NEW ESTIMATES OF CAPITAL GAINS REALIZATION BEHAVIOR: EVIDENCE FROM POOLED CROSS-SECTION DATA

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Summary

In this paper we develop and estimate a behavioral model of taxpayer response to capital gains taxation. This issue is of tremendous current policy interest. In part because of the series of tax law changes culminating in the Tax Reform Act of 1986, capital gains realizations have fluctuated widely from year to year, with significant implications for federal and state tax revenues. In order to properly evaluate the likely revenue impact of the current Bush Administration proposal reducing the maximum tax rate to 15 percent, analysts must have an accurate, reliable measure of the degree to which taxpayers would increase the equilibrium flow of realized capital gains. This paper offers important new insights into this complex issue.

The econometric problem facing us is not a new one; numerous prior reports and scholarly papers have examined the capital gains response, either at an aggregate level using time-series data or at the cross-sectional taxpayer level. The two approaches are often viewed as yielding contradictory results, although U.S. Treasury Department (1988) argues that a correct interpretation of the time-series coefficients implies that they are consistent with the cross-section analyses. In any case, there is general agreement that the optimal empirical approach would exploit cross-section data from several different years.

To date, the only published research study combining cross-section data from a number of years is the panel analysis in the Treasury Department's *Report to Congress on the Capital Gains Reductions of 1978* (U.S. Treasury Department 1985). Using data on capital gains for a sample of taxpayers over the years 1973-75, the study identified a high elasticity of realizations to the marginal tax rate on long-term gains. As in that panel study, we employ several years of taxpayer data from Internal Revenue Service Statistics of Income (SOI) files to estimate our model. The distinction is that our pooled cross-section (PCS) data do not represent a series of observations on the same group

of taxpayers, but rather a set of independent observations from a larger taxpayer sample, extending over a wider time span. Since we construct dynamic measures of tax rate change from auxiliary data, we overcome the presumed weakness of pooled cross-section data vis-a-vis panel data -- the lack of information on last year's tax rate -- while retaining the relative strengths.

We recognize that development of a "non-static" -- i.e., behaviorally based -- revenue estimate for a hypothetical capital gains tax change requires knowledge of not only the elasticity of declared long-term gains, but also whether there are either direct or indirect effects of the long-term rate on other categories of income. For this purpose, our basic behavioral model is broader in scope than the models used in prior capital gains research. It divides total capital income into five categories -- long-term capital gains, interest, dividends, business income, and short-term capital gains -- which are viewed as comprising a seemingly-unrelated system of income-determination equations at the individual level.

This research is also more ambitious than earlier studies in its econometric approach. The endogeneity of so-called "last-dollar" marginal tax rates, the importance of the entire progressive tax schedule, dynamic "unlocking" of long-term capital gains, and the censored (i.e., clustered at zero) nature of the realizations variable are handled in a more sophisticated fashion. Using a multinomial logit model, we estimate behavioral parameters explaining long-term losses as well as gains within a consistent, mutually exclusive framework. As noted above, capital gains are recognized as being part of a system of jointly-determined capital income categories, thus allowing for "income switching" effects. Finally, and perhaps most importantly, our data base extends over the period 1977-85, thereby including three significantly different regimes of capital gains taxation.

As have prior researchers, we find strong evidence of responsiveness to capital gains tax rates. The coefficients in our tables show that the marginal tax rate on long-term gains has a significant and powerful negative impact both on the proportion of taxpayers realizing gains and on the value of capital gains declared by realizers. That is, despite the theoretical misgivings that many analysts have expressed, the data continue to imply that the realizations response would be sufficient to yield revenue increases from capital gains rate reductions. Employing a measure of the year-to-year change in the rate schedule to allow for unlocking effects, we find that inclusion of the variable in no way negates the long-run tax impact.

Our other primary result is that income switching in response to capital gains tax changes was not evident in our data. Whereas the own tax rates were generally valuable explanatory variables in equations for all capital income categories, the long-term gains tax rate was usually either insignificant or entered with a counterintuitive sign when added to the other income models and the business tax rate was similarly uninformative when added to the capital gains equation. Identifying the degree to which income switching does in fact take place is a potential area for further research.

In the process of estimating our model we have recognized and addressed most limitations for which earlier studies have been criticized. We specifically analyzed capital losses as well as gains. We developed an instrumental variable procedure for measuring the impact of the marginal tax rate, and relaxed prior maintained restrictions in the modeling of the censored and clustered nature of the capital gains dependent variable. We employed the rate structure premium concept to recognize the progressivity of the tax schedule. We used sample survey weights in our estimation procedures to correct for sample selection bias. We tested the use of the business, or "ordinary," tax rate as well as the long-term gains tax rate in our capital gains equations to allow for the possibility that the rate differential might be the critical price variable. Finally, we estimated equations for other capital income components to test for the presence of income switching.

The review of time-series evidence in U.S. Treasury Department (1988) concludes:

> We do not argue that our time-series regressions provide conclusive evidence on taxpayer responsiveness to capital gains tax laws. In fact, we believe that cross-section regressions, with their large sample sizes and detailed wealth and demographic detail, are the most reliable basis for inferences.

Neither this nor any other single paper can constitute definitive proof regarding the revenue impact of capital gains taxes. However, despite the reluctance on the part of many policy analysts to accept the possibility of such elastic taxpayer behavior, we believe that it should now be possible to reach consensus regarding what data and econometrics tell us about the historical evidence. First, the panel analysis in U. S. Department of the Treasury (1985) implied that the capital gains tax cuts of 1978 and 1981 were both revenue-enhancing. Second, Auten, Burman, and Randolph (1989) obtained similar results in a recent study that also used panel data. That study, using different data and a different statistical model from ours, identifies a high realizations response and simulates substantial revenue gains from hypothetical capital gains rate reductions in 1982. Thus, all three recent econometric analyses using microdata from multiple years have reached essentially the same conclusion.

It is our view that the theoretical models of taxpayer behavior are not really in conflict with the econometric evidence. It has often been argued that the realizations response can only be a temporary, stock adjustment effect, since the equilibrium flow of realized gains is necessarily limited by the flow of accruals. However, Gravelle and Lindsey (1988) point out that the vast majority of capital gains are never realized for tax purposes. On average, according to their estimates, only 3.1 percent of the stock of accrued gains was realized in any given year during the 1960-84 period. The existence of a large flow of unrealized gains should provide ample theoretical plausibility to the strong behavioral response we and others have identified.

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I. Introduction

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This research is also more ambitious than earlier studies in its econometric approach. The endogeneity of so-called "last-dollar" marginal tax rates, the importance of the entire progressive tax schedule, dynamic "unlocking" of long-term capital gains, and the censored (i.e., clustered at zero) nature of the realizations variable are handled in a more sophisticated fashion. Using a multinomial logit model, we estimate behavioral parameters explaining long-term losses as well as gains within a consistent, mutually exclusive framework. As noted above, capital gains are recognized as being part of a system of jointly-determined capital income categories, thus allowing for "income switching" effects. Finally, and perhaps most importantly, our data base extends over the period 1977-85, thereby including three significantly different regimes of capital gains taxation.

The remainder of this paper is divided into six sections. Section II discusses our behavioral model and the econometric procedures used to estimate it. Section III describes the PCS data base, while Section IV describes exploratory analysis on a subsample of the data to determine functional form. Sections V and VI present the results of the two-step estimation of the behavioral model on four additional subsamples of the data. Section VII presents simulations of the model to measure the overall responsiveness of taxpayers to tax policy and Section VIII summarizes our results.

II. Methodological Approach

In this section we briefly discuss the essential aspects of our behavioral model, of the special problems in specifying the equations in the system, and of the econometric procedures we use to estimate the parameters of the equations.

The System of Capital Income Equations. We model capital income as accruing from five sources -- interest, dividends, business income, and short and long term capital gains (including all capital gains distributions). The behavioral equations determining the amount of declared gross income from each source are assumed, in principle, to comprise a seemingly-unrelated five-equation system at the taxpayer level. The explanatory variables in each equation would include total income, the marginal tax rates on each capital income source, and a vector of demographic and locational variables. (For estimation purposes we restrict each of our equations to include at most two marginal tax rates, as discussed in Section IV below.)

