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A GENERAL EQUILIBRIUM MODEL OF TAXATION THAT USES MICRO-UNIT DATA: WITH AN APPLICATION TO THE IMPACT OF INSTITUTING A FLAT-RATE INCOME TAX

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ABSTRACT

This paper develops a methodology in integrating the information from a micro-unit data file of tax returns into the framework of a general equilibrium model of taxation with endogenous financial behavior. It discusses how the available information on capital income flows can be used to impute portfolios to households, and how these portfolios and the other observed characteristics of the households can be made consistent with expected utility maximization.

In order to illustrate the value of this methodology, it is applied to a study of the general equilibrium impact of instituting a flat-rate income tax system. The analysis reveals that there would be substantial changes in the pattern of rates of return and the distribution of asset ownership. The sectoral allocation of capital does not, though, change substantially. The micro-unit data base shows that, in general, lower-income households are worse off and the higher-income households are better off, although there is substantial dispersion of welfare change within income groups.

Because these results rest on a very simple model of the economy and a particular data imputation procedure and parameterization, they should not be taken literally as a guide to policy decisions. Nevertheless, they do indicate that substantial insight can be provided by integrating micro-unit data with general equilibrium tax modeling.

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A GENERAL EQUILIBRIUM MODEL OF TAXATION THAT USES MICRO-UNIT DATA: WITH AN APPLICATION TO THE IMPACT OF INSTITUTING A FLAT-RATE INCOME TAX

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I INTRODUCTION

In recent years, micro-unit data files with detailed information on income sources and taxes have become increasingly available. Also in the last decade computable general equilibrium models of the effects of taxation have grown in both detail and sophistication. The primary goal of the research described here is to begin to develop a methodology for integrating the information from micro-unit data files into the framework of a general equilibrium model of taxation. It is hoped that this integration will be valuable for providing a detailed understanding of the impact of taxation, especially the taxation of capital income. In order to illustrate this value, the methodology is applied to a study of the economic impact of instituting a flat-rate income tax system.

The potential contribution of micro-unit data sets to research in taxation has been amply demonstrated in a number of applications. Several different files have been the basis of econometric investigations of the responsiveness of particular aspects of behavior to changes in the tax system. Among the aspects studied so far have been charitable contributions, capital gains realizations, demand for housing, and labor supply. Micro-unit data have also been used to provide detailed accounts of the impact of a particular aspect of the tax law, or the probable impact of a potential change in it. For example, the files have been applied to capital gains taxation and the integration of the corporate and personal income tax systems. Often the results of an econometric analysis are used to simulate behavioral responses to a particular policy.

The insights to be gained from a general equilibrium analysis of taxation have also been well documented.[1] Harberger's (1962, 1966) original one-consumer, two-sector model has been extended to include many consumer groups and many sectors by the work of Shoven and Whalley and their collaborators. The interaction between taxation and financial behavior has recently been introduced into general equilibrium modeling by Slemrod (1980, 1982, 1983). All previous research efforts have been based on representative households standing in for highly aggregated classes of individuals, and usually feature no more than 20 different classes, and often less than that.[2] These classes are distinguished by their endowment of capital and labor in efficiency units, family size, preferences concerning consumption goods, and possibly also their preferences concerning risk and their tax rates.

In this paper we propose to replace that state-of-the-art procedure of considering a small number of representative households, each of which can represent up to several million actual households, with a procedure where the number of households is expanded to a much higher order of magnitude. In particular, the number of representative households is expanded toward the sample size of a micro-unit data set, which may go as high as over 90,000 households, in the case of the U.S. Treasury Tax File. In what follows I first consider the incremental benefits of such a procedure and then the incremental costs.

The most obvious benefit from extensive further disaggregation is that the richness of statements about the distributional impact of a particular policy can be greatly increased. In the current models, a household with income of $7500 may represent all households in the $5000-$10,000 range. The welfare impact of a policy on the household with $7500 of income may be an inaccurate indicator of the impact on a $5000 income or a $10,000 income household. In a micro-unit data set there are likely to be households with income within a few dollars of $5000 and $10,000, so the welfare impact on them need not be extrapolated from the impact on a $7500 income household.

A more important advantage of using a micro-unit data base is that it recognizes the fact that there is a joint distribution of the household parameters of endowment and tastes. Thus, within what the current models refer to as "income class," there are households with very different capital-labor ratios, very different consumption patterns, and very different portfolios. In the event of such variation, the state-of-the-art methodology might conclude that policy change X would cause a dollar-equivalent welfare increase of $Y to group Z, but in fact there is a distribution of welfare effects whose mean is approximately $Y. The dispersion of the distribution of welfare losses is a relevant and perhaps critical piece of information to policymakers contemplating a tax reform.[3]

This information is certainly the most important input to any discussion of the horizontal equity implications of a policy. That is, it will allow us to investigate to what extent a policy has greatly varying welfare effects on households of essentially the same means.

This issue of the distribution of impact within an income class is especially interesting in the context of a general equilibrium model with financial behavior (GEFB). The key additional household characteristics that enter a GEFB model are the degree of risk aversion, which affects portfolio choice, and the housing tenure status. Intuition suggests that there is as much, if not more, variation in these areas than in, for example, tastes among broad aggregates of consumption goods.

There are two principal incremental costs from using a micro-unit data base for general equilibrium tax analysis. The first and most obvious is the additional computational expense involved. Even with the most efficient machine currently available, the computational expense of calculating equilibrium is not trivial. However, further technological advances in computational efficiency are likely to make this a less critical consideration.

Another issue arises due to the tremendous informational requirements of a general equilibrium analysis with micro-unit data. Current models already require a large amount of information and parameterization. In particular, for each representative household we require the endowment of capital and labor in efficiency units, and the household's equilibrium bundle of goods, including labor supply. Because in the baseline equilibrium the observed data must be the outcome of a consumer optimization problem, the usual procedure is to assume a particular functional form for the utility function and then solve "backwards" for the function's parameters which would generate the observed data as the optimal consumer choice. The basic approach is the same when the data base is actual household data rather than stylized households which represent an average of many households. The GEFB model, though, also requires information on the portfolios of households. However, the data set which has detailed information on income sources and the tax situation of households, the Treasury Tax File, has only indirect information about asset holdings. In particular, it has the flow of annual capital income for some kinds of income, such as shares of stock, and no information at all about other assets such as tax-exempt bonds and pension wealth. Thus, one critical set of data must be imputed to the households.

Once these imputations are made, the parameters of the utility function can be solved backwards so as to be consistent with the imputations. However, the preference parameters are only as accurate as the data imputations.

