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Measuring Permanent Responses to Capital-Gains Tax Changes in Panel Data

By Leonard E. Burman and William C. Randolph*

We use panel data and information about differences in state tax rates to separate the effects of transitory and permanent tax rate changes on capital-gains realizations behavior. The estimated effect of permanent change is substantially smaller than the effect of transitory change. The difference is even larger than differences between estimates from past micro data studies, which have primarily measured the transitory effect, and time-series studies, which have primarily measured the permanent effect. Our results resolve a long-standing conflict between micro data and time-series studies of how marginal tax rates affect capital-gains realizations behavior. (JEL H31)

"Observe due measure, for right timing is in all things the most important factor"

—Hesiod (700 BC)

For more than 40 years, policy analysts and economists have debated about how capital-gains realizations respond to changes in capital-gains tax rates (see e.g., Lawrence H. Seltzer, 1951). The issue has received attention in part because, if realizations of capital gains are responsive enough, the tax rate on capital gains could be cut at no cost to the Treasury. But it is also an important issue for tax reform because some argue that the welfare cost of the capital-gains tax could be large relative to the tax revenues collected if realizations are very sensitive to tax rates (Patric H. Hendershott et al., 1991).

The debate has been fueled by an array of disparate statistical estimates of the elasticity of capital-gains realizations with respect to the marginal tax rate on capital gains. The evidence from time series appears entirely inconsistent with the evidence from individual tax-return data. Time-series studies have generally found that capital gains are relatively unresponsive to tax rates. Estimates based on micro data, however, generally suggest that realizations are highly elastic.

These empirical estimates are viewed with great skepticism by many who have studied the issue. Some authors of time-series studies (Alan J. Auerbach, 1989; Jonathan Jones, 1989; Robert Gillingham and John S. Greenlees, 1992) have discounted their findings because they are subject to intractable aggregation biases and are extremely sensitive to sample period and seemingly minor changes in specification. Estimates from micro data studies have been even less robust.

More fundamentally, some authors of micro data studies have recognized that their estimates may systematically overstate the long-term response to tax changes. Indeed, the seminal empirical study of the effect of tax rates on realizations of capital gains

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raised this caveat:

An individual whose tax rate varies substantially from year to year will tend to sell more when his rate is low. To the extent that low rates in 1973 are only temporarily low, our estimates will overstate the sensitivity of selling to the tax rate. We have no way of knowing how important this is.

(Martin Feldstein et al., 1980 p. 785 [emphasis added])

Such timing behavior is very important. The Tax Reform Act of 1986 (TRA) created a natural experiment to test the hypothesis that timing matters. TRA was passed by Congress at the end of September 1986. It turned a “permanent” 20-percent maximum tax rate, in effect since 1981, into a temporary rate, to be replaced by a higher maximum capital-gains rate of 28 percent in 1987. In response, long-term capital gains on corporate stock in December 1986 were nearly seven times their level in December 1985 (Burman et al., 1994).

Timing behavior probably explains why micro data studies have produced such large elasticity estimates.1 As the transitory component of individuals’ taxable income varies, it provides them with opportunities to time capital-gains realizations in years when tax rates are relatively low. In a particular year, those with the lowest tax rates, other things constant, would be those with the largest capital-gains realizations. As a result, a regression based on micro data is likely to measure a negative correlation between marginal tax rates and capital-gains realizations. But without more information, it is impossible to determine how much of the measured correlation represents purely transitory timing behavior. Much of the policy debate, however, has centered on the permanent or long-term response to statutory tax changes.2

To distinguish permanent from transitory tax effects, we define a “permanent tax rate” as the tax rate on long-term capital gains, purged of individual and aggregate transitory effects. We estimate the relationship between capital gains and permanent tax rates in a panel of tax returns using an instrumental-variables estimator that also accounts for the endogeneity of tax rates and self-selection. Our instrument for permanent tax rates is the maximum combined federal and state tax rate on long-term capital gains. This instrument, which only varies among states, removes individual transitory effects because it is uncorrelated with transitory variations in individuals’ income. We move aggregate transitory effects by using time dummies.

Our estimates imply that the elasticity of capital-gains realizations with respect to permanent tax changes is much smaller than the transitory response. Our point estimates of permanent tax effects are smaller in absolute value than most estimates from time series. Our estimates of transitory tax effects are larger than estimates from previous studies based on micro data.

I. The Decision To Realize Capital Gains

There are two inherent problems in measuring taxpayer responses to capital-gains tax changes: standard theoretical models do not explain why people realize significant amounts of taxable capital gains, and some variables that would enter almost any theoretical model are not observed in available data. Nonetheless, the typical empirical model may be interpreted as a reduced form, given data limitations, to test the most general implications of theory. Our analysis extends the basic empirical model to permit


2Auerbach (1989) and Gravelle (1991) have questioned the large elasticities found in most micro data studies on conceptual grounds. They argue that such large elasticities would imply that even modest changes in tax rates could cause realizations to exceed accruals.
identification of a key policy parameter, the effect of permanent changes in tax rates.

The capital-gains tax is relatively easy to avoid. Tax on an asset’s gain or loss is not due until the asset is sold, and the tax may be avoided entirely if an asset is held until death or donated to charity. Stiglitz (1983) showed that, by borrowing, hedging, accelerating losses, and deferring gains, capital-gains taxes can be avoided altogether if capital markets are perfect and transactions are costless. He concluded that the existence of substantial taxable capital-gains realizations implies that the underlying assumptions of his model must be violated in practice.

