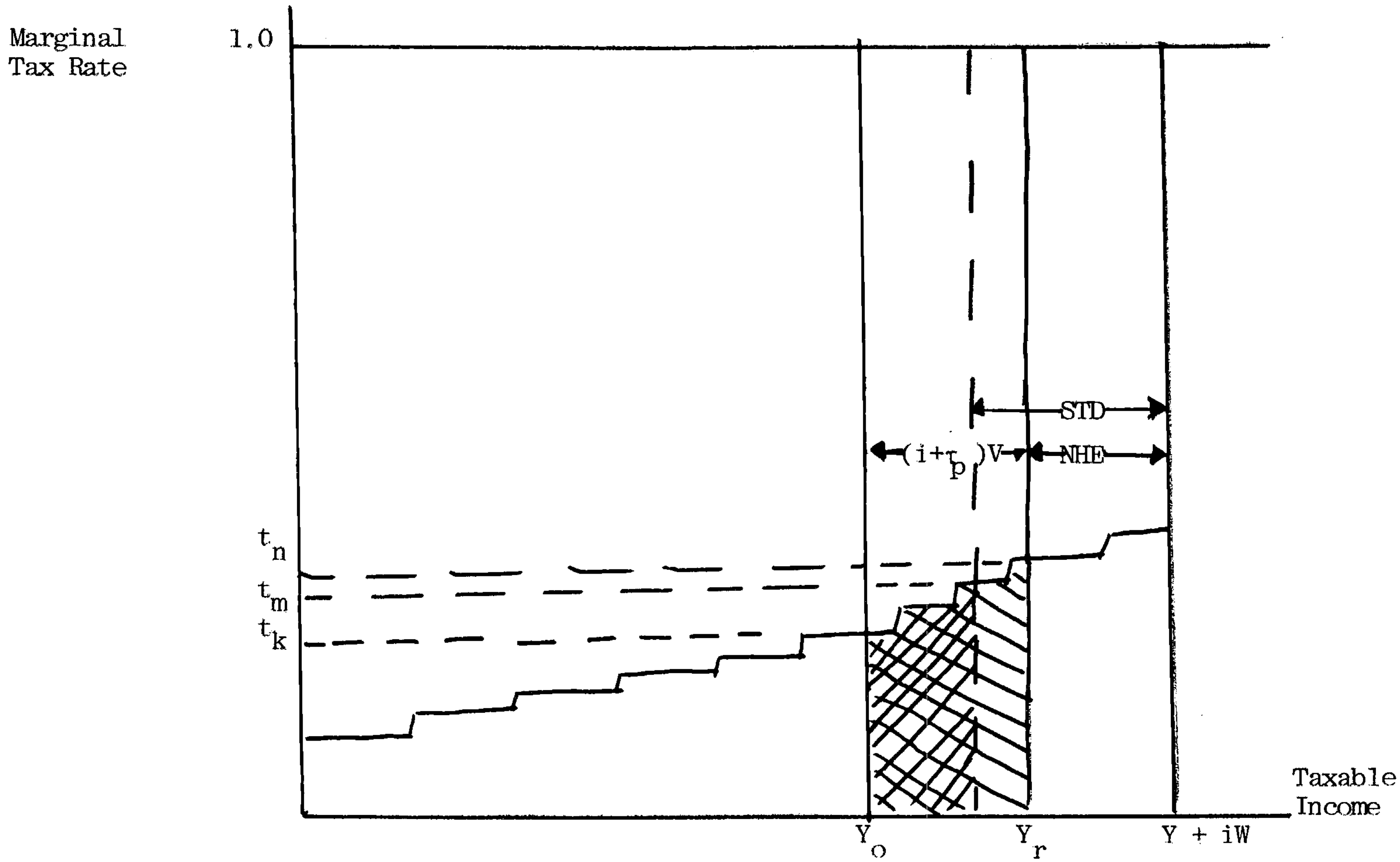
[3] Note that only current cash outlays on housing are netted out in equation (2), while equation (3) includes an imputed net (of depreciation) appreciation term as a negative cost.

which is the foregone income (opportunity cost) due to purchasing a house. As long as the owner is an itemizer at the margin of purchasing more housing, then $-\partial Y_o^a/\partial V$ equals $(1-t_k)(i+\tau_p)$. Thus in this case the appropriate interpretation of τ is t_k, the marginal tax rate. However, if at the margin the standard deduction is taken, then $-\partial Y_o^a/\partial V$ is $\left(1 - t_k[(1-\alpha)i/(i+\tau_p)]\right)(i+\tau_p)$. The appropriate tax value becomes t_k weighted by $(1-\alpha)i/(i+\tau_p)$, which is the ratio of implicit income on housing equity to the gross interest and property tax costs of housing. For a nonitemizer, only this fraction of these costs reduces the tax liability at the margin.

Next consider the tenure choice decision: should the household rent or buy? Here the household will compare the total opportunity cost of owning (C, appropriately measured) with the rental charge on an identical house (R). The τ to be employed in (3) in this calculation is the average percent tax saving on all housing expenses (due to owning rather than renting). To see this, note that the total opportunity cost of buying a house is, again ignoring capital gains and depreciation, $Y_r^a - Y_o^a$. From equations (1') and (2'), this is equal to $(i+\tau_p)V - R$ less the difference in federal tax liability (the terms in brackets) corresponding to the two alternatives. This latter difference is a complicated term depending on the marginal tax rates and optional itemizing status in the renter and owner situations.