The earlier work of Pechman & Okner (1974) employed an approach which is similar to that of this project, although the goal (to study the personal incidence of the total U.S. tax system) was somewhat different. Their results were based on a micro-unit data file of a sample of 72,000 families. This study was distinguished by the fact that in developing its assumptions about the incidence of particular taxes, it attempted to take seriously modern theoretical developments in incidence analysis, which are based on general equilibrium considerations. Specifically, one variant of incidence assumptions allocated all taxes on capital income, regardless of the statutory bearer, to property income earners in general. This is an incidence story that would emerge from a general equilibrium analysis assuming perfect mobility of capital among sectors, price flexibility, and perfect competition. A second variant of assumptions allocated the burden of the corporate income tax to stockholders in proportion to the dividends they received, and allocated the burden of the property tax on dwellings in proportion to the cash on imputed rents of households. These incidence assumptions are consistent with the view that capital is immobile among various uses.

The incidence assumptions used by Pechman & Okner are not, however, derived from an explicit theoretical framework, and thus can be internally inconsistent. For example, in discussing the incidence of the corporation income tax, they state ". . .assuming that the total supply of saving is fixed, the earnings of labor remain unchanged, and capital bears the entire tax" (p. 31). This statement is not, in general, correct within the context of the Harberger model, where the effect of a partial capital income tax on the wage rate need not be zero, and depends on the relative factor intensities of production in the two sectors, the two elasticities of substitution, and the demand substitutability.

There is no possibility of internal inconsistency when an analysis of the impact of taxes is carried out within the context of an explicit general equilibrium model, where the vector of prices assures supply and demand are equal for each market. The aim of this paper is to utilize the richness of the micro-unit data, as did Pechman & Okner, within the context of such a general equilibrium model of the effects of taxation. Before we proceed to lay out this model, we describe our approach to the imputation of some important data that is absent from our data file; this is done in Section II. Section III sets out the procedure for recovering the parameters of the expected utility function that are consistent with the household data, actual and imputed. In Section IV, we describe the general equilibrium model in which the micro-unit household data is imbedded, and describe the baseline equilibrium solution. The model is illustrated in Section V by simulating the impact of replacing the current U.S. income tax with a flat-rate system which yields the same revenue. Some concluding thoughts are offered in Section VI.

II IMPUTATION OF HOUSEHOLD INFORMATION

Each year the Internal Revenue Service (IRS) draws a large stratified random sample of income tax returns and makes the information publicly available. Thus, for each sample taxpaying unit, we have detailed information on the sources of income, the amounts and kinds of deductions and exemptions taken, marital status, state of residence, whether any household member is over 65 years of age, and other demographic information. Using a tax calculator developed at the National Bureau of Economic Research, we can calculate from this information the marginal tax rate for each household. The data base for this study is a random subsample of 459 taxpaying units taken from the IRS sample for 1977.

Unfortunately, no direct information about household portfolios is available on this data set. One approach to remedying this absence is to merge the tax return information with another data set that does have this information; an exact match would be ideal, but a synthetic match would be acceptable. This was not pursued, though, because there is no single micro-unit file which contains up-to-date information on households' complete pattern of wealth holdings. The Federal Reserve Board's Survey of Financial Characteristics of Consumers does have such information, but it refers to year-end 1962 and thus is too out-of-date to be a candidate for a merge with the tax return sample.

The approach taken in this paper is to impute the household portfolios. The imputation procedures utilize the information on the tax file containing capital income flows and other household data that conveys information about wealth holdings. These imputations also utilize econometric evidence about the determinants of wealth holdings, where relevant. In addition, the procedures are constrained to be consistent with known aggregate information about wealth holdings, which is in some cases disaggregated by income class. The goal is to construct a distribution of wealth holdings that represents the actual U.S. economy of 1977.

As is presented in detail in Section III, in the general equilibrium model household portfolio choice is based on an expected utility-maximizing framework that includes a portfolio of five assets. The assets are corporate equity, owner-occupied housing, other residential capital, tax-free bonds, and net taxable interest-bearing instruments. For the purposes of imputation the last category will be split into several assets and liabilities components. Specifically, holdings of taxable bonds, demand deposits, savings deposits, and home mortgage liabilities will be imputed separately. Specific procedures for imputing each category of asset will now be outlined.

II.A Corporate equity

The tax file contains the dollar value of dividends received for each taxpaying unit. If the dividend-price ratio was identical for all shares, it would be a trivial matter to capitalize the dividend flow into asset value. Of course, the dividend-price ratio does vary among different stocks. In fact, it is likely that that ratio varies systematically with the tax situation of the household. Shares of corporations that retain a relatively large portion of their earnings would be preferred by relatively high tax bracket individuals. Ignoring this systematic relationship by applying a constant capitalization rate to all households' dividends would, therefore, underestimate the concentration of stockholdings among the highest income earners, because income is positively correlated with tax rate.

In order to avoid this bias, we utilize the evidence collected by Blume et al. (1974) on the observed dividend-price ratios by income class in 1970. Two adjustments to their published figures are made. First, the income brackets used by Blume et al. are indexed to represent the same real income brackets in 1977. Second, each household's imputed stockholdings are adjusted proportionately so that the imputed aggregate equals the Flow of Funds entry for total corporate equity held by individuals in 1977.[4]

II.B Owner-occupied housing

II.B.1. Tenure choice. The first step in imputing the value of owner-occupied housing to households is to decide which taxpayers own a home. Non-owners will, of course, be assigned zero assets in this category.

In 1977, approximately one-half of all homeowners itemized their deductions. Identifying these homeowners is fairly straightforward. If the home mortgage interest and/or property tax deduction is present, then the household is considered to be a homeowner. This procedure relies on two assumptions. The first is that practically every homeowner pays some mortgage interest or property tax. The second is that practically all property taxes reported on Schedule A of Form 1040 (itemized deductions) correspond to homes. Property taxes on other assets, such as business or rental capital, are generally reported in other places, such as in the expenses section of Schedules C and E (which pertain to business and rental incomes, respectively).

A different procedure is necessary to identify those homeowning households that did not itemize their deductions, presumably due to insufficient mortgage interest, property tax, and other itemizable deductions. The total number of owner-occupied houses is listed by income class in the Census of Housing. Subtracting the number found to be owned by itemizers will yield the number of nonitemizing families that must have owned a house. Ownership will be assigned to this number of nonitemizing returns on the basis of estimated probabilities of ownership. Recently, much valuable work has been done on estimating the demand for housing, including the tenure choice decision, of which Rosen (1979 b) is one example. Rosen used cross-section data to estimate the probability that a family will be an owner-occupier. The tax file contains information on most of the explanatory variables used by Rosen, including income, tax price, number of dependents, and whether the head of household is elderly. Other variables such as race, sex, and other age categories are not available. Using Rosen's regression results, we estimate the probability of a household owning housing using the former set of variables, with the latter set subsumed into the constant term. As mentioned above, we can calculate how many nonitemizers owned a house in 1977; by extension, we know what percentage of nonitemizers owned. The estimated probabilities will be adjusted proportionately so that their average equals this percentage. Finally, whether any particular nonitemizing household owns housing is determined using a random process that has the (corrected) estimated probability of ownership.

II.B.2. Value of owner-occupied housing. The next step is to impute the value of housing held by the owners. Again, Rosen's econometric analysis forms the basis of our procedure. He estimated quantity of housing, using the same variables as in the tenure choice equation. Thus, we can predict the value of housing using the variables on which we have information, and include a constant term to reflect the others.