George M. Constantinides (1984) showed that realizing gains on stocks as soon as they qualify for preferential long-term tax rates may be optimal for very volatile stocks with low transaction costs. Yves Balcer and Kenneth L. Judd (1987) showed that, if borrowing and liquidity constraints are binding and options markets do not exist, capital gains would be realized following a LIFO strategy to maximize the benefits of deferral. However, none of these models would explain the $100 billion to $200 billion in taxable gains reported in a typical year.

Kiefer (1990) and Burman and Randolph (1992) developed models in which capital-gains realizations occur because capital markets are limited (there are liquidity constraints and no options markets) and individuals believe they can beat the market by trading. The latter study also showed that transaction costs could be important. As well as characterizing a long-run equilibrium in which significant amounts of capital gains could be realized, these analyses also shed light on the transition path from one steady state to another after tax laws change. Conventional wisdom holds that the short-run response to a permanent cut in capital-gains tax rates would be larger than the long-run response because of an immediate “unlocking” effect. Taxpayers holding assets to avoid capital-gains tax suddenly flood the market with these assets when the tax rate is lowered because the tax cost of selling the assets is reduced. However, this conventional view ignores the fact that the cost of selling assets is also an increasing function of accrued gain as a fraction of asset value. On average, this fraction would be higher immediately after a capital-gains tax cut than it would be in the new steady state. The high level of accrued gains will initially increase the cost of asset sales relative to the steady state and will therefore dampen adjustment in the short run. If the initial level of unrealized accruals is high enough, the short-run increase in realizations of capital gains could actually be smaller than the long-run increase.

The response to temporary reductions in capital-gains tax rates is clearer. A temporarily low capital-gains tax rate provides taxpayers with an opportunity to gain from timing. A temporary tax cut reduces the tax cost of selling now but leaves the tax cost of selling in the future unchanged. In contrast, a permanent tax cut reduces the tax cost of selling at any time. Thus, realizations of capital gains will be higher under a transitory rate cut than under a permanent cut, as illustrated by the response to TRA (Paul J. Bolster et al., 1989; Burman et al., 1994).

In micro data, variations in capital-gains tax rates include both permanent and transitory components. The permanent component results from expected differences in earnings capacity, sources of income, and deductions, and because capital-gains tax rates vary across states. It may change when tax laws change. The transitory component results from tax planning and temporary changes in income and deductions. The tax law may also cause aggregate transitory changes if the statutory change is anticipated or if a new tax law is phased in over several years. An empirical model should allow for the possibility that people respond differently to changes in the permanent and transitory components.

II. Empirical Model of Permanent and Transitory Tax Effects

An individual decides whether to sell specific portfolio assets and, incidentally, whether to realize capital gains. Capital gains enter the decision because the tax price of selling an asset is the product of the
capital-gains tax rate and the share of asset value that is a capital gain. Assets with relatively larger accumulated gains are more costly to sell than assets with smaller accumulated gains. Unfortunately, our panel of tax returns from 1979 to 1983 only includes total capital gains and losses with no detail about sales of specific assets. Thus, like all previous empirical studies of capital gains, we estimate a reduced-form relationship between total long-term capital gains and factors that may affect the decision to sell assets with capital gains.

For taxpayers who choose to realize capital gains, we model the relationship between capital gains and tax rates as follows:

\[
\ln g = X\gamma_0 + \gamma_1\tau_p + \gamma_2(\tau_t - \tau_p) + \gamma_3(\tau_t - \tau_{t-1}) + \varepsilon_2
\]

where \( g \) represents capital gains by an individual at time \( t \); \( X \) is a vector of predetermined and exogenous variables; \( \tau_p \) is the permanent tax rate; \( \tau_t \) is the current tax rate in year \( t \); \( \gamma_0, \gamma_1, \gamma_2, \) and \( \gamma_3 \), are fixed parameters; and \( \varepsilon_2 \) is a random error term. This semilog functional form has been used in most empirical capital-gains research. It implies that the elasticity of capital-gains realizations with respect to the marginal tax rate is an approximately linear function.\(^3\)

The decision of an individual to realize capital gains depends on the costs and benefits of realizing gains, the size and composition of the portfolio, and preferences. Taxes affect the costs and benefits of selling. The cost of selling depends on the effective marginal tax rate on capital gains and on the size of the average accrued gain. Equation (1) separates the marginal tax rate into permanent and transitory components. The permanent tax rate is the tax rate purged of its individual and aggregate transitory components. It is the expected (normal) tax rate in a typical year given federal and state tax laws and normal levels of income for each individual. The remaining transitory compo-

\footnote{In estimation, we also tested the assumption that the elasticity is approximately constant. This alternative does not affect the empirical results substantially.}

\footnote{The data are discussed in Section III.}

\footnote{A separate appendix, available from the authors upon request, shows that correcting for endogeneity and sample selection is especially important in this type of model. Failure to account for these problems properly may explain much of the volatility in previous research on capital gains.}
The tax terms are rearranged algebraically to simplify estimation.\(^6\)

\[
I^* = \mathbf{X} \alpha_0 + \alpha_1 \tau_p + \alpha_2 \tau_t + \alpha_3 \tau_{t-1} + \epsilon_1
\]

\[
(2) \quad \ln g = \begin{cases} 
\mathbf{X} \beta_0 + \beta_1 \tau_p + \beta_2 \tau_t + \beta_3 \tau_{t-1} + \epsilon_2 
& \text{if } I^* > 0 \\
0 & \text{otherwise}
\end{cases}
\]

and

\[
(3) \quad \tau_t = f(\mathbf{Z}, g)
\]

where \(I^*\) is a latent indicator of the decision to realize capital gains, the \(\alpha\) and \(\beta\) terms are unknown parameters, and \(\epsilon_1\) and \(\epsilon_2\) are normally distributed error terms, uncorrelated with \(\mathbf{X}, \tau_p, \text{ or } \tau_{t-1}\), such that \(E(\epsilon_i, \epsilon_j) = \sigma_{ij}\) for \(i, j = 1, 2\). The combined federal and state marginal-tax-rate function, \(f\), is a known nonlinear function of capital gains and \(\mathbf{Z}\), a vector including income items from various sources, deductions, exemptions, transfers, carried-over tax losses and credits, and taxpayer filing status.