The results derived here are illustrated graphically in Figure 1. The taxable income base is on the horizontal axis, and the marginal tax rate is on the vertical axis. Assume for the moment that STD$<$NHE (the taxpayer is an itemizer regardless of tenure choice) and ignore the vertical dashed line in the figure. The tax rates paid on the last dollar of taxable incomes of renters (Y_r) and owners (Y_o), respectively, are t_n and t_k. The latter is also the appropriate rate to use in the calculation of the user cost relevant to the quantity demanded decision of owners because it is the tax

Figure 1: Tax Rates for Housing Decisions



saving resulting from a marginal dollar of housing-related expenses. The average tax rate relevant to the tenure choice ($\bar{\tau}$) is the ratio of the slashed area to $(i+\tau_p)V$. It is the ratio of total tax savings due to the purchase of a house to the total opportunity cost of housing. Because $\bar{\tau}$ is a weighted average of tax rates ranging from t_k to t_n, denoted by t_{kn},

$$\bar{\tau} = t_{kn} > t_n.$$

When the taxpayer would not be an itemizer if he chose the renter tenure (STD > NHE), the vertical dashed line in the figure is operative, and the relation between $\bar{\tau}$ and t_k is ambiguous. Assume

$$NHE + (\tau_p + \alpha i)V > STD > NHE;$$

the household would be an itemizer if a house is purchased. Then $\bar{\tau}$ is the ratio of the hatched area to $(\tau_p+i)V$. Because the hatched area is the product of a weighted average of the tax rates between t_k and t_m, or t_{km}, and $(i+\tau_p)V - (STD - NHE)$, we can write

$$\bar{\tau} = t_{km}\left[1 - \frac{STD - NHE}{(i+\tau_p)V}\right].$$

Thus

$$\bar{\tau} \gtrless t_k \text{ as } 1 - \frac{STD - NHE}{(i+\tau_p)V} \gtrless \frac{t_k}{t_{km}}.$$

For STD sufficiently greater than NHE, $\bar{\tau} < t_k$. Because the standard deduction is less likely to exceed nonhousing itemized expenses the higher the income of households, we would expect $\bar{\tau}/t_k$ to rise with income and eventually exceed unity. The point here is that when STD > NHE, not all of the deductions due to homeownership are in fact net additions to the total of allowable deductions.[4]

An extreme example of this phenomenon occurs when the amount of deductible expenses is less than the standard deduction, even in the home-owning case, i.e., when

$$STD > NHE + (\tau_p + \alpha i)V.$$

Consider the appropriate tax rate for the decision of how much housing to purchase. An additional dollar of V increases the amount of foregone investment income by $(1-\alpha)i$ dollars. Thus the housing purchase lowers taxable income by $(1-\alpha)iV$ or from Y_r to Y_o in Figure 2. The marginal tax rate at that point is t_k. The marginal tax saving on an additional dollar of housing purchase, however, is only $t^* = t_k(1-\alpha)i/(i+\tau_p)$. That is, taxable income declines by none of property tax expense and only the equity portion of the financing expense.[5] The value of $\bar{\tau}$ is the ratio of the slashed area to $(\tau_p+i)V$. Thus $\tau = t_{km}(1-\alpha)i/(i+\tau_p)$. Because $t_{km} > t_k$, the tax rate relevant to the tenure choice is necessarily greater that that relevant to the quantity demanded decision.

The relationship between $\bar{\tau}$ and the marginal tax rate relevant to the quantity demanded decision, t, can be summarized as follows:

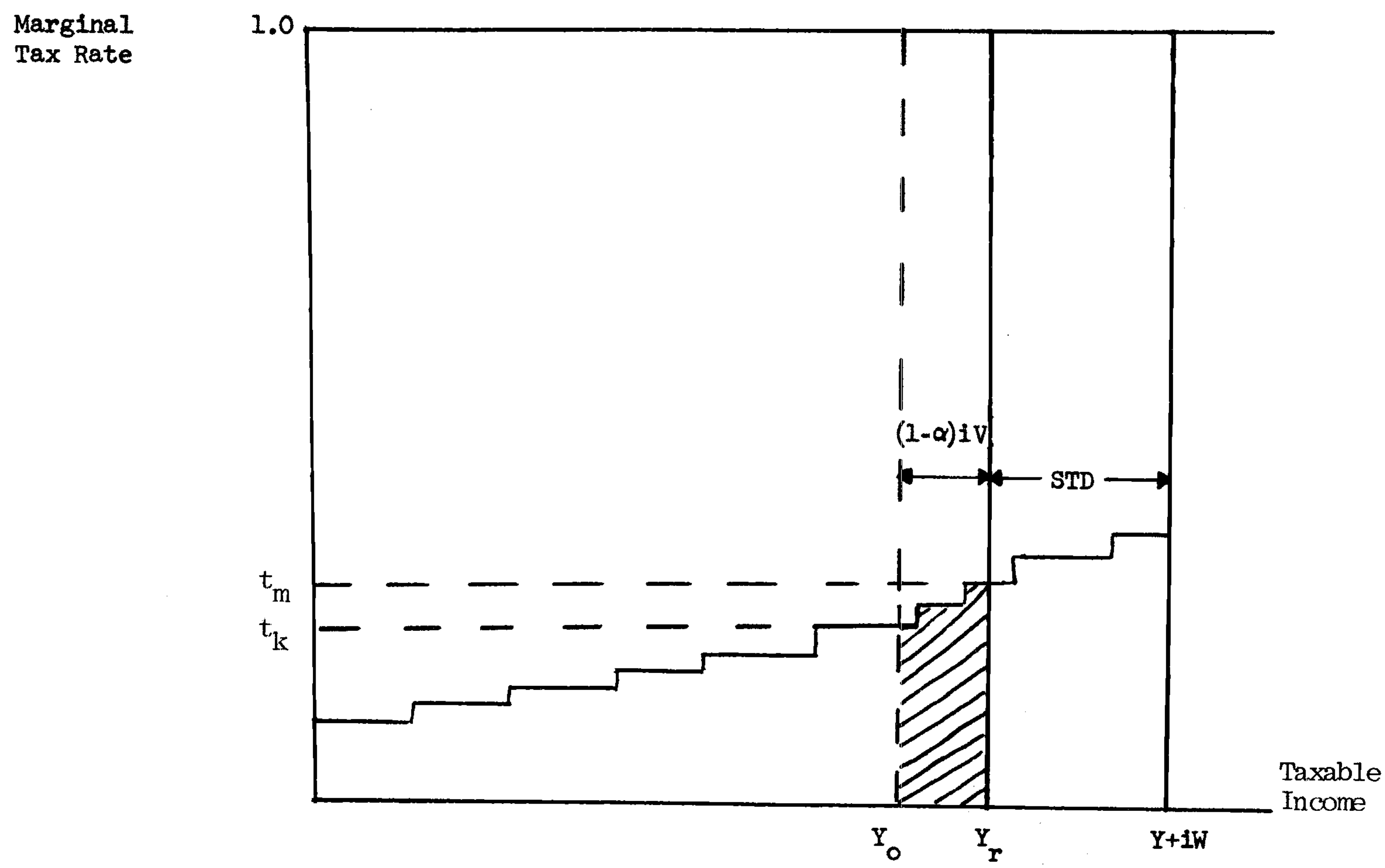
$\bar{\tau} > t$ when 1. $STD > NHE + (\tau_p + \alpha i)V$