For nonitemizers, this procedure is the only one we can use. For itemizers, however, there is an alternative imputation procedure suggested by Hendershott & Slemrod (1983). The idea is that property tax payments can provide an estimate of house value. If the effective property tax rate were known for each household's municipality, tax payments could be capitalized into an accurate estimate of house value. Such information is not available. However, the state of residence of each household is known, and by utilizing information on statewide average effective property tax rates,[5] we can (with some unavoidable error) capitalize property tax payments into house value. Lacking any obvious way to combine both sources of information about the house value of itemizing households, the imputed value is the simple average of the two. For nonitemizers, the first-mentioned measure is the imputed value. All imputations are then adjusted proportionately so that the imputed aggregate value of housing stock matches the aggregate net value of owner-occupied housing for 1977, reported in Musgrave (1981).

II.C Net taxable "bonds"

Although, in reality, there are innumerable different kinds of taxable financial instruments with fixed nominal return, in the general equilibrium model used here all such assets are aggregated into a category called "bonds." Nevertheless, in the imputation stage it seems valuable to separately estimate the holdings of a few important categories of assets and liabilities, and then sum their values to arrive at a value of net taxable "bond" holdings.

II.C.1. Bonds, time deposits, and demand deposits. For each household, the tax file provides a value for interest received. This figure includes interest on securities that earn the current market rate of interest and also interest on time deposits, which in 1977 earned a lower-than-market rate of return. There is no information on zero-yielding demand deposits, whose return presumably comes in the form of economizing of transaction costs that holding wealth in this form allows. Survey evidence suggests that the ratio of time and demand deposits to short- and long-term bond holdings is larger for lower income households, and that the former is a major portion of their asset holdings. Thus, ignoring these low-yielding assets will cause an overestimation of the inequality in the distribution of wealth. The procedure outlined below is designed to avoid this error.

Using survey data, we estimate the mean and standard deviation of the holding of time and demand deposits by income class. Then, assuming that these holdings are distributed according to a truncated (at zero) normal distribution, we generate imputed values for each household by drawing from a random normal distribution of the appropriate mean and variance, and setting negative values to zero. Multiplying the estimated deposits by the average 1977 rate of interest on these accounts yields an estimate for the interest received on time deposits. Then the difference (if positive) between the reported interest and the interest received on time deposits provides an estimate of interest received on securities that yield the market return. Using an average maturity for bonds held by households, we can calculate the real value of the assets that would correspond to this flow of interest receipts. Thus, this procedure yields separate values for demand deposits, time deposits, and bond holdings.[6] These values are then summed to give the imputed value for taxable "bond" assets.

II.C.2. <u>Home mortgage debt</u>. For households that itemize their deductions, the tax file contains information on the amount of mortgage interest paid. The approach[7] to imputing the real value of itemizers' mortgage debt from current mortgage payments relies on the institutional fact that, in 1977, most outstanding mortgages were of a standard form: fixed payment and a 30-year maturity. We assume that all mortgages were of this type and that the ratio of the original loan to the house value was uniformly 0.80. Looking backward in time from 1977, an outstanding mortgage could have been issued any time between 1947 and 1977. Using the average rate of interest on mortgages issued in any of these years, the ratio of the remaining principal to the original value of the house can be calculated. If we assume that all house values have increased by the rate of price increase in the average house, we can calculate the ratio of the outstanding principal to the current house value for a mortgage issued in any year from 1947 to 1977. Multiplying this by the interest rate at issue yields the ratio of current interest payments to current house value. It turns out, though this need not be true, that the relationship between time of issue and the ratio of current interest payments to current house value is virtually monotonic. Because of this monotonicity, for any observed ratio of interest payments to house value, we can determine the time to maturity of the outstanding mortgage. Knowing the time to maturity, interest rate at issue, and the long-term interest rate in 1977 is sufficient information to calculate the real value of the remaining mortgage debt. In sum, this procedure uses the imputed house value and known mortgage interest payments to generate a value for mortgage debt.

No information on mortgage payments by nonitemizing households is available. For these households, the sum of mortgage payments and all other itemizable deductions is probably less than the applicable standard deduction.[8] This ensures that any outstanding mortgage is not large. We assume that the real value of the mortgage liability of nonitemizers is zero.

II.C.3. <u>Total "bond" holdings</u>. The imputed figure for total net taxable bonds is simply the sum of the imputed values of demand deposits, time deposits, and bonds, minus the imputed real value of mortgage debt.

II.D Non-owner-occupied residential capital

All tax returns in the sample include a value for net rent received. A straightforward procedure for obtaining the value of non-owner-occupied residential capital (real estate) is to use a common capitalization rate to convert these flows into stocks. A natural capitalization rate to choose is one that generates an aggregate imputed stock equal to the estimated aggregate from Musgrave (1981). A serious obstacle becomes immediately apparent, though. In 1977, almost as many returns (2.43 million) reported a net loss on rental property as reported a net gain (2.60 million). These negative flows cannot be sensibly converted into negative asset holdings. The approach taken here is to capitalize the absolute value of reported rental income, on the grounds that the generation of losses requires capital in proportion to the reported loss. This procedure is unsatisfactory, but no superior procedure is apparent.

II.E Tax-exempt bonds

No information on the income from tax-exempt bonds is available on the tax file. Survey evidence from the 1962 Survey of Financial Characteristics of Consumers indicates that, as expected, the predominance of these assets increases with income. This survey also indicates that not all high income households hold tax-exempt bonds and the extent of holdings varies greatly. In the light of this evidence, one possible imputation procedure is to estimate a mean and variance of tax-exempt bonds by income class and then randomly draw holdings for households. This is essentially the procedure used for imputing demand and time deposits.

This procedure, though, seems to be inadequate in this context for the following reason. It is likely that if a household in a high tax bracket does not hold tax-exempt bonds, then it is holding some alternative tax-preferred asset. Thus, to assume that households in this position are not taking advantage of the tax "shelter" would be incorrect. A more satisfactory approach is to assume that all households take advantage of tax-preferred assets to the extent it is worthwhile. This suggests an approach to the imputation of these assets which is different from those already described. We assume that the household holds that amount of tax-exempt bonds that would be predicted by the maximization of a particular expected utility function for given market rates of return, the household's tax rate, and the appropriate wealth and income constraints. This procedure is described in detail in Section III.