A. Estimation Procedure

We extend the instrumental-variables procedure developed by Lung-Fei Lee et al. (1980) to allow for the presence of an unobserved variable, \(\tau_p\), and an endogenous variable, \(\tau_t\), in both the criterion function (2) and the level equation (3). The procedure is similar to the two-step regression estimation method developed by James J. Heckman (1976), except that fitted values are used in place of \(\tau_p\) and \(\tau_t\). The fitted value \(\hat{\tau}_p\) is created by regressing \(\tau_t\) on \(\mathbf{X}, \tau_{t-1}, \text{ and } \tau_s\), the maximum combined federal and state tax rate in each individual's state. The fitted value \(\hat{\tau}_t\) is created by regressing \(\tau_t\) on \(\mathbf{X}, \tau_{t-1}, \tau_s, \text{ and } \tau_0\), a "first-dollar" marginal tax rate on capital gains. The first-dollar marginal tax rate is computed by setting \(g\) and the other sources of income and deduct-

\(^6\)The \(\gamma\) parameters in (1) have a simple relationship to the \(\beta\)'s in (3): \(\gamma_1 = \beta_1 + \beta_2 + \beta_3; \gamma_2 = \beta_2 + \beta_3; \gamma_3 = -\beta_3\).

The parameters of (2) are estimated by probit maximum likelihood with the fitted \(\hat{\tau}_p\) and \(\hat{\tau}_t\) used in place of the actual values. The level equation, (3), is estimated by least squares using the sample of realizers, including the estimated inverse Mills ratio as a regressor to control for sample selectivity.\(^8\)

For estimation of (3), values for \(\hat{\tau}_p\) and \(\hat{\tau}_t\) are reestimated for the sample of realizers including the inverse Mills ratio as an additional variable in the fitted equations. The standard errors are corrected using a formula derived by Lee et al. (1980).\(^9\)

B. Consistency of the IV Estimator

Previous micro-data studies, which lacked appropriate instruments for \(\tau_p\), could only have produced consistent estimates of tax effects if transitory and permanent responses are the same. Under this condition, our estimation procedure would produce consistent estimates using almost any exogenous instruments for the permanent and transitory tax rates. However, if transitory and permanent responses are different, then appropriate instruments for \(\tau_p\) and \(\tau_t\) are

\(^7\)The first-dollar marginal tax rate is computed by setting long-term capital gains and other income and deduction items that are likely to be endogenous equal to zero and then computing the marginal tax rate on a defined long-term capital gain. This instrument retains a substantial amount of variation independent of the other explanatory variables because marginal tax rates are a known nonlinear function of numerous exogenous factors that do not directly affect capital gains, including consumer and mortgage interest deductions, contributions to pensions and IRA's, property taxes, certain health expenses, business and employment expenses, paid alimony, and many other deductions and adjustments to income.

\(^8\)The inverse Mills ratio is computed based on the fitted values from the probit step.

\(^9\)The standard-error estimates may be understated because the formula does not account for the use of instrumental variables in the probit equation. To check the standard errors, we randomly split the sample into 10 parts and estimated the parameters for each subsample. The standard errors of the sample mean of the 10 estimates were very close to those produced by the formula.
essential to estimate permanent and transitory tax effects consistently.

The estimation problem is unusual and interesting because we need to estimate the effects of two unobservable components of the tax rate. If \( \tau_t \) is defined as

\[
\tau_t = \tau_p + \mu_t
\]

where \( \mu_t \) represents transitory deviations in tax rates, then both \( \tau_p \) and \( \mu_t \) enter (1) as explanatory variables. This problem is similar in form to an errors-in-variables model. However, in the standard errors-in-variables model, only the systematic component, \( \tau_p \), would enter the model as an explanatory variable. To estimate the effect of \( \tau_p \) consistently, we need an exogenous instrument that is correlated with \( \tau_t \) but uncorrelated with \( \mu_t \), conditional on \( X \) and \( \tau_{t-1} \). Although much of the variation in \( \tau_p \) is related to the other exogenous variables, especially permanent income, wealth, and the portfolio mix, differences in state tax law provide an exogenous source of variation that is easily measured. Moreover, the variation in state taxes is closely related to an important policy question: how do realizations differ under different tax laws? Because state income taxes tend to be less graduated than the federal tax schedule, most gains are realized by taxpayers in the top state tax brackets. Thus, the top combined federal and state tax rate (\( \tau_s \)) captures most of the important differences in statutes and does not vary among individu-
als within a state. It is thus unlikely to be correlated with the transitory component, \( \mu_t \).

To estimate the transitory effect (\( \mu_t \)) consistently, we need a second exogenous instrument that is correlated with \( \tau_t \), but uncorrelated with \( \tau_p \), conditional on \( X \), \( \tau_{t-1} \), and \( \tau_s \). Our instrument has been used in various forms in most previous micro-data studies of capital gains: the first-dollar tax rate (\( \tau_0 \)). Because marginal tax rates are a highly nonlinear function of many variables that do not directly affect capital gains (see footnote 7), this instrument captures much of the variation in \( \tau_t \) but is purged of its endogenous components. Further, \( \tau_0 \) is unlikely to be correlated with \( \tau_p \), conditional on \( \tau_{t-1}, \tau_s \), and the variables included in \( X \).