or 2. $STD < NHE$

[4]In 1977, STD > NHE for over half of itemizing households in the income ranges (thousands of $) 0-10, 10-20, and 20-30 and over a quarter of households in the 30-50 range. By definition, STD > NHE for all nonitemizers.

[5]Of course, this creates a large incentive for equity financing .

Figure 2: Tax Rates for Housing Decisions When Itemizing is Suboptimal



$\bar{\tau} \gtrless t$ when NHE < STD < NHE + $(\tau_p + \alpha i)V$.

Note the anomaly that $\bar{\tau}$ is unambiguously greater than t both when NHE is very high and when NHE is very low (along with V).

III. Calculation Methodology and Underlying Data

In this section we describe the precise procedures and calculations underlying the computations and discuss our data set.

Assumptions and Precise Methodology

The calculations are performed in two steps. The first entails computation of the income and tax liability of an owning household if it instead were renting housing services. We add on estimate of the interest foregone on owner equity to the household's recorded before-tax income.

(4) $Y_r^j = Y^j + (1-\hat{\alpha}^j)i\hat{V}^j$,

where Y^j is the recorded income (labor and nonhousing capital) of the household, i is the current mortgage rate, and $\hat{\alpha}^j$ and $\hat{V}^j$ are estimates of the current loan-to-value ratio and house value of the household. The Y^j value is from the NBER TAXSIM file for 1977, and i (= 0.0901) is the average new mortgage rate in 1977 (1980 Economic Report of the President). (The specification of $\hat{V}^j$ and $\hat{\alpha}^j$ will be discussed shortly.) The taxable income of this household, if it had rented, would be

(5) $TAXIR^j = Y_r^j - \max(NHE^j, STD^j)$

and taxes, $TAXR^j$, could be computed as

$$(6) \qquad TAXR^j = \sum_{b=1}^{m^j} t_b A_b + t_n^j \, (TAXIR^j - \sum_{b=1}^{m^j} A_b).$$

The second step is calculation of the income and tax liability of the household if it had become an owner in 1977. We begin with the household's theoretical income as a renter from equation (4), reduce it by the interest income foregone on the own equity investment assuming that the household would have a loan-to-value ratio of α_{new} and then allow potential housing-related tax deductions equal to $(\alpha_{new}\, i+\tau_p)\hat{V}^j$:

$$(7) \qquad TAXIO^j = Y_r^j - (1-\alpha_{new})i\hat{V}^j - \max\,[NHE^j + (\alpha_{new} i+\tau_p)\hat{V}^j,\ STD]\,.$$

Taxes are computed as in (6), after replacing $TAXR^j$ and $TAXIR^j$ with $TAXO^j$ and $TAXIO^j$.

The tax rate relevant to the tenure choice is

$$(8) \qquad \bar{\tau}^j = \frac{TAXR^j - TAXO^j}{(i+\tau_p)\hat{V}^j}\,.$$

Expression (8) is the ratio of the total tax saving from owning to the total cost of owning a house. The tax rate relevant to the quantity of owner-occupied housing demanded is

$$(9) \qquad t^j = - t_n^j \left[\frac{dTAXIO^j/d\hat{V}^j}{i+\tau_p}\right]$$

$$= \begin{cases} t_n^j & \text{if itemizer} \\ t_n^j\,(1-\alpha_{new})i/(i+\tau_p) & \text{if nonitemizer.} \end{cases}$$

Expression (9) is the ratio of the tax saving from an additional dollar of owner-occupied housing related expenses to the cost of the additional dollar of housing.