II.F Labor supply

Each household is assumed to supply labor completely inelastically. One natural measure of a household's labor supply in efficiency units is its wage and salary income, which is known for each household.[9] This procedure is not, however, adopted here. Because the portfolio imputation procedures do not ensure that imputed taxable property income equals actual reported property income subject to tax, using actual wage and salary income as a measure of labor supply implies that imputed taxable income will be different from actual taxable income. Furthermore, tax liability in the baseline equilibrium will be different from actual tax liability. Because the change in the distribution of tax liability is one of the critical objects of investigation in this study, we have imputed labor supply as the residual between actual taxable income and imputed taxable property income plus exemptions and deductions. The virtue of this procedure is that it guarantees that the baseline equilibrium distribution of tax liability is identical to that observed in 1977 while at the same time retaining in the baseline equilibrium the actual distribution of deductions and exemptions. If actual wage and salary income were used as the measure of labor supply, either the tax liability (and tax rate) or the amount of deductions and exemptions would have to be imputed as a residual. Because both of these last two are critical to the impact of instituting the flat-rate tax and the distribution of labor income (in this model with inelastic labor supply) is not, it was decided to calculate the latter as a residual. It is reassuring that the total and distribution of imputed labor supply are not drastically different from the observed distribution of labor income in 1977.

II.G Rental housing services

For households that do not own their own housing, a value for rental housing services consumed is needed. Our procedure for imputing this value is to utilize the regression equation for rental housing estimated by Rosen (1979 b)[10] in a manner analogous to that described above for owner-occupied housing. As with owner-occupied housing, the predicted value is adjusted proportionately to yield an aggregate value consistent with the observed U.S. total in 1977.

III PORTFOLIOS AND EXPECTED UTILITY MAXIMIZATION

III.A An expected utility maximization framework

At this stage, each taxpaying unit has assigned to it a value of wealth as well as a division of wealth into five net asset categories. We will assume that this portfolio maximizes expected utility subject to the household's income constraint and constraint on total wealth. We can write these constraints as:

$$C_i = P_L L_i + r_B B_i + r_E E_i + r_M M_i + r_N N_i - \delta_H H_i - \pi W_i - TAX(P_L L_i + r_B B_i + \gamma r_E E_i + r_N N_i - DEDEX_i) + TRAN_i \qquad (3.1)$$

$$W_i = B_i + E_i + M_i + N_i + H_i \qquad (3.2)$$

where the notation is defined as follows:

C : expected consumption of non-housing good

P_L : wage rate

L : labor supply

r_B : nominal rate of return to taxable bonds

B : taxable bond holdings

r_E : expected nominal rate of return to equity

E : equity holdings

r_M : expected nominal rate of return to tax-exempt bonds

M : tax-exempt bond holdings

r_N : expected nominal rate of return to real estate

N : real estate holdings

δ_H : rate of depreciation of housing capital

H : owner-occupied housing

W : total wealth

π : fully anticipated rate of inflation

TAX : individual income tax function

γ : fraction of equity income subject to individual income tax

DEDEX : adjustments, exemptions, and deductions from gross income to taxable income

TRAN : transfer received from the government

In expression (3.1), consumption of the composite corporate good is equal to labor income plus nominal property income minus depreciation on owner-occupied housing, the decline in the real value of assets due to inflation, and tax liability, plus transfers received from the government. Tax liability is written as a function of taxable income, which is equal to labor income, plus taxable property income minus allowable deductions and exemptions. Income from tax-exempt bonds is not included in taxable income, and only a fraction of the income from equity is included, due to the preferential tax treatment of capital gains.

In order to simplify the consumer's problem, we assume that expected utility can be written as a function of the expected consumption of the two types of goods, housing services and a non-housing composite good, and the riskiness of the income flow, measured by its variance.[11] This assumption allows us to write down relatively simple expressions for consumption and asset demands that depend on wealth, income, relative prices, and assets' expected returns and after-tax riskiness.

We further simplify by imposing a particular form on the expected utility function, one in which the risk term is separable from the two expected consumption terms and which implies constant relative risk aversion. Specifically, we assume that

$$EU_i = U_i(C_i,H_i) - \frac{\beta_i R_i}{2W_i} \tag{3.3}$$

where β_i is a measure of relative risk aversion and R_i is the after-tax variance of the income stream. In (3.3) and hereafter it is assumed that one unit of housing capital produces one unit of housing services. For the U_i function, we use the constant elasticity of substitution form. It can be written as:

$$U_i = (\alpha_i C_i^{-\mu_i} + (1-\alpha_i)H_i^{-\mu_i})^{-1/\mu_i} \tag{3.4}$$

where the elasticity of substitution between C_i and H_i is equal to $1/1+\mu_i$.

The variance of the income stream depends on the portfolio chosen and also on the risk associated with the government transfer payment. On the assumption that the returns of the risky assets (E, M, and N) are uncorrelated, the variance of the household's income stream can be approximated by[12]

$$\begin{aligned} R_i = {} & \sigma_E^2 \,(E_i(1-t_{Ei}) + s_i t_{EA} E)^2 + \sigma_M^2 M_i^2 \\ & + \sigma_N^2 \,(N_i(1-t_{Ni}) + s_i t_{NA} N)^2 \,. \end{aligned} \tag{3.5}$$

In equation (3.5) the σ^2 terms refer to the before-personal-tax variance of the return, s_i refers to the share of total transfers that is paid to household i, and t_{EA} and t_{NA} are the average economy-wide tax rates on equity and real estate income, respectively, weighted by holdings of the assets.[13]

Collecting equations (3.1) through (3.5), we can write the household's problem as:

$$\underset{C_i,H_i,E_i,B_i,M_i,N_i}{\text{Maximize}} \quad (\alpha_i C_i^{-\mu_i} + (1-\alpha_i)H_i^{-\mu_i})^{-1/\mu_i} - \frac{\beta_i R_i}{2W_i} \tag{3.6}$$

subject to

$$\begin{aligned} C_i = {} & P_L L_i + r_B B_i + r_M M_i + r_N N_i - \delta_H H_i - \pi W_i \\ & - TAX(p_L L_i + r_B B_i + \gamma r_E E_i + r_N N_i - DEDEX_i) + TRAN_i \end{aligned} \tag{3.7}$$

$$W_i = B_i + E_i + M_i + N_i + H_i \tag{3.8}$$

$$R_i = \sigma_E^2 \, (E_i(1-t_{Ei}) + s_i t_{EA} E)^2 + \sigma_M^2 M_i^2 + \sigma_N^2 \, (N_i(1-t_{Ni}) + s_i t_{NA} N)^2 \tag{3.9}$$

$$M_i \geq 0 \tag{3.10}$$

The first-order conditions of this maximization problem yield closed-form expressions for all the choice variables. As they stand, though, these expressions have certain properties that make them inadequate for our current purpose, which is to have the predicted optimal consumer choices be consistent with the imputed portfolios.

The first undesirable property of this modeling as it stands is that, in order to consume housing services, the household must own its own housing. In fact, only about 65% of households are owner-occupiers. In order to generate rental as well as owner-occupying, we assume that housing services obtained by rental (HR) are not necessarily perfectly substitutable for services obtained from owned housing (HO). The rate of substitution may be thought to depend on such things as family size and expected mobility. Thus, we can rewrite the first part of the expected utility function of expression (3.4) as:

$$[\alpha_i C_i^{-\mu_i} + (1-\alpha_i)(\theta_i HO_i + (1-\theta_i)HR_i)^{-\mu_i}]^{-1/\mu_i} \tag{3.4'}$$

where θ_i is one if the household is an owner-occupier and zero otherwise. It is assumed that the two tenure possibilities are mutually exclusive.