The standard errors-in-variables model assumes that the random component (\( \mu_t \)) is uncorrelated with the \( X \) variables—an unwarranted assumption in our model. Transitory tax differences may well be correlated with such \( X \) variables as transitory income. As a result of this correlation and the non-standard form of our estimator, the coefficients on the \( X \) variables may be inconsistent, reflecting a combination of the direct effect on gains (\( \gamma_0 \)) and indirect effects through correlation with \( \mu_t \). While this may make interpretation of the effects of other variables more difficult, it does not affect the estimates of permanent and transitory tax effects.

Under our assumptions, it can be shown that the estimates of permanent and transitory tax coefficients in (1) will approach the following limits:

\[
\lim (\hat{\gamma}_1) = (1 - \theta_1) \gamma_1 + \theta_1 \gamma_2
\]

---

10We ignore sample selection in this discussion to focus on the key estimation problem. The IV results for the linear model, (1), are extended to the full model with truncation, (2)-(3), in a separate appendix (available from the authors upon request).

11Others have used state variation to identify permanent effects of statutory changes in a panel or cross-section in different contexts. See Daniel Feenberg (1987) for an application to charitable contributions and David Neumark and William Wascher (1992) for estimating the effects of minimum wages. William T. Bogart and William M. Gentry (1993) also use state data to estimate capital-gains tax effects, but their state-level aggregate data average out individual differences.

12The instrument could be endogenous if the choice of state depends on capital-gains tax rates. While we consider it unlikely that state tax rates on capital gains are very important to residential decisions, we test for this possible source of bias in our estimation.

13Probability limits for all the parameters are derived in a separate appendix (available from the authors upon request). The expression, Cov(x,y|z), is defined to be the partial covariance between x and y given z (i.e., after the linear influence of z is removed from x and y).
where

\[ \theta_1 = \frac{\text{Cov}(\tau_s, \mu_t | X, \tau_{t-1})}{\text{Cov}(\tau_s, \tau_{t} | X, \tau_{t-1})} \]

and

\[ (7) \quad \text{plim} (\hat{\gamma}_2) = \theta_2 \gamma_1 + (1 - \theta_2) \gamma_2 \]

where

\[ \theta_2 = \frac{\text{Cov}(\tau_0, \tau_p | X, \tau_s, \tau_{t-1})}{\text{Cov}(\tau_0, \tau_t | X, \tau_s, \tau_{t-1})} . \]

Equations (6) and (7) show that the probability limits for the permanent and transitory coefficient estimates are weighted averages of the true values of the coefficients. If, as assumed, the state-tax-rate instrument, \( \tau_s \), is correlated with \( \tau_p \), and uncorrelated with \( \mu_t \), conditional on the other variables, (6) implies that the estimated permanent coefficient is consistent because \( \theta_1 = 0 \). Similarly, (7) implies that, if the first-dollar instrument, \( \tau_0 \), is correlated with \( \mu_t \), and uncorrelated with \( \tau_p \), conditional on the other variables, then the estimated transitory coefficient, \( \gamma_2 \), will also be consistent because \( \theta_2 = 0 \).

Under the null hypothesis that the permanent and transitory tax coefficients are the same, (6) and (7) imply that the estimates are consistent even if \( \theta_1 \) and \( \theta_2 \) are nonzero. Under the alternative hypothesis that \( \gamma_1 \neq \gamma_2 \), the estimated difference between \( \gamma_1 \) and \( \gamma_2 \) is biased toward zero if \( \theta_1 \) or \( \theta_2 \) is nonzero, because both must lie between 0 and 1. Thus, even if the assumptions for consistency are violated, our estimates provide a conservative test of the hypothesis that \( \gamma_1 = \gamma_2 \), which is the key assumption required for the validity of previous micro-data studies.

### C. Alternative Estimators

Two studies (Auten and Clotfelter [1982] and U.S. Department of the Treasury [1985]) attempted to measure the permanent tax rate directly from panel data by using three-year averages of marginal tax rates on capital gains. The fundamental problem with this approach is that a three-year average of federal income tax rates would be correlated with the transitory component of the tax rate. Thus, such a proxy cannot be used to estimate separately the effects of permanent and transitory tax rates since it is, itself, a combination of the two.

Slemrod and Shobe (1990) used a fixed-effects model to control for differences in permanent tax rates and other unobservable fixed effects that may affect parameter estimates. This approach can produce consistent estimates of the coefficients of transitory tax rates and other nonfixed factors but does not allow identification of the response of capital gains to permanent tax rates, as was recognized by the authors.14

Bogart and Gentry (1993) use aggregate state data to estimate permanent capital-gains tax effects. This approach mitigates the problem of limited sample size common to aggregate time-series models, and the data set includes more years than our study. However, aggregate data preclude dealing with most of the econometric problems that we have found to be empirically important.

14Because the combined federal and state tax rates vary over time as well as among individuals, we could conceivably estimate an individual fixed effect in our model. We did not do this for two reasons. First, modeling fixed effects would make it difficult or impossible to control for sample selectivity, which Auten et al. (1989) found to cause substantial biases. Second, because only a minority of mostly small states changed their tax rates on capital gains between 1980 and 1983 (Bogart and Gentry, 1993), only about 3 percent of the independent variation in the state-tax instrument remains after controlling for both time and individual fixed effects. The sources of this variation are individuals who moved between 1980 and 1983, the 14 states that changed tax rates between 1980 and 1983, and the interaction effect between the change in federal tax rates in 1981 and the net capital-gains tax. Since the precision of instrumental-variables estimates depends on the correlation between permanent tax rates and the instrument, removing almost all of the variation in the instrument would yield uninformative results. Moreover, to the extent that the remaining variation corresponds to movers, who may have reasons for realizing capital gains independent of tax effects, interpreting the estimated coefficient as primarily a permanent tax effect may be unwarranted.
and suffer from some of the same problems that affect aggregate time-series studies.