This specification permits the relationship between total income and its components to be non-homogeneous. That is, the predicted share of interest in total capital income may decline as total income rises. More importantly, we test for "income-switching" behavior. We hypothesize, for example, that the coefficient of the capital gains tax rate in the dividends equation should be positive if taxpayers adjust their portfolios in response to changes in relative tax rates. With the exception of the time-series study by Cook and O'Hare (1987), previous studies of capital gains behavior have been single-equation models, estimating only the own-price effect of the long-term gains tax rate on total realized gains. It has often been suggested that the cross-price effect on other income categories would have an important offsetting effect on tax revenues. As we show below, our analysis does not support this contention.

Despite its similarity to theoretically-derived specifications for systems of production or consumer demand functions, our empirical model reflects a number of compromises between the requirements of theory and data. Ideally, we would like to model the portfolio asset choices of taxpayers, employing user costs and total wealth as determining variables. Under suitable assumptions, an underlying portfolio allocation model could be transformed to yield equations for income flows. However, like prior cross-section or panel researchers we have data only on capital income flows, not asset portfolios. Another difficulty is that the opportunity cost of capital, nominal rates of return on specific financial assets, and rate of price appreciation for equity assets are unobserved as well. Moreover, the problem is complicated considerably by the fact that capital gains are only observed when realized, not as they are accrued.

Given these data constraints, we prefer to view the income variable on the right hand side of our equations as a proxy for total wealth or permanent income, rather than as a total income constraint with accompanying adding-up restrictions for the parameters of the individual equations. In accord with this view, we will measure total income below, not as the explicit sum of the modeled components, but as the sum of positive values of the lower-level income items in our data set. This follows in the spirit of the Treasury Department's "Total Positive Income" concept.

The Logit Model of Gains and Losses. Previous researchers have had to confront the problem that capital gains realizations are heavily clustered at zero. This suggests a violation of the usual distributional assumptions underlying ordinary least square (OLS) estimation. One potential solution, employed in the 1985 Treasury report, was to employ Tobit estimation. The Tobit method is designed to estimate linear equations when the dependent variable is bounded at zero. While this procedure corrects for the violation of the OLS assumptions, it precludes the modeling of capital losses, which are excluded or recoded to zero for Tobit estimation. It also imposes a specific, and in our view arbitrary, parameter restriction on the relationship between the choice of whether or not to declare gains and the level of gains given that they are declared.

We employ a more general approach in which the i-th individual is presumed to choose among three mutually exclusive alternatives. In our case, alternative 1 is the declaration of net capital gains, alternative 2 is the declaration of net losses, and alternative 3 is the declaration of neither losses nor gains. Let us define the variable w_i, equal to j when alternative j is chosen, and let P_{ij} indicate the corresponding probability.

Corresponding to each alternative j we also have a level equation explaining the value of a continuous variable Y_{ij}:

$$(1) \qquad Y_{ij} = X_i\beta_j + u_{ij}$$

where X_i and β_j are vectors of explanatory variable values and parameters, respectively, and u_{ij} is a disturbance term. The value of Y_{ij} is observed only when w_i=j. In our application, Y_{i1} is the level of net capital gains (or the logarithm of gains) and Y_{i2} the value (or logarithm) of net losses. We thus assume separate coefficient vectors for the impacts of our explanatory variables on capital gains and capital losses, while the third level equation is degenerate: the value Y_{i3} and vector β_3 corresponding to the "no realization" alternative are normalized at zero, with no loss of generality.

The observed sample of the model is $\{w_i, Y_{ij}\}$, and the likelihood function is given by

$$(2) \qquad L_i = \begin{cases} P_{i1}f[Y_{i1} \mid w_i=1] & \text{for } w_i=1 \\ P_{i2}f[Y_{i2} \mid w_i=2] & \text{for } w_i=2 \\ P_{i3} & \text{for } w_i=3. \end{cases}$$

Implementation of this model requires first, the determination of a probability rule for choice among the three alternatives, and second, the specification of the conditional density functions f in equation (2). These decisions imply the form of the relationship between the choice among alternatives and the levels of the continuous variables. In the Tobit model, for example, the P and f distributions are not distinguished from each other. The observed values of Y_{i1} are assumed to follow a normal distribution, truncated from below at zero, while P_{i1} is the mass of that same distribution. (Since the Tobit is a binary choice model, we also must have $P_{i2}=0$ and $P_{i3}=1-P_{i1}$.)

A recent paper by Hay (1985) presents an alternate estimation technique based on multinomial logit estimation that we modify and adopt in Sections V and VI to obtain our behavioral parameters. The Hay model was designed for situations such as physician specialty choice, where each specialty is characterized by its own income equation. Estimation of the income function parameters is complicated by the self-selection of the samples; those physicians choosing a specialty are likely to be the ones most adept at earning income in that specialty. This implies that the income function must be estimated in conjunction with the estimation of a specialty choice model in order to obtain consistent coefficients. (Hay was also interested in the corollary problem of estimating the impact of specialty income on specialty choice, an aspect that is not directly relevant to our case. See also the similar model discussed by Dubin and McFadden (1984).)

Our estimation procedure is based on the familiar multinomial logit probability model, in which the probability that an individual will choose the j-th of J available alternatives is given by:

$$(3) \qquad P_{ij} = \exp(Z_i\gamma_j) / \Sigma_k [\exp(Z_i\gamma_k)]$$

where Z_i is a vector of explanatory variable values specific to the i-th individual and the γ_k's are vectors of parameters specific to each alternative. An equivalent way of specifying this probability model is to assume that the j-th alternative is chosen if the condition

$$(4) \qquad v_{ij} < Z_i\delta_j$$

is met, where v_{ij} is a (J-1) element vector of independent standardized logistic random variables and the k-th element of δ_j is equal to γ_j-γ_k.

The jointness of the level equation (1) and the choice equation (4) is implemented by assuming that u and v are correlated random variables. Without presenting the specific derivation here, we note that u_{ij} is assumed to have a conditional expectation equal to a linear weighted sum of the elements of v_{ij}. This yields an expression for the expectation of u_{ij} given that condition (4) above holds, i.e., given that alternative j is chosen and Y_{ij} is observed. In turn, this enables us to define a term Λ_{ij} which is proportional to that conditional expectation and which can be computed from the estimated probabilities P_{ij}.

Our model can be estimated in two steps. First, the standard logit maximum likelihood procedure is used to estimate the parameters γ_j. Second, the subsamples of individuals choosing each alternative are used to estimate the corresponding level equation parameters β_j. In this second step, the value of Λ_{ij} is used in the j-th equation to correct for the nonzero conditional expectation of the disturbances. This process can be thought of as an extension of the generalized Tobit models described by Amemiya (1984), modified to allow for the multi-alternative model and based on a logit rather than probit assumption regarding the probability densities.

Since the presence of positive, negative, and zero capital gains are three mutually exclusive alternatives, we estimate the impact of income, tax rates, and other variables on the probability of each outcome using the multinomial logit model. The results of this procedure are discussed in Section V. We then estimate capital gains level equations for "gainers" and "losers", including the Λ variables computed from the logit parameters to correct for least-squares bias in each equation. These results are presented in Section VI. Joint treatment of gainers and losers is important to obtain a theoretically consistent behavioral model and enable us to evaluate the total response to changes in tax policy. The simulations of taxpayer response which we present in Section VII explicitly recognize the impact of tax policy on both gain and loss behavior at the individual taxpayer level to yield meaningful estimates of total taxpayer response.

Since other capital income sources also are clustered at zero, we use the same technique for these categories as for capital gains. In the cases of interest and dividends, we need only model a binary choice model, with a single level equation, since negative values are not observed.

Tax Progressivity. We hypothesize that the declaration of capital gains is a function of, inter alia, a taxpayer's total income and his last-dollar tax rate -- the tax liability on the marginal dollar of capital gains. Under a proportional income tax system, this would be a relatively straightforward model. Tax progressivity, however, creates two distinct problems for characterizing the determination of long-term gains and other capital income levels. First, the measure of income must reflect the fact that under a progressive tax schedule the taxpayer is better off than if all income were taxed at the last-dollar rate. Second, the marginal tax rate depends on the amount of capital gains declared and so cannot be treated as an exogenous right-hand-side variable in our equations.