The specification of $\hat{\alpha}^j$, $\hat{V}_j$, and α_{new} remains to be discussed. At any point in time, k, α_k^j is the ratio of the outstanding mortgage principal $PRIN_k^j$, to the current house market value, V_k^j. Denote the house price and loan-to-value ratio at time of purchase by V_o^j and α_o^j, and let i_o and M be the interest rate on, and original maturity of, the mortgage. Then

$$PRIN_k^j = \frac{(1+i_o)^M - (1+i_o)^k}{(1+i_o)^M - 1} \alpha_o^j V_o^j .$$

Further, assume that the house has risen in value at the annual rate $\pi_o^j - \delta$ since time of purchase or that $V_k^j = (1+\pi_o^j - \delta)^k V_o^j$. Then

$$(10) \qquad \alpha_k^j = \frac{(1+i_o)^M - (1+i_o)^k}{[(1+i_o)^M - 1]\,(1+\pi_o^j - \delta)^k} \alpha_o^j .$$

As can be seen, the current α_k^j depends on how long ago the household obtained the mortgage, what the mortgage rate was at that time, i_o, what loan-to-value ratio was obtained, α_o^j, and what the net appreciation on the house has been, π_o^j.

Although none of these values are known to us, we do have some information which would allow us to estimate the $\hat{V}^j$ and $\hat{\alpha}^j$ with reasonable accuracy. For itemizers we know property tax payments, which are related through the effective property tax rate to house value. The relevant relationship is $\hat{V}^j = PTAX^j / \tau_p$.[6]

[6] τ_p comes from dividing total property tax payments in 1975 ($51.5 billion) by total assessed value of property in that year ($1063.9 billion) and applying a ratio of assessed value to market value (0.327, from 1972 Census of Governments).

We also know mortgage payments, which are a function of i_o and α_o^j. By assuming some simple functional relationships between these variables, we can estimate $\hat{\alpha}$ for each household. This procedure is explained in Appendix A.

For nonitemizers, neither property tax payments nor mortgage payments are known. Thus we not only have no way to estimate $\hat{\alpha}^j$, we also cannot tell if the household owns or rents housing. Our procedure in these cases is to assign homeowning or renting status randomly to the nonitemizers. For those that are presumed to be renters, there is no foregone interest on equity, so $\hat{\alpha}$ is set equal to unity. For those that are presumed to be homeowners, $\hat{\alpha}$ is undoubtedly a low number (they borrowed at a low rate some time ago and thus STD>[NHE + $(\alpha i+\tau_p)$V] such as 0.2, on average. On the basis of other information, we have determined the fraction of nonitemizers who are homeowners, by income class.[7] Thus, values of $\hat{\alpha}$=1.0 and 0.2 are randomly assigned to nonitemizers, with the porportion receiving each value depending on income.

The α_{new} parameter is not the initial loan-to-value ratio. This would be the appropriate parameter only if the household were to increase the mortgage pari passu with the net appreciation of the house. More likely, the mortgage is amortized. The appropriate α_{new} is a discounted weighted average of the α_k^j over the assumed life of the mortgage. With the latter

[7]If o_T is the ownership rate for all households in the income class, o_I is the ownership rate for itemizers, o_N is the ownership rate for nonitemizers and w is the fraction of households in the income class that itemize, then $o_T = wo_I + (1 - w)\, o_N$. We know o_T and w, and o_I is the fraction of itemizers with positive property tax payments. Thus we can solve for o_N. For the lowest four income classes, o_N is 0.47, 0.53, 0.56, and 0.17 respectively.

Table 1: Some Underlying Data

Adjusted Gross Income (thous. $)	% of households in class	% of total AGI earned by class	% ownership rate
0 - 10	49.2	16.6	49
10 - 20	29.7	32.4	66
20 - 30	14.0	25.2	83
30 - 50	5.5	15.1	87
50 - 100	1.3	6.5	90
> 100	0.3	4.3	90
Total	100	100	65

	% of Households that itemize	% of itemizers with PTAX	average PTAX ($) of itemizers with PTAX	average house value, V ($)
0 - 10	4.4	92.3	612	39,708
10 - 20	29.8	95.6	664	43,110
20 - 30	64.8	97.8	777	50,454
30 - 50	86.5	97.9	1121	72,773
50 - 100	93.7	98.7	1722	111,805
100 - 200	97.0	98.9	2671	173,455
> 200	98.5	99.4	4734	307,370
Total	26.4	96.9		

	observations in cell (itemizers)	observations in cell (nonitemizers)	Mean Surplus Standard Deduction (itemizers)	Mean Surplus Standard Deduction (nonitemizers)
0 - 10	220	1965	434	1932
10 - 20	1179	2035	547	1870
20 - 30	1373	692	453	1740
30 - 50	1698	292	195	1401
50 - 100	1921	--	52	--
> 100	9993	--	33	--
Total	16384	4984		
Median Income for Husband-wife Family ± 1	152	250	758	2036

equal to 10 years, we compute

$$\alpha_{new} = \sum_{k=0}^{10} \frac{\alpha_k^j}{[1 + (1 - \tau)i]^k} \Bigg/ \sum_{k=0}^{10} \frac{1}{[1 + (1-\tau)i]^k},$$

where the α_k^j are based on the current (1977) mortgage terms and the expected future net appreciation rate, and $(1-\tau)i$ is the nominal after-tax discount rate. With $i = 0.09$, $M = 26$ years, $\alpha_o = 0.75$, $\pi-\delta = 0.045$, and $(1-\tau)i = 0.0675$, $\alpha_{new}=0.60$.[8]

The Underlying Data

Some relevant data are listed in Table 1 by AGI (adjusted gross income) class. In 1977, virtually half of households (husband-wife family, other family, and primary individuals) had income under $10,000 while only 1.6 percent had income over $50,000. Nonetheless, households on the bottom half of the income ladder earned only one-sixth of total income, while the highest 1.6 percent earned over 10 percent.

Both the homeownership rate and proportion of households that itemize rise monotonically with income. This correspondence is not coincidence, as is indicated by the very high percentage (97) of itemizers who pay property taxes (i.e., own homes). Only a quarter of all households itemized in 1977, but over 90 percent of households with income above $40,000 did (less than 5 percent of households on the lower half of the income ladder did).