The price of housing services will generally differ depending on which tenure choice is made. The rental price is the same for everyone, but the price of owner-occupied housing includes the foregone after-tax interest receipts, the magnitude of which depends on the applicable tax rate. A household will prefer renting to owning housing if the relative cost advantage of renting versus owning is not outweighed by its relative preference for owner-occupation.[14] We do not inquire into the determinants of tenure choice, and take the imputed classification to be exogenously fixed.[15]

The consumer problem now has a sequential nature. First the household decides whether to own or rent housing. Then the household decides how to apportion its wealth among the available assets, which includes owner-occupied housing, if in the first stage the choice was made to be an owner. The amount of owner-occupied housing chosen in this second stage depends on its price and on the household taste parameters, α_i and μ_i. The only additional changes to be made in the foregoing description of the consumer problem is that the left-hand side of (3.7) becomes $C_i + R \cdot HR_i$ where R is the rental price of housing, and the correct interpretation of H_i in expressions (3.7) and (3.8) is HO_i, the amount of owned housing.

The remaining asset demands depend on the pattern of after-tax expected returns, the riskiness of the asset, and the measure of risk aversion, which may vary from household to houshold. However, this single varying parameter is not sufficient to generate the observed variations in the mix of risky assets held by households in the same tax situation. Moreover, it cannot explain why so many households do not hold any of a particular asset.[16]

One explanation of household differences in the mix of risky assets held is that portfolio decisions are made on the basis of subjective expectations of the return to various assets, which differ from the objective return distribution and which vary among households. Those with high subjective estimates of the return to an asset are the ones who hold it. If the distribution of these subjective evaluations is not perfectly correlated among different assets, then there will be variation in the mix of assets held.

Another possible explanation of this phenomenon is that households differ in the objective rate of return that can be earned from a particular capital investment. This argument applies mostly to real estate and less to equity and tax-exempt bonds.[17] Some people's talents are more applicable to real estate management than others', and they earn a higher return than others. A part of that return is, strictly speaking, a return to the particular talents, but for some reason it cannot be marketed separately from ownership of real estate.

In sum, households facing the same opportunity set may choose different portfolios for a number of reasons: (i) they have different tastes for owner-occupied versus rental housing; (ii) if they are owner-occupiers, they have different tastes for housing services versus non-housing goods; (iii) they have different degrees of risk aversion; and (iv) they have different subjective or objective expectations of the returns to the available assets.

Our preferred procedure draws on both of the possible explanations discussed above. First, we assume that the subjective rate of return on equity does not vary from household to household. This leaves only one free parameter in the equity demand equation, the risk aversion coefficient. Using the actual equity holdings, the equity demand equation can be solved "backwards" to yield the household's implied risk-aversion coefficient.[18] Second, we assume that households do differ in the rate of return they can (or believe they can) earn on real estate holdings. Using the risk-aversion coefficient derived from the equity equation, the real estate demand equation is solved backwards to determine the adjustment to the expected return to real estate that is consistent with the imputed holding of each household. Finally, the asset demand equation for tax-exempt securities, using the derived risk-aversion coefficient, is used to generate an imputed holding for each household.

One aspect of this procedure makes it more difficult than described above. In order to solve the equity demand equation backwards for the risk-aversion coefficient, a value for W_i (household wealth) is needed. This value is calculated as the sum of the imputed values of E_i, H_i, B_i, M_i, and N_i. A problem arises since our procedure that generates a value of M_i requires the value of β_i. Thus, the risk-aversion coefficient (β_i), M_i, and wealth (W_i) must be obtained through the backward solution of a system of three simultaneous equations.

III.B <u>Details of recovering preference parameters from household choices</u>

We begin with the demand for housing and the composite corporate consumption good. From the first-order conditions of the constrained expected utility maximization problem, the following housing demand function can be derived:

$$H_i = \frac{a_i y_i}{p_{Hi}^{\varepsilon_i} + a_i p_{Hi}} \tag{3.11}$$

where $a_i = (1-\alpha_i/\alpha_i)^{\varepsilon_i}$. In (3.11) ε_i is the elasticity of substitution between housing and the composite good and p_{Hi} is the price of housing services to household i, which is R for renters and $r_B(1-t_i) - \pi + \delta_H$ for owner-occupiers. H_i is properly interpreted as HO_i for homeowners and HR_i for renters. y_i is real income, equal to the right-hand side of equation (3.7) plus the imputed rental value of owner-occupied housing. We assume that the elasticity of substitution is the same for all households and equal to 0.5; this assumption enables us to solve (3.11) for a_i for each household.

The demand function for C_i is:

$$C_i = \frac{y_i}{1 + a_i p_{Hi}^{1-\varepsilon}} . \tag{3.12}$$

Knowing a_i, y_i, and p_{Hi} allows us to compute C_i. C_i, H_i, and α_i are sufficient to calculate U_{Ci}, the marginal utility of an expected unit of consumption, which is needed in the backward solution of the risky asset demand equations.

The asset demand equations for equity and tax-exempt bonds, respectively, are:

$$E_i = \frac{W_i U_{Ci}[r_E(1-\gamma t_i) - r_B(1-t_i)]}{\beta_i \sigma_E^2 (1-\gamma t_i)^2} - \frac{s_i t_{EA} E}{(1-\gamma t_i)} . \tag{3.13}$$

and

$$M_i = \max\left\{\frac{W_i U_{Ci}[r_M - r_B(1-t_i)]}{\beta_i \sigma_M^2}, 0\right\} . \tag{3.14}$$

Note that the second term of (3.13) reflects the covariance between the transfer received from the government and the risk from equity returns. The form of (3.14) reflects the assumption made in (3.10) that households cannot borrow at the tax-exempt interest rate.

Since our goal is to calibrate the baseline equilibrium to represent a stylized U.S. economy of 1977, we set r_B, r_M, and r_E to be consistent with rates of return prevalent at that time; specifically, we use 0.09, 0.058, and 0.12, respectively. We assume that s_i, the share of government transfers that goes to household i, is equal to the ratio of the household's adjusted gross income to aggregate adjusted gross income. Thus Σs_i is equal to one. The value of $t_{EA}E$ is the weighted average marginal tax rate on equity income, which can be calculated from imputed equity holdings and households' marginal tax rates.

Finally, E_i, M_i, and W_i are linked through the wealth identity:

$$W_i = B_i + E_i + M_i + N_i + H_i . \tag{3.15}$$

Given values of E_i, r_E, r_B, r_M, t_i, γ, s_i, $t_{EA}E$, σ_ε^2, and σ_M^2, the three equations (3.13), (3.14), and (3.15) can be solved for U_{Ci}/β_i, M_i, and W_i. Using the value of U_{Ci} obtained as described above and U_{Ci}/β_i, we can simply obtain β_i for each household.