Prior researchers have recognized the problems created by tax schedule progressivity in the context of modeling the demand for certain tax-deductible items such as charitable contributions. These problems are also faced in other areas, such as medical care or electricity demand, where consumers face piecewise-linear rate schedules. Hausman (1985) and Moffitt (1986) provide recent reviews of the econometric literature on the issue. Various empirical techniques have been proposed, ranging widely in complexity and sophistication, to deal with the two problems mentioned in the previous paragraph. We discuss our approaches to these two problems in turn below.

The concept of what Barnes *et al* (1981) call the rate structure premium (RSP) forms the basis for our treatment of the income effects of tax schedule progressivity. In general, the marginal tax rate on the last dollar of income will be higher than the rate on the first dollar, and the econometric model used to estimate capital income declarations should incorporate this incentive aspect. Holding constant the level of a taxpayer's total income and the marginal tax rate on each capital income category, the taxpayer benefits by the lower tax rates on inframarginal income. Previous authors, beginning with Nordin (1976) in the consumer demand context, have shown that a variable measuring this benefit should have a coefficient in the behavioral equation equal to the coefficient on income.

In our application, the RSP is computed as the product of the level of income and the marginal tax rate on that income, summed over all capital income sources (i.e. the total tax paid on capital income if all capital incomes were taxed at the last-dollar rate), less the actual total tax liability. We add the RSP to total positive before-tax income in our model equations, thus imposing the theoretical parameter constraint in the definition of what Burtless and Hausman (1978) have termed "virtual income." Note that labor income is not included in the first term of the RSP, since it is assumed to be exogenous; the marginal tax rate on labor income plays no role in our model. By the same token, the RSP nets out in the second term the taxes paid on labor income as well as capital income, reflecting the fact that all income variables have been measured on a before-tax basis. A derivation of the rate structure premium used in this study is presented in Appendix A.

The endogeneity of the marginal tax rate is the problem which has received most attention in prior studies of capital gains realizations. With a progressive tax schedule, taxpayers who declare large capital gains will face higher marginal tax rates completely aside from any behavioral incentive effect. In an econometric sense, the last-dollar marginal tax rate is correlated with the disturbance term of the equation, so that OLS estimation will yield biased coefficients. Several approaches have been taken to deal with this problem, including the replacement of the last-dollar rate with the first-dollar rate or the marginal rate evaluated at some "typical" level of capital gains for similar taxpayers. By construction, virtual income is also an endogenous variable, for two reasons. First, and most obviously, it includes the dependent capital income variables as components. Second, it is adjusted for tax schedule progressivity using the RSP computed with endogenous tax rates.

Recently, sophisticated econometric procedures have been designed to estimate models in which the equation disturbance is decomposed into two components. The first component reflects heterogeneity of behavior across individuals, for example due to unobserved determining factors. The second disturbance component represents random variation, or measurement error, of the dependent variable around the value chosen by the individual. Within this framework, behavior is a function of the entire vectors of tax rates and corresponding virtual income levels, and the observed marginal rate bracket need not even be the bracket in which the taxpayer is assumed to find equilibrium. An example of this approach is found in Reece and Zieschang (1985). Although it permits a theoretically richer specification of behavior, it is impractical in our application given the other econometric difficulties discussed in this section.

In our analysis we follow an instrumental variables approach. We compute an alternative total income level implied by the taxpayer's known characteristics but independent of his actual declared capital income. As detailed in Appendix B, we derive an exogenous measure of annual income by imputing the predictions from regressions of actual capital income components on a number of exogenous explanatory variables. We then calculate marginal tax rates and virtual income corresponding to the alternative income level. As in Feldstein *et al* (1980), we employ these as instruments for the observed values, rather than as proxy variables, in our behavioral equations. This procedure corrects for endogeneity while retaining the assumption that the last-dollar rate is in fact the incentive variable to which the individual taxpayer responds, rather than a first-dollar or average rate.

Weighting for Sample Selection Bias. A final complication in estimating our model derives from the design of the Internal Revenue Service SOI samples used in our estimation. As described more fully below, high-income taxpayers are heavily oversampled, giving us good coverage of those individuals most likely to declare capital gains. Unfortunately, when the dependent variable is a component of income, this sampling procedure imparts a sample selectivity bias to estimated regression parameters.

Truncating a sample by eliminating observations on the dependent variable below a specified cutoff leads to bias in much the same way that censoring at zero creates the bias addressed by the Tobit procedure (see Hausman and Wise 1977). In the SOI data, the sampling rates vary widely with income class. The sampling probability for a typical taxpayer might be roughly 1 in 1000, but if that taxpayer declared $2,000,000 in capital gains he would be sampled with certainty. This issue was pointed out in the capital gains context by Minarik (1984), who recommended weighted regression to correct the bias. Weighting by the inverse of the sampling probability does not fully resolve the problem -- in particular, computed standard errors of coefficients remain incorrect. However, since we will not rely on parametric estimates of sampling variance, it does provide a viable correction for us. We therefore use the SOI sampling weights in all the regressions reported below.

With respect to our logit equations, the SOI data make up a "choice-based sample," in the sense of Manski and Lerman (1977). The likelihood that a given choice will be observed depends upon the alternative chosen. Again, we follow the appropriate correction by weighting individual likelihood values by the SOI sample weights.

Nonparametric Standard Errors. Several aspects of our econometric specification call into question the computed standard errors yielded by the estimation programs we employ. In the logit step, the information matrix does not reflect the fact that some of the explanatory variables are generated by auxiliary regressions on tax rate and income instruments. The level equations yield consistent parameter estimates, but the disturbance terms are heteroskedastic by construction. Finally, as noted above, the use of sample weights to correct for selection bias is not reflected in the equation standard errors. Fortunately, however, our data base is sufficiently large that we can estimate our entire model separately on four independent subsamples. The means of the four sets of coefficient vectors can be used as our final parameter estimates, and one-half the standard deviations in the estimates provide nonparametric estimates of their accuracy.

III. The Pooled-Cross-Section Data Base

Taxpayer Files. The data base available for this research is an aggregate of four large cross-sectional taxpayer samples drawn from Internal Revenue Service SOI files. The construction and attributes of the annual SOI files are described in Internal Revenue Service (1986). The Office of Tax Analysis maintains subsamples of the SOI files for analytical use, and we employed four of these "production" files here.

For present purposes, the primary characteristic of this data set is its intensive coverage of high-income filing units. The files are drawn as stratified samples, with a sampling rate of unity for taxpayers with incomes above specified cutoffs (typically $2,000,000) and/or who file particular forms (such as Schedule C, for proprietorship income). As a result, we have unusual potential for accurate modeling of the types of individuals who are most likely to accrue and declare long-term capital gains and other types of capital income.

Because the data come from income tax returns, we have detailed information on the composition of both labor and, most importantly, capital income. We can therefore identify the determinants of tax liability, and marginal tax rates, much more accurately than would be possible with most other household survey data bases. On the other hand, SOI data provide little direct demographic information other than that which can be inferred from filing status and exemptions taken. That is, we can identify married, blind, and over-65 taxpayers, along with the number of dependents, but we have no information on education, work experience, or asset holdings.

The principal weakness of a cross-sectional file, for the purpose of capital gains modeling, is that virtually the only variation in tax rate is across taxpayers facing the same rate schedule. That is, it is difficult to establish a tax rate effect independent of the impact of taxable income or other variables correlated with income. We avoid this problem in two ways. First and most important, we use several independent cross-sections, each characterized by a different set of rate schedules. Second, we incorporate state income tax rates into the analysis.

Two milestones in the recent history of capital gains taxation were the Revenue Act of 1978 and the Economic Recovery Tax Act of 1981 (ERTA). The former law, by increasing the long-term gains exclusion from 50 to 60 percent, sharply reduced the tax rate on gains relative to other income for most taxpayers. In particular, the maximum statutory rate on gains dropped from 35 to 28 percent. ERTA reduced this maximum further, by lowering the top rate on all income to 50 percent. After 1981, the general federal tax rate schedules continued to move downward each year through 1984, although the top rate remained at 50 percent (20 percent for long-term gains). Indexation of schedules by the Consumer Price Index began in 1985, the last year of our sample.