Table 1 also lists the average property tax payments of itemizers by income class and their implied house value ($PTAX/\tau_p$ where $\tau_p = 0.0154$). Nonitemizers and renting itemizers create a problem in that property taxes (and thus those

[8] The mortgage terms are the averages for conventional mortgages closed in 1977 (FHLBB Journal, Table S.5.1). Amortization alone lowers α from 0.75 to 0.63 in 10 years. The net house appreciation lowers it further to 0.40.

value) are not available. Half of nonitemizers are owners, and hypothetical house values must be attributed to all renters in the calculation of their taxable income if they were owners. For these purposes, the $\hat{V}$'s in Table 1 are attributed to nonitemizers and renting itemizers with incomes in the relevant ranges.

The final problem is estimation of potential NHE for nonitemizers. It is invalid to assume that the distribution of NHE^i (conditional on income, if this explains potential deductions) is the same for nonitemizers as it is for itemizers because the choice of nonitemizing status itself depends on potential NHE^i. Specifically, we would expect that potential NHE^i will be lower for the nonitemizers than itemizers and that the crucial surplus standard deduction will be higher. Thus, any calculation of $\bar{\tau}^j$ for itemizers only will be biased upward as an estimate of average $\bar{\tau}^j$ in an income class because it tends to include more people who have extraordinarily high NHE^i (and possibly PTAX and INT). We have developed a procedure for generating an unbiased distribution of NHE to be attributed to nonitemizers and have employed it in our calculations of the $\bar{\tau}^j$. This procedure is described in Appendix B.[9] The average values of the imputed surplus standard deductions are presented in Table 1, beside the actual average values for itemizers. As expected, they are uniformly higher for nonitemizers than itemizers.

III. Estimated Tax Rates

The estimated tax rates are reported in Table 2. Beginning with the itemizers, the difference between $\bar{\tau}_I$ and t_I are not large. We do find $\bar{\tau}_I > t_I$ for the lowest and the three highest income classes, i.e., when NHE is especially low or high. In the \$20-30 thousand range, t_I slightly exceeds $\bar{\tau}_I$, reflecting STD NHE. For nonitemizers, the t_N's are roughly

[9] The procedure is based upon Hausman and Wise (1977).

Table 2: Calculated Tax Rates for Tenure Choice and Quantity Demanded Decisions in 1977 by Income Class

Adjusted Gross Income (thousands of $)	Itemizers $\bar{\tau}_I$	Itemizers t_I	Nonitemizers $\bar{\tau}_N$	Nonitemizers t_n	Weighted Average[a] $\bar{\tau}$	Weighted Average[a] t
0 - 10	.108	.088	.060	.073	.062	.074
10 - 20	.191	.191	.136	.196	.152	.195
20 - 30	.258	.263	.202	.281	.238	.269
30 - 50	.374	.356	.310	.348	.365	.355
50 -100	.498	.481			.498[b]	.481[b]
- 100	.568	.559			.586[b]	.559[b]
16.226 - 18.226[c]	.179	.191	.131	.201	.150	.197[d]

[a] $\bar{\tau} = \beta \bar{\tau}_I + (1-\beta)\bar{\tau}_N$, where β is the fraction of class that itemized in 1977; t is defined similarly.

[b] There are no nonitemizers with AGI over $50,000 in our sample. In general, 95 percent of households with AGI over $50,000 itemized in 1977.

[c] Median husband-wife family income ± $1.

[d] Estimates assume that two-fifths of households itemized.

comparable to those of itemizers, but the $\bar{\tau}_N$'s are 0.04 to 0.06 lower. This reflects the greater surplus standard deduction of nonitemizers relative to itemizers.[10] The last two columns are weighted average $\bar{\tau}$'s and t's for itemizers and nonitemizers. $\bar{\tau} < t$ for incomes below about $35,000. The largest difference between $\bar{\tau}$ and t occurs in the $10-20 thousand bracket, where $\bar{\tau}$ is 28 percent less than t, and 30 percent of households fall in this income range.

If one were to calculate single tax rates relevant to the tenure-choice and quantity-demanded decisions ($\bar{\tau}_A$ and t_A, respectively), they would be weighted averages of the $\bar{\tau}$'s and t's, respectively. For tenure choice, the portion of households in the different income classes (h_i) would seem to be the appropriate weights:

$$\bar{\tau}_A = \sum_{i=1}^{6} h_i \bar{\tau}_i,$$

where the h_i are given in Table 1. The appropriate weights for computing the aggregate t_A would appear to be the shares of income earned by homeowners in the different income classes ($y_i o_i / \Sigma y_i o_i$, where y_i and o_i are from Table 1):

$$t_{AH} = \Sigma y_i o_i t_i / \Sigma\, y_i o_i .$$

[10]The roughly half of the sample of nonitemizers who were homeowners in 1977 would virtually all have itemized had they been financing at α_{new} and i = 0.0901. In our calculations, they do, indeed, itemize. This switch in filing status might lead them to increase their nonhousing expenses and thus lower their excess standard deduction, thereby raising $\bar{\tau}$. To the extent that nonhousing expenses are responsive, we have overstated the difference between t and $\bar{\tau}$.

The results of these calculations are $\bar{\tau}_A = 0.137$, $t_A = 0.274$. While the individual $\bar{\tau}_i$ and t_i are not that different, significant differences in the h_i and the $y_i o_i$ lead to a large difference in the relevant aggregate tax rates to employ is user cost calculations for the two distinct housing decisions.