III. Data

The data are from a panel of individual income tax returns for about 11,000 taxpayers for the years 1979–1983. (U.S. Department of the Treasury, 1979–1983) In addition to detailed tax return data, the panel includes the ages of taxpayers for each return. The panel sample was stratified to oversample high-income taxpayers; thus, a much larger proportion of the sample (53.4 percent) had capital gains than in the population at large (18.5 percent). The Treasury department edited the data for consistency and developed programs to calculate marginal tax rates (James M. Cilke and Roy A. Wyscarver, 1987) Some observations were discarded because the data were internally inconsistent.

Summary statistics for the data and instruments used in estimation are shown in Table 1. Weighted and unweighted statistics differ because the sample was stratified. We use unweighted data for estimation but test for the possibility that endogenous stratification biases the estimates.15

Our data were originally prepared by Auten et al. (1989), but we have made several improvements. We created the instrument for permanent tax variation (τₚ) by computing the combined federal and state marginal tax rate on capital gains for a taxpayer with $100 million of taxable income. We also modified the first-dollar tax-rate instrument (τ₀) by setting several possibly endogenous components of income and deductions equal to zero. This was done for long- and short-term capital gains and losses, capital-loss carryovers, interest, dividends, business losses, charitable contributions, and the deduction for taxes paid and investment interest expense. Auten et al. (1989) did not consider the deduction items other than charitable contributions to be endogenous.

The sample period for estimation is 1980–1983 so that lagged values could be used. Observations on individuals were included in estimation whenever the current and lagged data were valid, which yielded a total of 42,406 observations. The dependent variable is net long-term capital gains before carryover of prior-year losses as reported on Schedule D. The tax rate measure is the combined federal and state marginal rate, based on applicable tax law for each year and each taxpayer’s income and deductions.16 To smooth out kinks in

15The sample was stratified based on income, which includes capital-gains realizations and other possibly endogenous variables.

16Because of the way the data were coded by the IRS, state of residence is available for all returns only in 1981. In other years, we used the actual state if it was available, or the state in 1981, otherwise.
the tax schedule and to represent the lumpiness of capital-gains transactions, the marginal tax rate on capital gains was computed for a defined transaction, rather than for a dollar of capital gains. The capital gain on the defined transaction is the maximum of $1,000 or the square root of imputed wealth.\(^\text{17}\) The computed marginal tax rate is the change in tax liability divided by the amount of the defined capital gain.\(^\text{18}\)

Other regressors are discussed above in Section II, and summarized in Table 1. Wealth was imputed by using a tobit model to regress the logarithm of total wealth, as reported in a 1982 sample of estate tax returns, on age and log capital income reported on 1981 income tax returns. The estimated wealth regression was used to impute wealth for taxpayers in our panel sample for each year based on lagged values of the regressors. Corporate stock was imputed the same way. Lagged business losses were computed as the sum of losses on rental property, losses reported on partnership returns, and losses reported by personal-services corporations.

Permanent income was imputed by using the panel sample to regress the logarithm of a five-year average (1979–1983) of real positive income on taxpayer characteristics.\(^\text{19}\) The regression estimates were used to impute annual permanent income based on lagged values for the regressors. Current income, listed in Table 1, is defined as positive income excluding endogenous sources such as capital gains.\(^\text{20}\) In the regression model, transitory income is the logarithm of the ratio of current income to permanent income.

Family size is the number of personal and dependent exemptions claimed on the tax return. Marital status is based on tax filing status. Age was derived from Social Security records.

The sample period includes the Economic Recovery Tax Act (ERTA) of 1981, which reduced top tax rates on both ordinary income and capital gains by 29 percent and introduced many new tax preferences. The advantage of covering this period is that the change in tax law adds substantial variation to the statutory tax rates. The primary disadvantage is that the major tax change was far from a controlled experiment, and some of the response to the statutory change in capital-gains tax rates may be transitory, although the aggregate change was controlled for by time dummies.

### IV. Estimation Results

Estimates for equations (2) and (3) are shown in Tables 2 and 3. Table 2 shows estimates of tax-rate coefficients, the corresponding elasticities, and results for three restricted models. Table 3 shows the coefficient estimates for the nontax variables.

The first three columns in Table 2 show the marginal-tax-rate coefficients in the level equation (3) and the criterion function (2). To interpret these coefficient estimates, recall from footnote 6 that the total effect of changes in the permanent tax rate depends on the sum of the three tax-rate coefficients, whereas the effect of transitory deviations

\(^{17}\) As a sensitivity test, we also estimated the model using a marginal tax rate computed with a defined transaction of $1,000. This made almost no difference for the estimated effect of permanent tax rates but increased slightly the estimated effect of transitory tax rates.

\(^{18}\) Slemrod and Shobe (1990) argue that the marginal rate should be adjusted when the taxpayer has net capital losses to account for the fact that unused losses are at least partially deductible in future years. In our tax calculation, we consider only the current year, which implies a zero marginal tax rate on capital gains for taxpayers with non deductible net losses. Given the small fraction of returns subject to the capital-loss limitation, this difference is unlikely to affect empirical estimates. Moreover, since the capital-loss limitation is essentially transitory, the estimates of permanent effects are unlikely to depend on the treatment of losses.

\(^{19}\) Positive income includes all positive components of income (including net positive capital gains). It is an approximation of economic income used by the IRS and in several earlier studies.