Our PCS data base was designed to span the three general tax regimes indicated above, by analyzing the years 1977, 1979 (following the effective date of the 1978 Revenue Act), 1983 (following ERTA), and 1985. The remaining odd-numbered year, 1981, was characterized by an ambiguous incentive structure: the maximum effective tax rate changed in the middle of the year, and it is unclear when the rate change was fully anticipated by taxpayers for planning purposes. (See Slemrod and Shobe (1989) for one attempt to construct a marginal tax rate variable for 1981 taxpayers.) Further, with the passage of ERTA many taxpayers -- though not those with very high incomes -- knew with certainty that rate schedules would fall sharply again in 1982, potentially affecting their realizations behavior in a way that would be difficult to model. With 1981 therefore excluded from study, our taxpayer sample sizes by year are:

1977 - 74,763
1979 - 72,035
1983 - 81,806
1985 - 88,725

Our model focuses on the relationship between permanent income and the current realization of capital income. If the representative taxpayer's transitory income fluctuates widely from year to year, he or she may pursue an aggressive strategy of declaring gains only when taxable income and hence marginal rates are low. Without carefully designed estimation procedures, coefficients might tend to exaggerate the long-run response of realizations to tax rates.

Our instrumental variable procedure, however, specifically addresses this problem. Our income instrument includes the measured level only of labor income, and transitory fluctuations in labor income are presumably not sufficiently important to be of major concern. For the capital components, we use predicted values of income which are independent of year-to-year fluctuations at the individual level. Although ideally we could observe and use the level of transitory income, it should not be correlated with any of our included variables, and so its absence should not bias our results.

The other dynamic issue often raised in the context of capital gains behavior is the "unlocking" effect. If we observe a sample of taxpayers in the years immediately preceding and following a tax reduction, for example, we may overestimate the long-run realizations response if there is a one-time unlocking of a backlog of accrued gains at the new, lower rate. There is clear theoretical plausibility to this scenario, and there is obvious evidence of anticipatory unlocking behavior in particular episodes such as in the months just prior to the effective date of the Tax Reform Act of 1986. Surprisingly, econometric time series studies have yielded surprisingly little evidence of a systematic effect of lagged tax rates on current realizations (cf. Congressional Budget Office (1988) and U. S. Department of Treasury (1988)).

We also address this issue directly, by constructing a measure of the degree to which the capital gains rate changed from the previous sample year. This variable is constructed from unpublished annual data on effective marginal tax rate by AGI class developed for Congressional Budget Office (1988) and graciously provided by Larry Ozanne. We compute for each sample taxpayer the absolute difference between the current-year effective rate for his AGI class and the prior-year effective rate corresponding to the same level of real AGI. For example, this procedure yields a rate change of -7.03 percentage points for a taxpayer with an AGI of $150,000 in 1979, the year following the Revenue Act. This compares to no change in tax rate in 1985 for a taxpayer at $300,000, who continued to face the ceiling 20 percent rate.

We thereby obtain a quantitative measure of the unlocking incentive without the need for multiple observations on the same taxpayer. Because the change in effective rate is specific to AGI class, and because AGI is an endogenous variable in our model, we compute a second rate change variable based on our exogenous measure of AGI described earlier and in Appendix B. The exogenous estimate of effective tax rate change is then used as an instrument in estimation.

It is often contended that panel data are necessary to adequately treat the dynamics of capital gains realizations behavior. Our treatment of behavioral dynamics allows us to obtain the same richness of model using pooled cross sections and, at the same time, frees us to examine a time period with a far more varied history of tax policy than that for which panel data are currently available.

Tax Calculator Programs. We computed federal marginal tax rates and total tax payments for our sample taxpayers using the OTA's Individual Income Tax Simulation Models (Cilke and Wyscarver 1987). A separate simulation model is available for each of our four sample years. The programs are ordinarily used to compute taxable incomes and liabilities under hypothetical tax regimes. In this application, we incremented each of the various categories of capital income in turn to determine marginal effective tax rates for each sample taxpayer. This process is more precise than the simple capture of the statutory marginal rate at a particular taxable income level. Obviously, the long-term gains rate differs from the statutory rate because of the 50 or 60 percent exclusion. Just as important, the true effective rate may lie below the statutory rate due to, for example, tax credits or the alternative minimum tax rules. Alternatively, the effective rate may exceed the statutory rate because of such factors as the taxation of social security income or income-dependent floors on Schedule A deduction items. With respect to long-term gains, the effective rate will depend also on the presence or absence of short-term capital gains or losses.

In a similar, though somewhat more rudimentary fashion, we calculated state marginal tax rates and tax liabilities using a set of state tax calculators based on programs developed by the Office of Tax Analysis. State systems differ in many ways besides having unique income tax rate schedules. Most obviously, several states have no income tax at all. Others tax only interest and dividends, and some states granted no exclusion for long-term capital gains during our period of study. The state tax calculators reflect these and other special treatments of income and/or deductions.

Both the federal and state programs determined the additional tax generated by successive increments of $100 in dividends, interest, business income, short-term capital gains, and long-term gains. To avoid having the dividend exclusion distort the marginal rates, we assumed that taxable dividends are incremented by $100. The interest, dividend, and business calculations all yield the same result at the federal level, roughly what would be considered the "ordinary" capital income tax rate. (Personal services income was taxed at a special maximum rate of 50 percent prior to 1981.)

The first panel of Table 1 presents mean last-dollar federal and state marginal tax rates by year and capital income category, with the rates for sample taxpayers weighted by the SOI sampling weights (but not by dollars of income). The table shows the decline in the long-term capital gains rate following the Revenue Act of 1978, while the tax rate on, for example, business income was rising due to bracket creep. In 1983 and 1985, following ERTA, the federal rates on both capital gains and business income were both somewhat lower than in 1979.

In the second panel of the table, we display the rates applicable to taxpayers with actual Adjusted Gross Income levels above $200,000. For this group of taxpayers the decline in the last-dollar long-term capital gains rate was matched by large reductions in federal marginal rates for the other capital income categories, due to ERTA's reduction in the top statutory rate from 70 to 50 percent. Interestingly, no such trend is evident at the state level.

We combined the federal and state rates into a total effective tax rate recognizing that for taxpayers who itemize deductions on their federal returns, the deductibility of state taxes implies that the total effective rate is less than the sum of the two components. Our procedure also accounts for the different rules regarding deductibility of federal taxes on state tax returns.

IV. Exploratory Analysis

We estimated our model in two stages. First, we used a 10 percent subsample of our data to address a number of functional form questions. (The full four-year subsample has 30,791 observations, including 12,668 with capital gains after carryover and 2,517 with losses.) This approach allowed us to make decisions on which variables to include in our analysis without "mining" the data actually used to estimate our model. In the second stage, we estimated the model selected in our exploratory analysis on four additional 10 percent subsamples. The use of four subsamples allows us to estimate nonparametric standard errors for the parameters of our model, as well as our simulated measures of taxpayer response.

Our exploratory analysis focused on three questions: (1) is the realization of a particular type of capital income sensitive to the tax rate on other types of capital income; (2) what is the best tax rate measure to use in the model; and (3) is the model sensitive to the inclusion of dummy variables for tax year.

The first question addresses the theoretical "income-switching" issue discussed in section II above. In the only previous study to address this question, Cook and O'Hare (1987) included the differential between the maximum capital gains and ordinary tax rates as an additional regressor in time-series equations explaining long-term capital gains and the sum of interest and dividends. The coefficient on this variable was insignificant and of the a priori wrong sign in the gains equation, but significant in the dividends and interest equation. However, Jones (1989) recently discovered that this latter result was an artifact of the errors in computing the dependent variable and the exclusion of a price deflator. Thus, prior analyses have not found evidence of income-switching behavior.

We tested for cross-price effects by adding the business income tax rate to the long-term capital gains equations (both logit and level) and the long-term gains tax rate to the equations for each of the other types of capital income. Although the existence of important income-switching effects has great theoretical plausibility, we also found little evidence consistent with this hypothesis. The coefficients on the cross price terms had the a priori incorrect sign in more than half the cases, and the estimated own price coefficients were very sensitive to the inclusion of the cross price term. For instance, in the long-term gains logit equation, the coefficient on the business tax rate was -.057 with an asymptotic standard error of .017. The coefficients on the two tax rate variables were highly correlated, and the major impact of including both terms was to distribute the total tax rate effect between the two coefficients in a manner which had no theoretical justification. In what follows we include only the own price term, and feel that it is appropriate to interpret the coefficient on this variable as the net effect of the tax change.