As noted in the introduction to this paper, the most detailed earlier study is that of Diamond (1980). He correctly recognizes the relevance of both the implicit income earned on owner's equity (the entire financing cost, not just α of it, lowers the taxable income base) and the "surplus" standard deduction (STD - NHE acts as an offset to deductible housing expense — including the equity cost — in the calculation of $\bar{\tau}$). Furthermore, he distinguishes between the tax rate effects on the tenure and housing demand decisions. However, his calculations, which refer only to the median income, husband-wife family that itemized, differ from those we presented for this group in two ways.

On a conceptual level, Diamond does not distinguish between the marginal tax rates relevant to the quantity demanded decision and to the calculation of $\bar{\tau}$. In a progressive tax system, the former will be less than the latter. In terms of the symbols employed in the discussion of Figure 1, $t_k < t_{km}$. The rate utilized by Diamond (t_m) for both calculations is greater than either of these rates. Thus, his t for the quantity-demanded decision, 0.22, exceeds the 0.191 we have computed.

On an empirical level, Diamond assumes that nonhousing deductible expenses for the median-income, husband-wife family amounted to \$880 in 1977. Thus, \$2,320 (the standard deduction of \$3200 minus \$880) of the deduction due to owning a house are assumed not to provide a net reduction in taxable income. This amounts to 50 percent of our estimate of the total potential tax reduction to owning.[11] In contrast, our results utilize the average amount of non-housing deductions actually reported by itemizers in computing the excess standard deduction, or \$758. Thus, only 17 percent of the total potential tax reduction due to homeowning is lost in our calculation. As a result, Diamond's calculation of $\bar{\tau}$ is, by our computation, only 0.110, far less than our 0.179.

Rosen and Rosen (1980) assume that the median (income) household would itemize, which is correct given α_{new} and the current i, but they use historic housing expense deductions based upon far lower α and i values. Application of their methodology to 1977 would give a tax rate of about 0.2, or 44 percent greater than the household-weighted economy-wide value we propose for explaining tenure choice.

deLeeuw and Ozanne (1979) employ a tax rate of 0.30 in their analysis of the quantity-demanded decision. This rate is computed as an income-weighted average of marginal tax rates of owners, i.e., is equivalent to t_A. Data from the Brookings tax file for 1970 were employed. While the procedure seems appropriate, the 0.30 rate is too high. Owing to bracket creep, we would expect t_A for 1970 to be less than that for 1977, i.e., 0.274. We suspect that deLeeuw and Ozanne used actual housing deductions for 1970 based on historic α's and i's, rather than α_{new} and the i for 1970.

IV. A Possible Extension: Endogenous Tax Law

In our view, the principal weakness in the present analysis is the implicit assumption that the tax law (the t_i and STD) is fixed for all time. This is not a particularly appealing assumption, and it could be important to the calculation of the tax rates relevant to housing decisions.

[11] That is, $2,320/(i+\bar{\tau}_p)V \tilde{=} 0.5$.

Consider the t_i. If government expenditures financed by income taxes are expected to grow over time as a share of GNP, then the t_i would be expected to rise. Experience in the U.S. over the previous decade would have led a rational household in 1977 to expect rising t_i, even net of periodic tax "cuts." Higher future t_i would raise both $\bar{\tau}_A$ and t_A if they, like α, were computed in a discounted present value manner, although the increases would likely not be substantial.

Future expected changes in STD might have a greater impact. In 1977, 26 percent of households itemized, virtually all of which were homeowners. If all of these owners refinanced at $i = 0.09$ with an α_{new} of 0.6, then practically all owners would itemize. Of course, at any point in time many owners will have α's less than 0.6, some far less. Nonetheless, with no further changes in i and no change in STD, the proportion of households itemizing could well double. This would almost certainly lead the Treasury to seek, and Congress to legislate, a major increase in STD.[12]

The impact of an increase in STD on the tax rates relevant to housing decisions depends on the income level, preferences for housing, and non-housing deductible expenses of households. The impact of an increase in STD to STD* on $\bar{\tau}$ and t depends on the value of STD* relative to values of NHE and deductible housing expenses, as shown in Table 3. For very high income households, both $\bar{\tau}$ and t would be unaffected; for somewhat lower income households, $\bar{\tau}$ alone would decline; for low to moderate income households, both $\bar{\tau}$ and t would decline. Because the economy-wide average tax rate relevant to the quantity-demanded decision (t_A) is income weighted, the decline in this rate would not be large. In fact, given the expectation

[12] Past increases in the standard deduction have been defended on the grounds of reducing the proportion of itemizing households and the additional administrative and compliance costs itemizing entails. See, for example, Senate Report #91-552 on the Tax Reform Act of 1969, pp. 584-586.

Table 3: The Impact of an Increase in the Standard Deduction from STD to STD^*

Relative Value of STD^*	Income Level of Households Affected	Impact $\bar{\tau}$	Impact t
$STD^* < NHE$	very high	0	0
$NHE < STD^* < NHE + (\alpha i+\tau_p)V$	moderate to high	↓	0
$STD^* > NHE + (\alpha i+\tau_p)V$	low to moderate	↓	↓

of rising t_i discussed above, our estimate of t_A is probably reasonable, However, the economy-wide average tax rate relevant to tenure choice is household weighted. Thus a significant increase in STD would undoubtedly lower $\bar{\tau}_A$ significantly. As a result, even our low 0.137 estimate is probably too high. That is, the tax rate relevant to the tenure decision on an economy-wide basis is probably less than half that relevant to the quantity demanded decision.