The final step is to determine the subjective/talent factor that generates the asset demand for real estate. The asset demand function is:

$$N_i = \frac{W_i U_{Ci}[r_N(1-t_i) - \zeta_i - r_B(1-t_i)]}{\beta_i \sigma_N^2 (1-t_i)^2} - \frac{s_i t_{NA} N}{(1-t_i)} \qquad (3.16)$$

where ζ_i is the subjective/talent factor. In (3.16), all values other than r_N and ζ_i have already been determined. Calibrating the baseline equilibrium to satisfy a particular value of r_N (in this case, $r_N = 0.10$) then allows us to calculate ζ_i for each household.

IV INCORPORATION OF A GENERAL EQUILIBRIUM MODEL

Upon completion of the procedures outlined in Sections II and III, the following information is available: all of the 1040 information, total wealth, net holdings of each of five assets, and taste parameters that generate the observed portfolios from an expected utility maximization problem. The aggregate portfolio holdings are consistent with known information about economy-wide asset holdings.

The next step is to integrate this information with a general equilibrium model of taxation. Essentially, several economy-wide parameters, such as the wage rate, and the yields on the menu of assets, are determined endogenously by a system of equations that represent the equilibrium conditions. A general equilibrium model with endogenous financial behavior (GEFB) has already been developed by Slemrod (1980, 1982, 1983). This model is a generalization of the Harberger and Shoven-Whalley models, which feature a simple capital market equilibrium condition that the after-tax rates of return on all assets be equal. In the GEFB models, this is replaced by explicit market-clearing relationships for each of the several assets. Asset demands are derived from expected utility maximization by risk-averse individuals. Asset supplies may also be made endogenous.

The goal in designing the general equilibrium model to be used here was to construct a very simple model that would allow us to analyze the major aspects of tax policy proposals, and highlight the usefulness of a micro-unit data base. The model has two real factor inputs, capital (K) and labor (L), and two outputs, a composite corporate good (C), and the services from housing, which may be either owner-occupied (HO) or rented (HR). Corporate output is produced with a Cobb-Douglas production function, and housing services require only capital input. Labor is supplied inelastically. Without loss of generality, it is assumed that one unit of housing capital produces one unit of housing services.

In equilibrium all markets must clear. The market-clearing conditions of this model are:

$$\Sigma_i E_i^* = (1-b)K_c \tag{4.1}$$

$$\Sigma_i N_i^* = \Sigma_i HR_i^* \tag{4.2}$$

$$\Sigma_i M_i^* = \bar{M} \tag{4.3}$$

where an asterisk superscript indicates that the value is the optimal choice of the ith household given its income and wealth constraints. Expression (4.1) says that the aggregate demand for equity must equal its supply, which is equal to the corporate capital stock multiplied by the exogenously specified corporate equity-capital ratio (1-b). Expression (4.2) represents market-clearing for rental housing: the left-hand side is the aggregate demand for rental housing capital, and the right-hand side is the aggregate demand for rental housing services. The aggregate demand for tax-exempt bonds is set equal to the exogenous supply, $\bar{M}$, in (4.3). There is no explicit market for owner-occupied housing. Market-clearing in the markets for bonds and the composite corporate consumption good are assured by Walras' Law applied to the wealth constraint and income constraint, respectively.

The federal government purchases no goods; it merely returns its revenues, minus real payments on its debt, to households. Each household receives a fixed share, s_i, of whatever revenues are returned. We write this relationship as:

$$TRAN_i = s_i(\Sigma_i TAX_i + TAXCORP - (r_M-\pi)\bar{M} - (r_\beta-\pi)\bar{B}_G) \tag{4.4}$$

where $\bar{B}_G$ is outstanding federal government debt, taken to be exogenous.

Corporation income is subject to a flat-rate corporate income tax at rate t_c. Payments to debt-holders are deductible from taxable income, as is a depreciation allowance, δ_c^*, per unit of capital. The depreciation allowance differs from actual depreciation, δ_c, both because of historic cost depreciation and because the schedule of allowances differs from true economic depreciation even in the absence of inflation. Corporate capital income after corporation income tax is paid to either bond holders or equity owners. Thus, we can write a corporate earnings exhaustion equation in the form:

$$br_B + (1-b)r_E = f_k - \delta_c - t_c(f_k - br_B - \delta_c^*) + \pi \qquad (4.5)$$

where f_k is the gross earnings of a unit of capital. Total corporation income tax revenues are described by:

$$\text{TAXCORP} = t_c K_c (f_k - br_B - \delta_c^*) \ . \qquad (4.6)$$

Competition in factor markets and in the market for rental housing enforces the following relationships:

$$f_k = g \left[\frac{K_c}{\bar{L}}\right]^{g-1} \qquad (4.7)$$

$$P_L = (1-g) \left(\frac{K_c}{\bar{L}}\right)^{g} \qquad (4.8)$$

$$R = r_N + \delta_H - \pi \ . \qquad (4.9)$$

Equation (4.7) requires the gross earnings of capital to equal the gross marginal product of capital; (4.8) requires the wage rate to be equal to the marginal product of labor; (4.9) represents the relationship between the rental price of housing and the return to real estate.

An equilibrium for this system is a vector of expected returns for each asset, a price for rental housing services, and a portfolio allocation and consumption decision for each household, which implies aggregate totals for each asset (including the allocation of real capital). Because all consumer decisions are based on expected utility maximization, a value for expected utility can be calculated for each household.

V A SIMULATION EXPERIMENT: THE EFFECTS OF INSTITUTING A FLAT-RATE INCOME TAX

V.A A description of the policy experiment

In this section the methodology is illustrated by simulating the general equilibrium impact of replacing the 1977 income tax system with a flat-rate income tax.[19] The flat-rate system that we consider has a particularly simple form. It completely eliminates any personal exemptions, all currently itemizable deductions other than interest paid, and the standard deduction. It retains the exempt status of interest on state and local securities and the preferential treatment of capital gains. Thus, the tax base becomes adjusted gross income minus interest paid instead of (what in 1977 was called) taxable income. All of the tax base, starting from the first dollar, is subject to a constant proportional tax rate. The tax rate is chosen so that the same amount of revenue is raised under the flat-rate system as is raised under the 1977 individual income tax system.[20]

Under this flat-rate income tax system, all households with positive adjusted gross income face the same marginal and average tax rate. The impact effect (before any general equilibrium considerations) of such a tax change is to shift the burden of taxation from the wealthy to the lower- and middle-income groups. However, because the extent to which households under the current system take deductions varies widely, the impact within income groups is not uniform. Households that took extraordinary advantage of deductions under the old system may pay more tax even though their average tax rate declines, because the base on which tax is assessed goes up so much. This detailed look at the distributional impact of taxation is the virtue of a micro-unit data base.