Most previous studies of taxpayer response to capital gains tax rates have used either the level of the tax rate or the logarithm of the "you-keep-it" rate, i. e., the logarithm of 100 minus the tax rate, as the tax rate variable. Each of these choices yields a function in which the elasticity of realizations with respect to the tax rate increases with the tax rate, a desirable property on a priori grounds. We tested both variables and found that the level of the tax rate had higher explanatory power in all cases, although the differences were small and the implications of the two models were essentially identical. Because of its slightly better explanatory power, we used the level of the tax rate, but this was obviously not a crucial decision.

One of the benefits of pooled cross-section data is that tax rates vary across tax regimes as well as across individuals. Given this fact, we were hesitant to include year dummies in the estimated equations, thereby purging the tax variable of its interyear variation. (In addition, exclusion of year dummies greatly simplifies estimation of the logit models. In a three-alternative model, it reduces the number of parameters by six, and the CPU time required for estimation on Treasury's VAX 8800 system by over four hours.) Despite this reluctance, we tested whether inclusion of year dummies would seriously alter the implications of our analysis. In several of our equations, year dummies significantly increased explanatory power, but their only qualitative impact on our results was to slightly *increase* the estimated responsiveness of realizations to the tax rate. In order to preserve the interyear tax rate variation in our data and reduce computer time requirements, we excluded year dummies from our analysis.

After making these decisions on model formulation, we proceeded to the next stage of our estimation procedure. In section V we will discuss estimation of the logit choice equations, and in section VI we discuss estimation of level equations conditional on choice.

V. Logit Maximum Likelihood Estimation

We assume that recipiency of long-term capital gains can be analyzed using a multinomial logit model, with three alternatives corresponding to the sign of net long-term gains after carryover. Using this model we estimate two parameter vectors β_1 and β_2 representing the effects of several independent variables on the probability of declaring long-term gains and long-term losses, respectively, relative to the third alternative of having neither losses nor gains. Numerically, the value of each coefficient in β_j measures the impact of a unit change in the associated explanatory variable on the logarithm of the ratio P_{ij}/P_{i3}, what is termed the log-odds of alternative j relative to alternative three.

For this analysis, we estimated the logit model using four 10 percent subsamples of our data. The table on the next page summarizes frequencies of recipiency in the subsamples for each of the capital income categories analyzed. (Total sample sizes are not identical because within each subsample taxpayers filing for other than the current year were deleted.) In addition to a constant term, the independent variables in the model are the logarithm of income and the squared logarithm of income, dummy variables for married taxpayers and for taxpayers aged 65 or over, number of dependents, and the own marginal tax rates.

The income variable is measured as total virtual income. As discussed in Section II, it can be viewed alternatively as a total net income constraint or as a proxy for permanent income. Computationally, virtual income consists of the sum of all positive components of income plus the value of the rate structure premium. The RSP, in turn, is defined as the inner product of income and marginal tax rates for the five capital income categories, less total income tax paid. We measure virtual income in thousands of 1982 dollars, using the National Income and Product Accounts personal consumption expenditures deflator to derive the constant-dollar figure.

Sample Sizes and Frequencies of Recipiency

	Subsample			
Sample Partition	1	2	3	4
Total Sample	30,816	30,837	30,845	30,804
Long-term Gains	13,111	13,134	13,090	13,165
Long-term Losses	2,514	2,547	2,530	2,492
Business Profits	13,307	13,369	13,314	13,307
Business Losses	9,961	9,873	9,890	9,920
Short-term Gains	3,840	3,863	3,772	3,793
Short-term Losses	4,408	4,534	4,520	4,469
Dividends	17,041	17,077	16,930	17,050
Interest	26,386	26,356	26,378	26,299

We adopted the instrumental variables approach in our logit estimation as well as in the subsequent level equation step. We regressed the marginal tax rate variable and the virtual income variables, which were defined using actual marginal tax rates and capital income levels, on the exogenous explanatory variables in the model and on a set of instruments. One of the instruments for each equation was the own tax-rate instrument derived in Appendix B. The others were the logarithm and squared logarithm of an exogenous income variable, defined as total labor income (including wages, salaries and pensions), plus the regression-based capital income imputations described in Appendix B, plus the RSP based on the instrument income and tax rate vectors. The predictions from these auxiliary regression equations then became the tax and income variables actually used in the logit equations.

Table 2 presents parameter estimates for the multinomial logit model of long-term capital gains recipiency. The coefficients in Table 2 are maximum likelihood estimates, obtained using a program developed by Kimberly Zieschang based on the Kalaba-Tesfatsion-Wang table algorithm for semi-automatically computing analytical derivatives. The parameter estimates reported here are the average of the parameters from the four subsamples. The standard errors are simply one-half of the standard deviation of the subsample estimates, i. e., the standard error of the mean in a sample of size four.

The reported parameter results in Table 2 are substantially in line with expectations. Capital gains and losses are both significantly more likely for households with taxpayers or spouses aged 65 or over, and both probabilities are negatively related to the number of dependents. Married taxpayers are more likely to declare gains. Gains and losses are also found to be positively related to virtual income over most of the observed income range.

Turning to the coefficients of most interest, declaration of long-term gains is negatively associated with the marginal tax rate on gains, as theory predicts. The estimated tax rate effect is important; it implies, for example, that for a typical taxpayer a percentage-point decrease in the marginal tax rate would raise the probability of declaring gains from 7.6 percent to 8.9 percent. On the other hand, the capital gains tax rate also is estimated to have a significant, though smaller, negative effect on declaring losses. We might conclude from this that the tax rate on gains works primarily through the incentive to hold capital assets, which can generate either gains or losses.

Table 3 reports on parallel logit model estimation for the four other capital income categories. The set of independent variables and instruments is identical. Again, most of the coefficients in the table are plausible in sign. All of the own tax rate effects except that for interest are negative, and all have t-statistics greater than two. That is, the likelihood of income recipiency (and loss declaration in the case of business income and short-term gains) is in all but one case found to be negatively related to the marginal tax rate.

VI. Level Equation Estimation

The final step in our econometric analysis is instrumental-variables estimation of long-term capital gains and other capital income equations separately for the samples of taxpayers with gains and taxpayers with losses. The coefficients in these equations show the effects of explanatory variables on the levels of gains and losses *conditional* on the mix of recipiency. The results of the logit equation are used to construct additional regressor variables, which we refer to as Λ and which, under the assumptions of our model, should be proportional to the expected value of the equation residuals. The inclusion of these variables is designed to correct for the censored nature of the dependent variable in each equation.

For the three-alternative model used for long- and short-term gains and business income, the term Λ is defined by:

$$(5) \qquad \Lambda_i = (2/3)\log(P_{i1}) + (1/3)\log(P_{i2})[P_{i2}/(1-P_{i2})] + (1/3)\log(P_{i3})[P_{i3}/(1-P_{i3})]$$

for gains and

$$(6) \qquad \Lambda_i = (2/3)\log(P_{i2}) + (1/3)\log(P_{i1})[P_{i1}/(1-P_{i1})] + (1/3)\log(P_{i3})[P_{i3}/(1-P_{i3})]$$

for losses, where the i subscript refers to the taxpayer and the second subscript indicates the gain, loss, and zero alternatives, respectively. When there are only two states, as for interest and dividends, we define recipiency as the first state and compute Λ as:

$$(7) \qquad \Lambda_i = [P_{i1}\log(P_{i1}) + P_{i2}\log(P_{i2})] / P_{i1} \quad .$$

Two specifications of the long-term capital gains and losses equations are shown in Table 4. The explanatory variables, and their associated instruments, are the same as those in the logit equations, except for the inclusion of three dummy variables for regional location and, in one of the specifications, the disturbance expectation term Λ. The latter variable is endogenous because the probabilities P_{ij} are computed using actual values of the logit explanatory variables. The instrument for Λ uses the same formula evaluated with predictions from the auxiliary tax rate and income regressions.