\(^{20}\) Current income and permanent income were scaled so that they had the same weighted population means. The unweighted mean for current income exceeds mean permanent income because the sample was stratified to oversample high-income taxpayers. Thus, people in the sample tend to have high transitory incomes. The wealth and stock variables were scaled to match the aggregates reported in the Survey of Consumer Finances for 1983, converted to 1981 dollars.
Table 2—Estimated Coefficients and Elasticities of Marginal-Tax-Rate Variables

<table>
<thead>
<tr>
<th>Estimated model</th>
<th>Marginal-tax-rate coefficient</th>
<th>Current</th>
<th>Lagged</th>
<th>Permanent</th>
<th>Permanent elasticity</th>
<th>Transitory elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full model:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level equation [Equation (3)]</td>
<td>−0.145</td>
<td>0.0013</td>
<td>0.116</td>
<td></td>
<td>−0.18</td>
<td>−6.42</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.011)</td>
<td>(0.036)</td>
<td></td>
<td>(0.48)</td>
<td>(0.34)</td>
</tr>
<tr>
<td>Criterion function [Equation (2)]</td>
<td>−0.084</td>
<td>0.003</td>
<td>0.088</td>
<td></td>
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<tr>
<td></td>
<td>(0.005)</td>
<td>(0.006)</td>
<td>(0.016)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Exclude transitory and lagged tax rates:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level equation</td>
<td></td>
<td>−0.020</td>
<td></td>
<td></td>
<td>−0.17</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td></td>
<td></td>
<td></td>
<td>(0.42)</td>
<td></td>
</tr>
<tr>
<td>Criterion function</td>
<td></td>
<td>−0.007</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>(0.010)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Exclude permanent tax rate:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level equation</td>
<td>−0.144</td>
<td>0.039</td>
<td></td>
<td></td>
<td>−6.10</td>
<td>(0.33)</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.005)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Criterion function</td>
<td>−0.083</td>
<td>0.036</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.002)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Exclude permanent and lagged tax rates:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level equation</td>
<td>−0.113</td>
<td></td>
<td></td>
<td></td>
<td>−4.19</td>
<td>(0.22)</td>
</tr>
<tr>
<td></td>
<td>(0.010)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Criterion function</td>
<td>−0.051</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: Standard errors are in parentheses. Estimated coefficients of other variables included in the model are in Table 3. Elasticities are computed at an average tax rate of 18.0 and an average θ of 2.52; see equation (8).

The lagged tax-rate coefficient is small and insignificant, which implies that lagged tax rates do not affect current capital-gains decisions, holding current and permanent tax rates and other included variables constant. This result is inconsistent with the conventional wisdom that the response in the first year to a capital-gains tax change is larger than the long-run response. It is, however, consistent with Kiefer’s (1990) simulations, discussed in Section I.22

---

21Although our model includes measures of permanent and transitory income, the transitory tax-rate component may also proxy for variation in transitory income not controlled for by other variables.

22Kiefer’s (1990) simulations suggest a potentially larger “intermediate-term” effect, several years after a tax change. Unfortunately, there is not enough independent variation in tax rates in our data set to allow us to measure such effects with any precision.
### Table 3—Estimated Coefficients of Nontax Variables Included in Model

<table>
<thead>
<tr>
<th>Right-hand variable</th>
<th>Level equation</th>
<th>Criterion function</th>
<th>Elasticity or percentage change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>3.78</td>
<td>-9.70</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>(1.25)</td>
<td>(0.30)</td>
<td></td>
</tr>
<tr>
<td>Permanent income (L)</td>
<td>0.17</td>
<td>0.15</td>
<td>0.55</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
<td>(0.02)</td>
<td></td>
</tr>
<tr>
<td>Transitory income (L)</td>
<td>-0.12</td>
<td>-0.10</td>
<td>-0.37</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.006)</td>
<td></td>
</tr>
<tr>
<td>Wealth (L)</td>
<td>0.56</td>
<td>0.61</td>
<td>2.10</td>
</tr>
<tr>
<td></td>
<td>(0.08)</td>
<td>(0.02)</td>
<td></td>
</tr>
<tr>
<td>Stocks/wealth (L)</td>
<td>-0.09</td>
<td>0.07</td>
<td>0.10</td>
</tr>
<tr>
<td></td>
<td>(0.03)</td>
<td>(0.008)</td>
<td></td>
</tr>
<tr>
<td>Business losses lagged (L)</td>
<td>0.03</td>
<td>0.05</td>
<td>0.16</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.003)</td>
<td></td>
</tr>
<tr>
<td>Rent losses lagged (L)</td>
<td>-0.002</td>
<td>0.006</td>
<td>0.01</td>
</tr>
<tr>
<td></td>
<td>(0.005)</td>
<td>(0.002)</td>
<td></td>
</tr>
<tr>
<td>Family size</td>
<td>0.009</td>
<td>-0.012</td>
<td>-0.06</td>
</tr>
<tr>
<td></td>
<td>(0.02)</td>
<td>(0.006)</td>
<td></td>
</tr>
<tr>
<td>Married (D)</td>
<td>0.19</td>
<td>0.03</td>
<td>30.9&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(0.07)</td>
<td>(0.02)</td>
<td></td>
</tr>
<tr>
<td>Age 30–39 (D)</td>
<td>-0.03</td>
<td>0.20</td>
<td>62.2&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(0.15)</td>
<td>(0.04)</td>
<td></td>
</tr>
<tr>
<td>Age 40–49 (D)</td>
<td>-0.61</td>
<td>0.41</td>
<td>44.9&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(0.15)</td>
<td>(0.04)</td>
<td></td>
</tr>
<tr>
<td>Age 50–59 (D)</td>
<td>-0.87</td>
<td>0.47</td>
<td>28.7&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(0.15)</td>
<td>(0.04)</td>
<td></td>
</tr>
<tr>
<td>Age 60–69 (D)</td>
<td>-0.81</td>
<td>0.49</td>
<td>41.0&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(0.16)</td>
<td>(0.04)</td>
<td></td>
</tr>
<tr>
<td>Age 70 or older (D)</td>
<td>-0.85</td>
<td>0.48</td>
<td>31.4&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(0.17)</td>
<td>(0.05)</td>
<td></td>
</tr>
<tr>
<td>Southern region (D)</td>
<td>0.23</td>
<td>0.009</td>
<td>29.1&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(0.05)</td>
<td>(0.02)</td>
<td></td>
</tr>
<tr>
<td>Western region (D)</td>
<td>0.17</td>
<td>-0.019</td>
<td>12.4&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
<td>(0.02)</td>
<td></td>
</tr>
<tr>
<td>Northeast region (D)</td>
<td>0.35</td>
<td>-0.13</td>
<td>1.6&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(0.06)</td>
<td>(0.02)</td>
<td></td>
</tr>
<tr>
<td>Year 1981 (D)</td>
<td>0.17</td>
<td>0.15</td>
<td>72.3&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(0.14)</td>
<td>(0.04)</td>
<td></td>
</tr>
<tr>
<td>Year 1982 (D)</td>
<td>-0.51</td>
<td>0.13</td>
<td>-17.3&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(0.11)</td>
<td>(0.04)</td>
<td></td>
</tr>
<tr>
<td>Year 1983 (D)</td>
<td>-0.36</td>
<td>0.17</td>
<td>6.4&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>(0.08)</td>
<td>(0.03)</td>
<td></td>
</tr>
<tr>
<td>Inverse Mills ratio:</td>
<td>-2.68</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>(0.18)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Standard error ($\sigma_{22}$): 3.43  
Number of observations: 22,635 42,406  