V.B <u>The general equilibrium response</u>

The general equilibrium effects of the switch to a flat-rate tax are substantial, and tracing their impact provides some important insights. The policy change induces large portfolio shifts. For those high-income households that formerly had high marginal tax rates, the lower tax rate makes tax-favored assets such as tax-exempt bonds and equities relatively less attractive. The relative attractiveness of taxable debt and real estate increases. The marginal opportunity cost of owner-occupied housing increases dramatically, causing a flight from this asset. For those low-income households that face a higher marginal tax rate under the flat-rate system, the financial response may also be large. These households are not usually real estate owners or holders of tax-exempt securities, so their portfolio reallocation is away from nominal debt holdings toward owner-occupied housing and equity holdings. These shifts in asset demand cause changes in the assets' pre-tax rates of return and the cost of housing which, in turn, induce behavioral response. In this paper we consider only the situation when the system comes to rest at a new equilibrium position. Table 5.1 presents some summary statistics of the two equilibria.

The flat-tax rate which generates the same revenue as the baseline tax system is 0.152. With this tax rate, the tax disadvantage of holding taxable bonds (and the tax advantage of borrowing) declines;

Table 5.1 Characteristics of the Baseline and Flat-Rate Tax Equilibria

	Baseline	Flat-Rate
Expected rate of return to taxable bonds	0.0900	0.0800
Expected rate of return to tax-exempt bonds	0.0580	0.0731
Expected rate of return to equity	0.1200	0.1221
Expected rate of return to real estate	0.1000	0.0898
Rental price of housing	0.0850	0.0748
Corporate capital stock ($ billion)	1388.3	1409.2
Owner-occupied housing stock ($ billion)	1320.0	1303.1
Rental housing stock ($ billion)	395.0	391.0
Individual income tax revenue ($ billion)	184.4	184.4
(Fraction Held by Low-Income* Households)		
Total wealth	0.40	0.40
Taxable bonds	1.10	0.72
Tax-exempt bonds	0.02	0.40
Equity	0.09	0.33
Real estate	0.65	0.67
Owner-occupied housing	0.21	0.25

*Low-income is defined as having a real income in the baseline case of $20,000 or less.

the increased demand for this asset forces down its equilibrium nominal rate of return from 0.0900 to 0.0800. Conversely, the tax advantage derived from holding tax-exempt bonds drastically declines, inducing an increase in its expected nominal return from 0.0580 to 0.0731. Note that the premium earned by taxable bonds compared to tax-exempt bonds falls from 35.6% of the taxable bond yield to just 8.6%. The equilibrium expected return to equity, the income from which is partially tax-favored but not tax-exempt, does not change substantially.

The impact on the allocation of capital is not particularly large. As Table 5.1 indicates, the corporate capital stock increases by 1.4%, the owner-occupied housing stock decreases by 1.3%, and the rental housing stock decreases by 1.0%. That the change in capital allocation is not larger may seem surprising at first glance, because the opportunity cost of housing presumably increases greatly as a result of the decreased marginal tax rate. Two factors work against this intuition. First, the change to this flat-rate system does not reduce the marginal tax rate of all homeowners. In fact, it increases the marginal tax rate from zero to 0.152 for a large number of low-income homeowners, thus reducing their user cost. Second, the before-tax user cost of housing for all households declines as a result of the drop in the riskless rate of return from 0.0900 to 0.0800. This implies that the critical tax rate is 0.246: households that, in the baseline equilibrium, had a marginal tax rate lower than this experience a lower user cost; those households that had a tax rate above this face a higher cost under the flat-rate equilibrium. Though the aggregate owner-occupied housing stock is only slightly smaller under the flat-rate equilibrium, it is certainly more efficiently allocated because all households face the same user cost, while in the baseline equilibrium the price varied widely across households due to differences in marginal tax rates.[21] The fact that the rental housing stock declines even though its relative price falls is due to the decline in real income of the low-income households who tend to be renters of housing services.

Although the allocation of capital among sectors is not greatly altered, the distribution of asset ownership is very different. Table 5.1 documents the fact that, under the flat-rate system, asset ownership is much less segmented. Households with incomes less than $20,000 expand their share of equity ownership from 9% to 33%, and of tax-exempt bonds from 2% to 40%. High-income households that in the baseline equilibrium held negative amounts of taxable bonds, own 28% of taxable bonds in the flat-rate equilibrium. The low-income households expand their share of owner-occupied housing from 21% to 25%.

V.C The differential incidence of the flat-rate tax system

In this section we investigate the distributional impact of instituting the flat-rate income tax system. For two important reasons, this is not identical to simply investigating how the pattern of tax liabilities changes. First, there are distributional implications to the change in the pattern of rates of return and relative prices. For example, high-income households, which were previously induced to hold the low-yielding but tax-exempt bonds, may now hold a portfolio with a higher before-tax expected return but with a higher tax liability.[22] The second reason arises because households in this economy are risk averse. A change in the tax system may induce them to hold more or less risky portfolios. Thus, any change in tax paid may be offset by the change in the amount of risk borne. For example, a portfolio shift away from tax-preferred equity toward fully taxable bonds may be accompanied by larger expected tax payments, but may be a preferred position due to the diminished riskiness of the income stream.

As is well known, there is no unambiguously superior measure of change in welfare. In what follows, the measure used is the amount of certain real income that would have to be given to the household in the baseline equilibrium to provide a change in welfare equivalent to the change caused by the switch to the flat-rate tax system. This amount is expressed as a percentage of the household's certainty equivalent real income in the baseline equilibrium.

The second column of Table 5.2 shows the average percentage change in welfare by real income class.[23] As expected, the higher-income households experience a welfare increase, while the lower-income households are, on average, worse off. The average percentage welfare gain increases monotonically with real income. It should be kept in mind that this is a comparative equilibrium analysis. Thus it does not account for the capital gains and losses on existing assets that would undoubtedly arise in the event of a move to a flat-rate income tax. For example, tax-exempt bonds would decline in value, and their predominantly high-income owners would suffer a capital loss.

Table 5.2 Average Percentage Welfare Change and Distribution of Welfare Change, by Real Income Class

Real Income	Average Percentage Change in Welfare	Percentage of Households Whose Change in Welfare is: Less Than -10%	-5% to -10%	-5% to 0	0 to +5%	+5% to +10%	+10% to +15%	+15% to +20%	More Than +20%
$0 - $20,000	-5.5*	23.2	24.2	35.0	14.1	0	0	0	3.5
$20,000 - $50,000	+1.6	4.1	0	15.9	66.3	11.5	1.8	neg.	0.4
$50,000 - $100,000	+18.3	0	neg.	5.5	11.6	15.4	6.4	23.2	37.8
$100,000 - $200,000	+35.1	0	0	0	0	0.7	8.5	15.4	75.3
More Than $200,000	+59.2	0	0	2.1	1.1	0	0.5	0.5	95.7

*This figure does not include a small number of households whose baseline income was close to zero, yielding very large percentage changes in welfare.

neg. = negligible.