The dependent variable in the equations reported in Table 4 is the logarithm of (the absolute value of) long-term gains after carryover (in thousands of deflated dollars). As discussed above, the tax rate on capital gains enters linearly on the right-hand-side. The parameters in the gains equation are consistent with expectations: the level of gains increases, at an increasing rate, with the level of virtual income and decreases with the level of the tax rate. The coefficient on Λ is insignificant but its inclusion does have an impact on a number of the other coefficients. The most notable is the coefficient on the marginal tax rate, which is reduced by more than 25 percent when Λ is included. Including Λ in the losses equation also has a seemingly important effect on the coefficient on the marginal tax rate, which is insignificant and less than half as large with Λ included as it is with Λ excluded. Comparison of these seemingly inconsistent results demonstrates how important it is to recognize that the effects of all these variables, including the marginal tax rate, are also incorporated in the coefficient on Λ.

It follows from equations (5) and (6) that Λ is a nonlinear combination of most of the other variables in the level equation (the exceptions are the regional dummies, which were excluded from the logit equation to reduce computational expense). While the purpose of including Λ was to correct for censoring bias, it may also simply act to permit estimation of a nonlinear relationship in the level equation. In any case, the estimated marginal effect of, for example, the dummy variable for age 65 or over on the conditional level of gains is a function not only of its own coefficient but also of the coefficient on Λ.

What appears to be inconsistency between the two specifications disappears when the full effect of an independent variable -- through its own coefficient and the coefficient on Λ -- is evaluated. Evaluated at sample means, the elasticity of expected gains (losses) with respect to the marginal tax rate, conditional on recipiency status, is -1.62 (-0.43) when evaluated with the equation including Λ and -1.52 (-0.54) when evaluated with the equation excluding Λ. Furthermore, the variation in the elasticity with the level of the marginal tax rate is very similar in both equations.

Whether the coefficient on Λ represents correlation in the errors of the level and choice equations or the fitting of a somewhat more nonlinear relationship between the independent and dependent variables is open to question. What is not open to question, however, is that the two specifications have similar implications for the relationship between the dependent and independent variables, even in those cases where the coefficient on Λ is large and significant. Since the specifications without Λ are easier for the reader to interpret, we report those specifications in the remainder of this section; the specifications with Λ included are reported in Appendix C.

Table 5 displays level equation estimates for the other income categories. As with capital gains, the signs of the coefficients are almost all in line with expectations. All of the own tax rate coefficients are negative. Interestingly, however, the coefficients on dividends and interest are small relative to the coefficients on long-term gains and business income. This might reflect the fact that taxpayers have substantially more discretion over the levels of gains and business income realized than they do over either dividends or interest income. The relatively large negative coefficient on the marginal tax rate in the short-term losses equation may at first seem anomalous. However, this may reflect the fact that short-term losses are more prevalent than short-term gains, and they are often written off against long-term gains.

VII. Simulations of Realizations Elasticities

The nonlinear modeling of gains and losses, the interactions between long-term gains and other capital income, and the two-step choice-level specification make it difficult to infer the aggregate quantitative response of net capital gains to tax rates simply by reference to coefficient values. Any specific proposal to alter the tax schedule by way of, for example, a capital gains exclusion or rate cap would have a unique immediate impact on each taxpayer's marginal tax rate and rate structure premium. These values would be further altered as the taxpayer adjusts his or her realizations and moves to a new equilibrium. Our parameter estimates could be used for this policy simulation, using a sample of taxpayer records that reflects current levels of incomes and tax rates. The time pattern of response would depend on the coefficients both of the "permanent" tax rate and the tax rate change from the prior year.

In this paper we do not attempt such an ambitious task, given the demands for a more current simulation. Instead, we provide an heuristic, but quantitative summary of the implications of our model by simulating the marginal effect of a small change in the tax treatment of long-term gains. For this purpose we employ the four subsamples of taxpayers used to obtain our final model estimates. This enables us also to evaluate the sensitivity of our simulation results to the data and parameter values used.

Specifically, we compute the long-run effect of increasing each taxpayer's marginal tax rate on long-term gains by one percent -- for example, from 20 percent to 20.2 percent. For convenience, we assume that the taxpayer remains in the same rate bracket and that his inframarginal rates are unaffected, so that the rate structure premium remains the same.

Based on the coefficients from the logit equations, we compute the predicted probabilities of declaring capital gains and losses. The predicted level of net long-term gains is obtained by multiplying these probabilities by the conditional expected values of gains and losses from the level equation estimates, then subtracting the taxpayer's expected losses from expected gains. We repeat this process at the alternative tax rate values to yield the predicted proportional change in net gains. Finally, we compute the predicted change in gains as the product of the predicted proportional change and the taxpayer's base level of actual net gains. (The use of actual, rather than predicted, gains in the last step is a convenient means of "calibrating" the simulation, given that in this model with nonlinear disturbance terms total expected gains in the sample will not equal total actual gains.)

The impact of a rate change can be decomposed into two parts: the effect on the probability of recipiency of gains (losses) and the effect on the level of gains (losses) conditional on recipiency. The latter effect can be further decomposed into the component due to the tax rate coefficient and the component resulting from the coefficient on Λ, which is itself affected by the change in the tax rate. As we noted in the previous section, our estimated equations with and without Λ included are more similar in their implications than their estimated parameters would seem to imply, since the Λ coefficient reflects impacts which in its absence would be imputed to the other included explanatory variables directly. To demonstrate this, we simulated the response elasticity using both forms of the level equations for capital gains and losses on our sample of taxpayers for 1985.

The table on the next page shows the simulated elasticity of net capital gains using the four subsamples of data (and the four associated sets of parameter values) and the level equations with and without Λ. All eight simulations imply a very strong realizations response. The long-run elasticity of long-term gains, net of carryover, is simulated to be approximately 4.3 (without Λ) or 3.8 (with Λ).

We emphasize that these are only point estimates. They should not be interpreted as implying that long-term gains would actually fall by four percent, for example, in response to a one percent decrease in statutory rates. As realizations increase in reaction to a lowering of the tax schedule, some taxpayers would move into higher marginal rate brackets, damping the response implied by our point elasticity estimates. Other taxpayers, subject to the alternative minimum tax before and after the tax law change, might remain in equilibrium with both their marginal tax rate and realizations unaffected. (This is likely to be especially important for high income taxpayers during our sample period.) In general, the impacts on total realizations, average effective tax rates, and total capital gains revenues would depend on the complete set of provisions of the particular tax policy change. The appropriate conclusion to draw is that, given these simulated point elasticities, a more complete policy simulation of our model would certainly show capital gains rate reductions to be revenue-enhancing.

Simulated Realizations Elasticities

	Specification	
Subsample	Without Λ	With Λ
1	-3.8	-3.2
2	-4.2	-4.6
3	-4.0	-2.7
4	-5.3	-4.6
Mean	-4.3	-3.8
(Std. Dev.)	(0.7)	(1.0)

VIII. Implications of the Results

As have prior researchers, we find strong evidence of responsiveness to capital gains tax rates. The coefficients in our tables show that the marginal tax rate on long-term gains has a significant and powerful negative impact both on the proportion of taxpayers realizing gains and on the value of capital gains declared by realizers. That is, despite the theoretical misgivings that many analysts have expressed, the data continue to imply that the realizations response would be sufficient to yield revenue increases from capital gains rate reductions. Employing a measure of the year-to-year change in the rate schedule to allow for unlocking effects, we find that inclusion of the variable in no way negates the long-run tax impact.

Our other primary result is that income switching in response to capital gains tax changes was not evident in our data. Whereas the own tax rates were generally valuable explanatory variables in equations for all capital income categories, the long-term gains tax rate was usually either insignificant or entered with a counterintuitive sign when added to the other income models and the business tax rate was similarly uninformative when added to the capital gains equation. Identifying the degree to which income switching does in fact take place is a potential area for further research.

In the process of estimating our model we have recognized and addressed most limitations for which earlier studies have been criticized. We specifically analyzed capital losses as well as gains. We developed an instrumental variable procedure for measuring the impact of the marginal tax rate, and relaxed prior maintained restrictions in the modeling of the censored and clustered nature of the capital gains dependent variable. We employed the rate structure premium concept to recognize the progressivity of the tax schedule. We used sample survey weights in our estimation procedures to correct for sample selection bias. We tested the use of the business, or "ordinary," tax rate as well as the long-term gains tax rate in our capital gains equations to allow for the possibility that the rate differential might be the critical price variable. Finally, we estimated equations for other capital income components to test for the presence of income switching.