**Notes:** Standard errors are in parentheses. For the right-hand variables, logarithmic variables are indicated by "(L)"; dummy variables are indicated by "(D)." In the last column, numbers represent elasticities for continuous variables or percentage changes in expected long-term gains for dummy variables. All elasticities and percentage changes are evaluated at unweighted sample means of right-hand variables.

<sup>a</sup>Percentage changes.
In contrast to the transitory effects, the estimated coefficient of the permanent tax rate is positive, nearly as large as the current-tax-rate coefficient, and significant at the 1-percent level in both the level equation and criterion function. This result implies that permanent changes in the tax rate have substantially smaller effects than transitory changes. These large and significant differences refute the basic assumption underlying the validity of previous micro-data studies.

The last two columns show the elasticities. The elasticity (\(e\)) measures the effect of a small change in the permanent tax rate:

\[
(8) \quad e = \tau_p [(\beta_1 + \beta_2 + \beta_3) + (\alpha_1 + \alpha_2 + \alpha_3) \cdot \lambda (h + \sigma_{\tau_2})]
\]

where \(\lambda (h + \sigma_{\tau_2})\) is the reciprocal of the Mills ratio evaluated at the mean of the systematic part of the criterion function (\(h\)) plus the covariance between the error terms in the criterion function and the level equation (\(\sigma_{\tau_2}\)).\(^{23}\) The transitory elasticity is given by a similar equation, excluding the permanent and lagged tax-rate coefficients. It is interpreted as the elasticity with respect to a change in the current tax rate, holding the permanent and lagged tax rates constant.

The estimated permanent elasticity is \(-0.18\), which implies that a 1-percent decrease in permanent tax rates would increase expected realized net long-term capital gains by approximately 0.18 percent at average levels for all variables in 1983. However, the relatively large standard error implies that we cannot reject the hypothesis that permanent changes in capital-gains tax rates have no long-term effect on capital-gains realizations.\(^{24}\) The standard error is also large enough that long-run elasticities of 0.0 and \(-1.0\) are both included in a 95-percent confidence interval.

The estimated transitory elasticity is \(-6.42\), which is larger in absolute value than most previous elasticity estimates from micro data.\(^{25}\) The high transitory elasticity suggests that the response to a temporary tax change would be extraordinary, with realizations expected to increase by more than six times the percentage change in the tax rate. This is consistent with the dramatic increase in realizations just after passage of the Tax Reform Act of 1986, as discussed in the Introduction.

The second panel of Table 2 shows what happens to the estimated permanent elasticity when the current and lagged tax rates are excluded from the estimated model. Assuming that the transitory component of the tax rate is uncorrelated with the permanent (state) tax-rate instrument, the estimates of the permanent-tax-rate coefficient and elasticity are still consistent when the current and lagged tax rates are excluded. The permanent-elasticity estimate changes very little, from \(-0.18\) to \(-0.17\), but the precision increases slightly. The transitory elasticity cannot be determined from this specification.

The third panel shows the effect of excluding the permanent tax rate but including the current and lagged tax rates, as in Auten et al. (1989). The current-tax-rate coefficients and implied transitory elasticity decrease slightly, and the lagged tax-rate coefficients increase and become highly significant. This result makes sense because

\(^{23}\)Derivation is available from the authors upon request. Permanent and transitory elasticities were computed for 1983 means of the permanent tax rate and \(\lambda\), which were 18.0 and 2.52, respectively.

\(^{24}\)We refer to long-term changes because variation in the permanent-tax-rate instrument represents essentially cross-section variation in state marginal tax rates. While the combined state and federal marginal tax rates changed over time during our sample period, much of the possible influence of this source of variation was removed by including time-dummy variables in our model.

\(^{25}\)For example, see Auten et al. (1989), Gillingham et al. (1989), and Slemrod and Shobe (1990) for recent estimates.
the average of tax rates over two years should be positively correlated with the omitted permanent tax rate. The omission would thus positively bias the current and lagged tax-rate coefficient estimates. This result suggests that the lagged tax rate partially proxies for the omitted permanent tax rate.