The last several columns of Table 5.2 provide information about the dispersion of the distributional impact within real income groups. For the \$0-\$20,000 income group, more than 80% of the households are made worse off, though the extent of the welfare decline varies quite a bit. Almost two-thirds of the households in the \$20,000-\$50,000 group experience a slight (less than 5%) gain in welfare, although the other one-third experience a wide range of impact. The dispersion among the \$50,000-\$100,000 group is also very large, with nontrivial numbers of households experiencing a welfare decline and also welfare increases in excess of 20%. Above \$100,000, the fraction of households with a welfare increase less than 20% decreases, although even in the highest income group some households would be worse off under this flat-rate system.

Because these simulation results rest on a very simple model of the economy, which has neither labor supply nor savings responsiveness, and also rest on a particular data imputation procedure and parameterization, the results should certainly not be taken literally as a guide to policy decisions. Nevertheless, they do indicate the additional insights that can be provided by using micro-unit data in the context of an explicit general equilibrium framework. The micro-unit data base certainly allows a more disaggregated view of the impact of a policy change, and the general equilibrium framework picks up the effect of changing prices on the distributional impact of the switch to a flat-rate tax.

VI CONCLUSIONS

The purpose of this section is to assess the potential value of a general equilibrium policy analysis that uses micro-unit data. Because this paper is only a first step in the direction of a full-fledged modeling effort, some of what is said will be speculation. As it turns out, some of the speculation could have been made before this research was begun. Hopefully, though, grappling with building such a model has produced some additional insights of value.

As of this writing, the computational cost associated with calculating an equilibrium with several thousand agents is not trivial. However, within a few years, the computational cost will likely not be an important constraint on the investigator. The enduring question, then, is whether it is worth bothering with at all, whatever the cost. The answer to this question, I think, depends on two factors: (i) the quality of the micro-unit data base and (ii) the amount of confidence we can have in the specification of the households' utility functions.

The issue of the quality of the data base is central to any use of micro-unit data, be it general equilibrium or not. The investigator is using differences in household data to make predictions about the differential impact of a policy change. The predicted dispersion in impact will be overestimated to the extent that the variations in data are due to errors in measurement. This problem is especially relevant to this study where several household variables of interest had to be imputed. Clearly, the results stated here about the differential impact of policy rest to some degree on the accuracy of these procedures. This concern, though, also applies to the numerical general equilibrium models without financial behavior, where among the key data needed are expenditures by type of good. In highly disaggregated models which feature many different goods, individual household expenditure data is the likely data base and is undoubtedly subject to substantial measurement error problems.

The other critical factor in my assessment of the potential of the technique explored in this paper has to do with the specification of households' utility functions. The standard procedure for recovering preference is to assume a particular functional form for the utility function and also a critical parameter, which is assumed not to vary across households. Then, the observed decisions of a household force the remaining parameters to take certain values. In this paper, the constant elasticity of substitution utility function is assumed to prevail with a given elasticity of substitution. Observed decisions of households then determine the remaining free parameter of the utility function. Similarly, a constant relative risk-aversion expected utility function is assumed and the risk aversion parameter is determined by observed equity holdings. The choice of different functional forms or the choice of a different set of free parameters would clearly imply a different picture about how tastes differ between individuals. For example, an alternative assumption about how preferences vary is that all households have the same share parameter (α_i) but differ in their elasticity of substitution (ε_i) between housing services and the composite corporate good. The values of ε_i could, as before, be recovered from observed consumption decisions. The implications of the distribution of taste parameters for the efficiency costs and the incidence of a tax change could, conceivably, be quite different from the implications obtained using the other procedure for determining household utility functions. Because the detailed incidence conclusions rest so heavily on the way in which household utility functions differ, the reliability of any predictions depends on reducing the arbitrariness of the specification of utility.

In spite of these caveats, the usefulness of the marriage of micro-unit data sets with computable general equilibrium clearly is unquestionable. The combination allows the analyst to trace the effects of policy on the complete range of households in the economy and at the same time can incorporate in a rigorous way the response of the economy to policy changes.

NOTES

1. See the survey by Fullerton et al. (1983).

2. Although, see Piggott & Whalley (forthcoming), where 100 different consumer types are represented in the model.

3. King (1981, 1983) has stressed the importance to policy decisions of disaggregated welfare analysis.

4. Note that no adjustment is made for the fact that dividend/price ratios actually differ among households within an income class, nor have we tried to account for any systematic underreporting of dividends. Details of this procedure are available from the author.

5. These data were obtained from the Advisory Commission of Intergovernmental Relations (1974).

6. Details of this procedure are available from the author.

7. This procedure is a more general version of the approach adopted in Hendershott & Slemrod (1983). Details are available from the author.

8. Potential itemizable deductions may exceed the standard deduction for a nonitemizing household if the household is unwilling to spend the effort required to document the deductions.

9. A more accurate measure of labor supply would include some portion of the net return to business, profession, farm, and partnership activities as an approximation to the labor input share in self-employment, plus employer contributions for social insurance programs and other fringe benefits.

10. This regression equation is not included in the published version of Rosen's paper, and was graciously provided by the author.

11. See, among others, Tobin (1958), Mossin (1969), and Feldstein (1969), for discussion concerning the mean-variance framework for portfolio choice.

12. Equation (3.5) is an approximation because it ignores the fact that in a progressive tax system with less than perfect loss offset provisions, the after-tax variance depends not just on the marginal tax rate, but on, in general, the entire schedule of tax rates.

13. See Slemrod (1982) for the derivation of this expression.

14. See Hendershott & Slemrod (1983) for a detailed discussion of the tax components of the relative price of owning, versus renting, housing.

15. Although, see Gordon & Slemrod (1983), for a numerical general equilibrium model where the fraction of households that own housing is determined endogenously.

16. The theory predicts that as long as each risky asset earns an expected premium over the riskless asset, all households should hold some of each risky asset (in the case of zero covariances among returns).

17. It would also seem applicable to capital in unincorporated enterprises, which is not treated in this study.

18. The method of "backwards" solution to obtain parameters is discussed in Mansur & Whalley (1983).

19. The parameter values for this simulation experiment are as follows: $\gamma = 0.625$, $\sigma_E^2 = 0.0304$, $\sigma_M^2 = 0.015$, $\sigma_N^2 = 0.009$, $b = 0.4$, $\pi = 0.05$, $g = 0.15624$, $t_c = 0.46$, $\delta_H = 0.035$, $\delta_c = 0.036$, $\delta_c^* = 0.004$, $\bar{M} = 3.566 \times 10^{11}$, $\bar{K} = 3.65 \times 10^{12}$, $\bar{B}_G = 1.904 \times 10^{11}$, $\bar{L} = 1.2181 \times 10^{12}$. Space constraints do not allow a discussion here of the choice of these values. See, though, Slemrod (1980) and also Gordon & Slemrod (1983) for a treatment of related parameter choice issues.

20. In the new equilibrium, the revenue raised by the corporation income tax may, though, be different from that in the baseline equilibrium.

21. See Slemrod (1982) for a discussion of the efficiency cost of differing user costs for owner-occupied housing.

22. The low return earned on tax-preferred assets may be thought of as an implicit tax. This point has been stressed by Galper & Toder (1982).

23. The classification variable is real income in the baseline equilibrium situation.

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