The review of time-series evidence in U.S. Treasury Department (1988) concludes:

> We do not argue that our time-series regressions provide conclusive evidence on taxpayer responsiveness to capital gains tax laws. In fact, we believe that cross-section regressions, with their large sample sizes and detailed wealth and demographic detail, are the most reliable basis for inferences.

Neither this nor any other single paper can constitute definitive proof regarding the revenue impact of capital gains taxes. However, despite the reluctance on the part of many policy analysts to accept the possibility of such elastic taxpayer behavior, we believe that it should now be possible to reach consensus regarding what data and econometrics tell us about the historical evidence. First, the panel analysis in U. S. Department of the Treasury (1985) implied that the capital gains tax cuts of 1978 and 1981 were both revenue-enhancing. Second, Auten, Burman, and Randolph (1989) obtained similar results in a recent study that also used panel data. That study, using different data and a different statistical model from ours, identifies a high realizations response and simulates substantial revenue gains from hypothetical capital gains rate reductions in 1982. Thus, all three recent econometric analyses using microdata from multiple years have reached essentially the same conclusion.

It is our view that the theoretical models of taxpayer behavior are not really in conflict with the econometric evidence. It has often been argued that the realizations response can only be a temporary, stock adjustment effect, since the equilibrium flow of realized gains is necessarily limited by the flow of accruals. However, Gravelle and Lindsey (1988) point out that the vast majority of capital gains are never realized for tax purposes. On average, according to their estimates, only 3.1 percent of the stock of accrued gains was realized in any given year during the 1960-84 period. The existence of a large flow of unrealized gains should provide ample theoretical plausibility to the strong behavioral response we and others have identified.

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Table 1

Marginal Tax Rates by Income Category
Weighted Means In Percent

Year	Category	Long-term Gains	Business Income	Short-term Gains	Dividends & Interest
		All Taxpayers			
1977	Federal	9.0	18.2	17.7	18.2
	State	1.8	3.1	3.0	3.3
1979	Federal	7.8	19.5	19.2	19.5
	State	1.6	3.2	3.1	3.3
1983	Federal	7.5	18.4	18.1	18.4
	State	1.6	3.2	3.2	3.4
1985	Federal	7.4	18.2	17.8	18.2
	State	1.6	3.2	3.2	3.4
		AGI over $200,000			
1977	Federal	28.6	64.1	48.7	64.1
	State	2.9	5.0	4.2	5.4
1979	Federal	25.4	62.1	50.3	62.1
	State	2.3	4.8	4.2	5.1
1983	Federal	19.1	45.1	36.7	45.1
	State	2.6	5.2	4.5	6.0
1985	Federal	19.2	45.4	38.1	45.4
	State	2.9	5.4	4.9	6.4

Table 2

Estimated Choice Equation Parameters
Long-Term Capital Gains

Explanatory Variable	Gains	Losses
Log of Virtual Income	-1.062	-0.749
	(-7.74)	(-2.30)
Square of Log of Virtual Income	0.501	0.439
	(47.46)	(14.80)
Marginal Tax Rate	-0.178	-0.099
	(-10.06)	(-5.32)
MTR Change	0.096	0.194
	(3.07)	(4.86)
Age 65 or Over	1.122	1.289
	(11.80)	(13.27)
Married	0.366	-0.262
	(4.27)	(-1.47)
Dependents	-0.138	-0.101
	(-6.47)	(-3.63)
Intercept	-2.270	-4.570
	(-13.48)	(-12.50)

Note: Nonparametric t-statistics in parentheses

Table 3

Estimated Choice Equation Parameters
Other Income Categories

	Business		Short-term			
Explanatory Variable	Profits	Losses	Gains	Losses	Dividends	Interest
Log of Virtual Income	-1.341	-1.042	-0.044	-0.099	-1.393	-1.453
	(-19.28)	(-4.84)	(-0.19)	(-0.67)	(-22.85)	(-11.44)
Square of Log of Virtual Income	0.519	0.432	0.509	0.505	0.502	0.484
	(32.55)	(30.87)	(37.66)	(124.95)	(62.59)	(39.99)
Marginal Tax Rate	-0.119	-0.032	-0.127	-0.124	-0.020	0.020
	(-41.75)	(-3.34)	(-6.38)	(-11.38)	(-3.77)	(4.17)
Age 65 or Over	0.770	0.268	0.193	0.227	1.565	2.420
	(16.19)	(3.30)	(1.74)	(3.74)	(36.83)	(15.77)
Married	1.215	0.635	-0.678	-0.693	-0.064	0.381
	(26.75)	(5.23)	(-4.85)	(-4.72)	(-0.97)	(12.95)
Dependents	-0.043	-0.050	-0.194	-0.209	-0.164	-0.313
	(-8.64)	(-2.07)	(-10.46)	(-6.00)	(-10.29)	(-12.52)
Intercept	-0.450	-2.665	-5.329	-4.928	-1.698	-0.084
	(-5.49)	(-16.38)	(-22.23)	(-40.84)	(-25.68)	(-0.75)

Note: Nonparametric t-statistics in parentheses

Table 4

Estimated Level Equation Parameters
Long-Term Capital Gains

Explanatory Variable	Gains		Losses	
Log of Virtual Income	-1.333	-1.111	-2.400	-0.973
	(-1.40)	(-1.38)	(-0.96)	(-0.72)
Square of Log of Virtual Income	0.274	0.311	0.328	0.191
	(2.81)	(3.18)	(1.32)	(1.17)
Marginal Tax Rate	-0.116	-0.160	-0.021	-0.057
	(-2.72)	(-10.13)	(-0.53)	(-5.98)
MTR Change	-0.040	-0.037	-0.054	0.019
	(-0.91)	(-0.63)	(-0.68)	(0.28)
Age 65 or Over	0.001	0.277	0.003	0.244
	(0.00)	(1.45)	(0.01)	(1.91)
Married	0.035	0.138	0.350	0.061
	(0.33)	(3.81)	(0.90)	(0.41)
Dependents	0.022	-0.002	0.067	0.046
	(0.70)	(-0.11)	(1.19)	(1.24)
Northeast	0.065	0.070	-0.012	0.044
	(0.56)	(0.36)	(-0.06)	(0.26)
Midwest	0.027	0.028	-0.577	-0.528
	(0.60)	(0.65)	(-1.62)	(-1.93)
West	0.396	0.404	-0.044	-0.015
	(6.05)	(4.14)	(-0.33)	(-0.12)
Lambda	0.498		0.484	
	(1.63)		(0.72)	
Intercept	3.767	2.151	6.064	2.109
	(1.54)	(1.44)	(0.94)	(0.81)

Note: Nonparametric t-statistics in parentheses

Table 5

Estimated Level Equation Parameters
Other Income Categories

Explanatory Variable	Business Profits	Business Losses	Short-term Gains	Short-term Losses	Dividends	Interest
Log of Virtual Income	-0.793	-1.464	2.924	1.547	-1.822	-1.195
	(-3.30)	(-13.34)	(1.40)	(0.68)	(-4.94)	(-9.99)
Square of Log of Virtual Income	0.522	0.313	-0.171	-0.094	0.382	0.341
	(12.06)	(19.86)	(-0.82)	(-0.40)	(8.49)	(24.86)
Marginal Tax Rate	-0.208	-0.001	-0.097	-0.067	-0.019	-0.024
	(-39.06)	(-0.41)	(-2.95)	(-1.66)	(-4.13)	(-5.77)
Age 65 or Over	-0.553	-0.549	0.021	-0.441	1.245	2.414
	(-20.79)	(-15.48)	(0.14)	(-1.86)	(11.07)	(118.89)
Married	-0.137	0.079	-0.222	-0.375	-0.274	0.358
	(-1.62)	(1.09)	(-0.59)	(-1.52)	(-5.82)	(5.93)
Dependents	-0.073	-0.021	-0.049	-0.014	-0.148	-0.234
	(-3.53)	(-1.20)	(-1.77)	(-0.47)	(-6.06)	(-28.05)
Northeast	0.208	-0.320	0.218	0.083	0.339	0.339
	(2.86)	(-3.92)	(1.07)	(0.45)	(2.28)	(9.06)
Midwest	0.335	-0.168	0.220	-0.018	-0.033	0.153
	(3.74)	(-3.15)	(1.19)	(-0.10)	(-0.43)	(3.17)
West	0.350	-0.090	0.246	0.230	-0.071	0.205
	(9.41)	(-1.01)	(1.24)	(1.95)	(-0.85)	(3.74)
Intercept	3.286	2.153	-5.899	-2.666	1.121	-0.691
	(8.08)	(26.84)	(-1.56)	(-0.62)	(1.73)	(-4.07)