V. Summary

Conceptually, the tax rates relevant to the quantity demanded (t) and tenure choice ($\bar{\tau}$) decisions are different, although which is higher is unclear. With no excess standard deduction (with STD $<$ NHE), then, $t < \bar{\tau}$. But with STD $>$ NHE, we could easily have $t > \bar{\tau}$.

In 1977, $|t - \bar{\tau}| \leq 0.02$ for itemizers in each of our six income classes. Thus, for example, t and $\bar{\tau}$ are quite close (0.191 and 0.179 respectively) for itemizing husband-wife families with the median income (in contrast to Diamond's calculations). For nonitemizers (with STD NHE by definition), t is greater than $\bar{\tau}$ by as much as 0.08. In percentage terms, t is over 25 percent greater than $\bar{\tau}$ for over 60 percent of these households. Thus it appears to be important to distinguish between t and $\bar{\tau}$ in a microeconomic study that includes nonitemizers.

On an economy-wide basis, we compute $t_A = 0.274$ and $\bar{\tau}_A = 0.137$. This result follows from the different weighting schemes employed in the calculations. The weights for the income class t's are the portion of total homeowner income earned by homeowners in the various income classes; the weights for the income class $\bar{\tau}$'s are the portion of total homeowners in the various income classes. Thus, the appropriate tax rate to use in the computation of the user cost employed in the estimation of an aggregate tenure choice equation might be only half that employed in the estimation of an aggregate quantity demanded equation.

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Appendix A: A Method of Estimating $\hat{\alpha}^j_t$

The ratio of current interest payments to the current value of the house is the product of the original mortgage coupon rate and the current loan-to-value ratio:

$$\frac{INT^j}{\hat{V}^j} = i_o \hat{\alpha}^j_k .$$

Denote $INT^j/\hat{V}^j$ by $\hat{X}^j = INT^j/(PTAX^j/.0154)$. Then

$$\frac{\hat{X}^j}{i_k \alpha_o} = \frac{i_o}{i_k} \left(\frac{\hat{\alpha}^j_k}{\alpha_o} \right),$$

where i_k is the current coupon rate, 0.09, and α_o is the original loan-to-value ratio, 0.75, and is assumed to have been the same for all households for all time. Thus,

$$\frac{\hat{X}^j}{.09(.75)} = \frac{i_o}{.09} \; \frac{\alpha^j_k}{.75} \quad .$$

We know that i has risen through time and thus that $i_o/.09$ is smaller the larger is t (the further back is o). Of course, $\hat{\alpha}^j_k/.75$ falls through time with the impact of amortization and net appreciation. We make the assumption that $i_o/.09 = (\hat{\alpha}^j_k/.75)^{\beta}$. Thus, we can solve for

$$\hat{\alpha}^j_k = .75 \left[\frac{\hat{X}^j}{.09\ (.75)} \right]^{\frac{1}{1 + \beta}}$$

Given β and $\hat{X}^j$, we can determine $\hat{\alpha}^j_k$. It is reasonable to require additionally that $0 < \hat{\alpha}^j_k < 0.85$, unless $PTAX^j = 0$, in which case $\hat{\alpha}^j_k = 1.0$. As for β, based on inspection of the time path of mortgage rates, we have chosen a value of 0.25.

Appendix B

A Procedure for Generating a Distribution of Nonhousing Deductions for Nonitemizers

In order to calculate t_n^i and τ^i for nonitemizers, a value for potential nonhousing-related deductions is needed. It is invalid to assume that the distribution of NHE^i (conditional on income, if this explains potential deductions) is the same for nonitemizers as it is for itemizers because the choice of nonitemizing itself depends on potential NHE^i. Specifically, we would expect that potential NHE^i will be lower for the nonitemizers than itemizers. Thus, any calculation of τ^i for itemizers only will be biased upward as an estimate of average τ^i in an income class because it tends to include more people who have extraordinarily high NHE^i (and possibly PTAX and INT).

We generate an unbiased distribution of NHE^i for nonitemizers as follows. Assume that NHE and housing related expenses $[H = (\tau_p+\alpha i)V]$ are described by the following model:

(1) $NHE^i = aY^i + \varepsilon_i^i$

(2) $H^i = bY^i + \varepsilon_2^i$

where $$\begin{bmatrix} \varepsilon_1^i \\ \varepsilon_2^i \end{bmatrix} \sim N\left\{ \binom{0}{0} ; \begin{bmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{12} & \sigma_2^2 \end{bmatrix} \right\}$$

and Y^i is adjusted gross income.

Now define the sum of NHE^i and H^i as TOT^i. What we observe in the TAXSIM file is the distribution of H^i, NHE^i, and TOT^i, conditional on $TOT^i \geq STD^i$, where STD^i is the standard deduction (which depends on the marital status of the taxpaying unit). Thus an observation is in the sample only if

$$(3) \qquad NHE^i + H^i \geq STD^i$$

$$(4) \text{ or } \quad (a + b)Y^i + \varepsilon_1^i + \varepsilon_2^i \geq STD^i.$$

The probability that the observation is in the sample is

$$(5) \text{ prob } [\varepsilon_1^i + \varepsilon_2^i \geq STD^i - (a + b)Y^i].$$

We know that

$$(6) \qquad \varepsilon_1^i + \varepsilon_2^i \sim N(0, \sigma_1^2 + \sigma_2^2 + 2\sigma_{12})$$

so that

$$(7) \quad \text{prob } (\quad) = \int_{(STD^i - (a + b)Y^i)/\sigma}^{\infty} f(u)du = 1 - F\left\{\frac{STD^i - (a + b)Y^i}{\sigma}\right\},$$

where f is the probability density function of the normal distribution, F is the cumulative density function, and σ is equal to $(\sigma_1^2 + \sigma_2^2 + 2\sigma_{12})^{1/2}$.