The fourth panel shows the effect of omitting both the lagged and permanent tax rates, as in Gillingham et al. (1989). The transitory-elasticity estimate becomes smaller, probably because the first-dollar tax-rate instrument is positively correlated with the permanent tax rate. A positive correlation would cause a positive bias in the transitory-elasticity estimate, which may explain why previous micro-data studies have yielded smaller transitory-elasticity estimates. This result is consistent with Slemrod and Shobe’s (1990) finding that elasticity estimates were biased toward zero by failure to control for unmeasured fixed effects, such as the permanent tax rate.

The effects of other variables are summarized in Table 3, which reports estimated coefficients for the level equation, the criterion function, and the combined effects of implied changes in the values of both functions on the expected value of capital-gains realizations. For continuous variables, the estimates in Table 3 are reported as elasticities. For dummy variables, [i.e., those followed by (D) in the table], the effects are reported as percentage changes in expected capital-gains realizations implied by changing each dummy variable from 0 to 1.

The results seem generally consistent with life-cycle motives for saving and consumption, modified somewhat by the incentive to hold assets with gains until death. Capital-gains realizations are significantly positively related to permanent income, but negatively related to transitory income, suggesting a consumption motive for realizations. Wealthier people are much more likely to realize capital gains, and they realize larger gains than average. The composition of wealth also matters. A larger share of stocks in the portfolio, as measured by the stock/wealth variable, makes people significantly more likely to realize gains, but the average size of a gain is smaller, ceteris paribus. This result may be a consequence of the lower transaction costs for stocks than for other kinds of assets, such as real estate. The positive and significant relationship between gains and lagged business losses reflects the well-known relationship between tax shelters and capital gains, although rental losses (a subset of business losses) do not seem to have a very large independent effect on realizations.

Holding wealth and other variables constant, the pattern of realizations follows the expected life-cycle profile except for the oldest cohort. The level of realizations declines steadily through the peak earning years of 50–59, and then increases. The likelihood of realizing gains steadily increases, perhaps reflecting the fact that older people are more likely to own assets that yield capital gains. The percentage change in realizations is also U-shaped through age 69. However, the oldest taxpayers realize smaller capital gains than the 60–69 cohort, and they are slightly less likely to realize. Although the difference is statistically insignificant, it is consistent with older taxpayers avoiding realizations to take advantage of the step-up in basis at death.

The Mills-ratio coefficient equals the product of the standard error of the error term in the level equation, (3), and the correlation between error terms in equations (2) and (3). The fact that the coefficient is nonzero implies that ignoring sample selectivity would lead to biased and inconsistent parameter estimates. The negative sign implies that the error terms are negatively correlated. Thus, the tobit model used in some previous studies, which assumes a correlation of 1, would be inappropriate.

Sensitivity tests for alternative specifications and segments of the data set are reported in Table 4. The results all confirm our basic finding that permanent elasticities are much smaller than transitory elasticities.

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26 Recall from Section II that these coefficients may not be estimated consistently.
The permanent elasticity is not significantly different from zero in any specification.

The log-log model tests an approximately constant elasticity specification, which we view as inferior to the semilog form. The results are similar to those under the semilog form. Weighted estimates are also consistent with our basic results. This result suggests that Joseph J. Minarik's (1981) finding that weighting could substantially alter elasticity estimates was a consequence of other estimation problems rather than endogenous sample stratification. We excluded taxpayers from high- and low-tax states to test for the possibility of endogeneity bias in our state-tax-rate instrument. This experiment raises the standard errors significantly because much of the variation in the instrument is sacrificed, but it does not alter the key conclusions. Results are similar when the sample is restricted to 1982 and 1983 (after enactment of ERTA). Even when truncation is ignored and the model is estimated by two-stage least squares, the elasticity estimates do not change much. Estimating the model by two-stage least squares based on a sample of realizers only, the transitory elasticity changed significantly, but the effect on the permanent-elasticity estimate is small and insignificant.

V. Conclusion

It has long been suspected that differences between transitory and permanent responses to capital-gains tax changes were at the heart of the conflicting empirical evidence from cross-section and time-series data. Using state tax rates to distinguish transitory from permanent tax effects, and correcting other econometric problems with previous studies, we find that the difference is large and statistically significant. The difference in estimated response is even larger than the differences between past empirical results from careful micro-data studies, which measured a combination of permanent and transitory effects, and time-series studies, which are likely to have measured primarily permanent effects of changes in tax rates.

Our analysis has some limitations. First, the capital-gains-realizations elasticity is only one of many factors that affect the proper taxation of capital gains. For example, our analysis ignores the effects of capital-gains taxes on the cost of capital and the allocation of capital among kinds of investments, and it says nothing about arguments for taxing capital gains on equity grounds. Second, this paper has followed all previous empirical research in estimating a reduced-form model. Although this was necessitated by data limitations, it was also important to show that permanent and transitory tax effects could be estimated separately using a model otherwise similar to previous research. Any explicit structural model would require assumptions about the nature of preferences and individuals' optimization problems, and the estimation method itself would be a radical departure from all prior research. That might lay open such an analysis to the criticism that the
structure of the model was generating the results. The drawback of estimating a reduced form, however, is that the estimated parameters are functions of the tax law and macroeconomic environment and may thus change over time.

The distinction between transitory and permanent tax effects may explain some other empirical anomalies. For example, the empirical evidence on the tax-sensitivity of charitable contributions seems to exhibit a similar divergence between time-series and micro-data estimates. The methodology developed here may help to resolve such disparities.

REFERENCES


Heckman, James J. “The Common Structure