Note: Nonparametric t-statistics in parentheses

Appendix A

The Rate Structure Premium

The taxpayer's total income y is the sum of incomes from different sources which may be treated distinctly by the tax laws. Let $Y = [Y_0, Y_1, \ldots, Y_m]'$ denote the array of of the amounts of these, say, $m + 1$ types of income, where $y = R_{i=0,1,\ldots,m} Y_i$. The first category, indexed by 0, will be taken by convention as labor income, and we will refer to the vector of the remaining income types as $Y = [Y_1, \ldots, Y_m]'$, so that $Y = [Y_0, Y]'$. The income taxes owed by the taxpayer are a function $T(Y, a) = T(Y_0, Y, a)$ of the income array and the characteristics of the taxpayer, a. Total after-tax income is thus:

$$\text{(A1)} \quad y_T = Y_0 + [\Sigma_{i=1,\ldots,m} Y_i] - T(Y_0, Y, a).$$

This identity can be rearranged in terms of marginal tax rates on endogenous income $t = \partial T(Y_0, Y, a)/\partial Y$ as

$$\text{(A2)} \quad y_T - [t'Y - T(Y, a)] = Y_0 + [\Sigma_{i=1,\ldots,m} (1 - t_i)Y_i].$$

In the analysis in this paper, labor income is taken as exogenous and is used as a conditioning variable. Taxpayer behavior determining the sources of nonlabor income is a function of marginal tax rates t_Y, since they determine the marginal "tax price" or "you-keep-it-rate" of an income source $(1 - t_i)$. The quantity $[t'Y - T(Y, a)]$, which is the *rate structure premium* (RSP) of the tax schedule with respect to the endogenous income categories Y, is the difference between what the taxpayer would have paid on his *endogenous* income had it been taxed entirely at marginal rates, and what he actually paid on *all* income. By definition, if the tax system is proportional on endogenous types of income the rate structure premium is simply the tax on exogenous income, but it will generally differ from this when marginal tax rates vary with income levels. Virtual income is defined as $V = y +$ RSP. The taxpayer is indifferent between his current observed situation and an alternative state with total income V and $T(Y, a) = \Sigma_{i=1,\ldots,m} t_i Y_i$.

Appendix B
Construction of Instruments

Our econometric estimation procedure first requires the development of a set of equations for the endogenous capital income categories. Exogenous marginal tax rates were then computed at the total income level predicted from the regressions. We also measured the rate structure premium corresponding to the vectors of predicted capital incomes and marginal tax rates.

We define components of income for this research as follows. Labor income, which we treated as exogenous, consists of wages and salaries, alimony receipts, and fully and partially taxable pensions. The five capital income categories are taxable interest, dividends before exclusion, business income, short-term capital gains, and long-term gains. Business income comprises those sources reported on Schedules C (business income), E (rent, royalty, estate, partnership, and small business corporation income), and F (farm income), plus gains from sale of non-capital assets and other unspecified income. Capital gains are measured after loss carryovers and before exclusions and include all capital gain distributions.

Simple linear ordinary-least-squares regressions were run on the entire taxpayer sample for each of the four years in our data base. The set of explanatory variables was the same in each equation: the level of labor income, dummy variables indicating joint filing status and a taxpayer or spouse aged 65 years or older, and number of dependents. The squared value of labor income was included to allow for a possible nonlinear relationship. We also included dummy variables for the Northeast, Midwest, and West regions. The regressions were weighted by the SOI sample weights. These 20 regressions are not of special interest in themselves and are not described further here. As might be expected with large cross-section data sets, the explanatory power was low but the statistical significance of the coefficients was generally high.

The observed distribution of each of the income categories has a clustering of values at zero, a characteristic that was not reflected in the predictions from the regression. In addition, dividends and interest cannot be negative. To incorporate this constraint, we recoded any negative predicted values of these components to zero, and subtracted a corresponding value from predicted business income to retain an unbiased prediction of total income.

In evaluating this unsophisticated procedure for generating income predictions, it should be kept in mind that the objective is merely to impute a level and mix of capital income for the purpose of obtaining exogenous marginal tax rate instruments. An alternative method would have been to impute zero values of capital income, and then compute "first dollar" marginal rates. Our method can be thought of as a slight elaboration of the procedure, followed in some earlier studies (e. g., U. S. Department of the Treasury (1985) and Congressional Budget Office (1988)) of computing a taxpayer's marginal capital gains rate at the mean level of capital gains for his or her AGI class.

We also used the income instruments to calculate both federal and state marginal tax rate instruments for each taxpayer in our sample. Appendix Table B-1 is analogous to Table 1 in the text, but displays the instrument tax rates.

Appendix Table B-1

Instrumental Marginal Tax Rates by Income Category
Weighted Means In Percent

Year	Category	Long-term Gains	Business Income	Short-term Gains	Dividends & Interest
		All Taxpayers			
1977	Federal	9.4	18.5	12.5	18.5
	State	1.8	3.1	2.4	3.4
1979	Federal	8.4	19.7	10.5	19.7
	State	1.6	3.2	2.2	3.5
1983	Federal	7.9	18.5	9.5	18.5
	State	1.6	3.3	2.1	3.5
1985	Federal	7.8	18.3	11.9	18.3
	State	1.6	3.3	2.4	3.5
		AGI over $200,000			
1977	Federal	13.6	25.9	13.5	25.9
	State	1.9	2.9	2.2	3.1
1979	Federal	12.3	29.2	12.3	29.2
	State	1.5	2.9	1.8	3.1
1983	Federal	12.5	27.7	12.5	27.7
	State	1.7	3.0	1.9	3.6
1985	Federal	12.9	28.1	27.6	28.1
	State	1.9	3.4	3.4	4.0

Note: Actual adjusted gross income used to classify taxpayers.

Appendix C

Estimated Level Equation Parameters
Other Income Categories Including Lambda

Explanatory Variable	Business Profits	Business Losses	Short-term Gains	Short-term Losses	Dividends	Interest
Log of Virtual Income	-0.938	-1.572	2.203	37.993	-1.567	-1.053
	(-2.86)	(-3.77)	(0.97)	(1.00)	(-3.03)	(-3.49)
Square of Log of Virtual Income	0.589	0.331	-0.093	-3.605	0.249	0.247
	(4.22)	(4.35)	(-0.45)	(-0.97)	(3.71)	(4.16)
Marginal Tax Rate	-0.231	0.004	-0.086	-0.954	-0.022	-0.045
	(-3.77)	(1.47)	(-1.63)	(-1.05)	(-2.76)	(-3.52)
Age 65 or Over	-0.405	-0.537	0.031	-2.823	0.441	1.424
	(-2.50)	(-3.46)	(0.18)	(-1.18)	(1.97)	(3.73)
Married	0.166	0.164	-0.121	-5.158	-0.349	0.062
	(1.13)	(2.49)	(-0.26)	(-1.05)	(-3.01)	(0.93)
Dependents	-0.077	-0.017	-0.045	-1.172	-0.087	-0.093
	(-2.38)	(-0.86)	(-0.82)	(-1.01)	(-1.94)	(-3.09)
Northeast	0.199	-0.323	0.190	2.733	0.368	0.363
	(2.51)	(-2.59)	(1.72)	(1.00)	(2.48)	(3.84)
Midwest	0.331	-0.174	0.205	2.124	-0.008	0.160
	(2.90)	(-2.65)	(1.08)	(0.97)	(-0.83)	(2.89)
West	0.345	-0.093	0.195	1.719	-0.063	0.225
	(4.90)	(-1.16)	(2.47)	(1.11)	(-1.01)	(3.45)
Lambda	-0.428	-0.144	-0.061	-9.025	0.665	1.046
	(-1.82)	(-4.33)	(-0.14)	(-1.02)	(3.20)	(3.70)
Intercept	2.707	1.824	-4.905	-86.765	3.561	1.531
	(3.10)	(3.46)	(-0.81)	(-1.00)	(2.61)	(3.02)

Note: Nonparametric t-statistics in parentheses

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