The conditional likelihood of an observation (NHE^i, H^i) given the sample $NHE^i + H^i > STD^i$ is

$$(8) \quad \frac{\phi(NHE^i, H^i)}{1 - F\left(\frac{STD^i - (a+b)Y^i}{\sigma}\right)}$$

where

$$(9)\qquad \phi(NHE^i, H^i = 2\pi\frac{1}{|\Omega|^{\frac{1}{2}}} \exp [- \tfrac{1}{2} \begin{pmatrix} NHE^i - aY^i \\ H^i - bY^i \end{pmatrix} \Omega^{-1} \begin{pmatrix} NHE^i - aY^i \\ H^i - bY^i \end{pmatrix}] .$$

Then the likelihood function can be written as

$$(10)\qquad L(NHE^i, H^i|a,b) = \sum_1^N \frac{1}{2\pi|\Omega|^{\frac{1}{2}}} \frac{\exp [-\tfrac{1}{2} \sum_1^N \begin{pmatrix} NHE^i - aY^i \\ H^i - by^i \end{pmatrix} \Omega^{-1} \begin{pmatrix} NHE^i - aY^i \\ H^i - bY^i \end{pmatrix}]}{1-F(\frac{STD^i - (a+b)Y^i}{\sigma})}$$

The log-likelihood function is

$$(11)\qquad \frac{N}{2} \ln k - \frac{N}{2} \ln|\Omega| - \frac{1}{2} \sum_1^N \left\{ \begin{pmatrix} NHE^i - aY^i \\ H^i - bY^i \end{pmatrix} \Omega^{-1} \begin{pmatrix} NHE^i - aY^i \\ H^i - bY^i \end{pmatrix} \right\} \sum_1^N \ln [1-F(\frac{STD^i - (a+b)Y^i}{\sigma})]$$

where k is a constant. This can be further simplified to

$$(12)\qquad \frac{N}{2} \ln k - \frac{N}{2} \ln (\sigma_1^2\sigma_2^2 - \sigma_{12}^2) - \frac{1}{2}\frac{1}{(\sigma_1^2 \sigma_2^2 - \sigma_{12}^2)} \sum_1^N \{ \sigma_2^2 (NHE^i - aY^i)^2 -$$

$$2\sigma_{12} (NHE^i - aY^i)(H^i - bY^i) + \sigma_1^2 (H^i - bY^i)^2\} - \sum_1^N \ln 1-F\left(\frac{STD^i - (a+b)Y^i}{(\sigma_1^2 + \sigma_2^2 + 2\sigma_{12})^{1/2}}\right).$$

Expression (12) was maximized with respect to a, b, σ_1^2, σ_2^2, and σ_{12} using a numerical optimization algorithm. In order to reduce computational expense, the optimization was carried out on a random sample of 300 observations of joint filers, whose relevant standard deduction amounted to \$3200 in 1977. The estimated coefficients were:

$$
\begin{aligned}
(13)\quad \hat{a} &= .1093 \\
\hat{b} &= .0330 \\
\sigma_1^2 &= 4.828 \times 10^7 \\
\sigma_2^2 &= 8.394 \times 10^6 \\
\sigma_{12} &= 6.604 \times 10^6
\end{aligned}
$$

The final step is to use these estimates to generate a distribution of potential NHE to be attached to the nonitemizers on the TAXSIM file. A random generator with a joint normal distribution described by the estimated parameters was used to produce drawings of ε_1^i and ε_2^i. For each nonitemizer in the file, we calculate $(\hat{a} + \hat{b})Y^i$. Then we make a drawing of ε_1 and ε_2. If $(\hat{a} + \hat{b})Y^i + (\varepsilon_1 + \varepsilon_1)$ is less than the standard deduction appropriate to the taxpaying unit, then $\hat{a}Y^i + \varepsilon_1$ is attached to the file as the amount of NHE that is available to the individual. If $(\hat{a} + \hat{b})Y^i + (\varepsilon_1 + \varepsilon_2)$ is greater than the standard deduction, another drawing of ε_1 and ε_2 is made. The process continues until a drawing of $\varepsilon_1 + \varepsilon_2$ is sufficiently low so as to make $(\hat{a} + \hat{b})Y^i + (\varepsilon_1 + \varepsilon_2)$ less than STD. If the accepted $\hat{a}Y^i + \varepsilon_1$ is less than zero, then a value of zero is attached; if $\hat{a}Y^i + \varepsilon_1$ is more than the standard deduction, then the standard deduction is attached. (Both these situations are possible because reasonable values of H^i and NHE^i are nonnegative, but the normal distribution does not, of course, recognize such economically meaningful truncations.)

This procedure encountered the problem that the dispersion of the estimated distributions of H^i and NHE^i was so large that a very large fraction of the imputations of NHE^i ended up being either zero or the standard deduction. In order to generate a more reasonable distribution, the maximum likelihood procedure was re-estimated on a sample of taxpaying units with AGI less than

$50,000. By eliminating the high income nonitemizers from the sample, the estimated dispersion was substantially reduced. However, the fraction of imputations at the extreme values was still quite high. To reduce the frequency of this, the imputations used a variance-covariance structure equal to one-ninth times the estimated values. Thus, in the reported experiments, the imputed values of potential deductions were distributed as follows:

$$
(14) \quad \begin{aligned}
\hat{a} &= .0934 \\
\hat{b} &= .0403 \\
\sigma_1^2 &= 1.284 \times 10^6 \\
\sigma_2^2 &= 5.889 \times 10^5 \\
\sigma_{12} &= 3.227 \times 10^5
\end{aligned}
$$