DYNAMIC INCOME, PROGRESSIVE TAXES, AND THE TIMING OF CHARITABLE CONTRIBUTIONS*

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Abstract

The permanent income hypothesis suggests that empirical studies have underestimated how much permanent income affects charitable giving if people smooth their giving when transitory income changes. But the studies may have also overestimated the effect of permanent changes in tax prices. This is because changes in transitory income also change the relative tax prices of current and future giving when marginal tax rates increase with income, which may cause people to substitute between current and future giving. I first examine these issues using a simple demand model. I then study the issues empirically using a ten-year panel of tax-return data (1979-1988) that spans two major tax-law changes. The data allow me to separately estimate the effects of permanent income, transitory income, current tax prices, expected future tax prices, and other variables. Compared to price elasticities from previous studies, I find that giving is much less elastic with respect to permanent changes in tax prices, but more elastic with respect to transitory price changes. I also find that giving is much more elastic with respect to permanent income, but less elastic with respect to transitory income changes. The results imply that people smooth their giving when transitory income changes, but time their giving to exploit transitory price changes.

1. Introduction

Governments have historically supported philanthropic causes through a variety of direct spending and transfer programs, and by providing incentives designed to encourage private philanthropy through matching grants and special provisions of the tax system. Since its beginning, the U.S. income tax has provided incentives for private philanthropy by allowing people to deduct charitable gifts from taxable income. This deduction is widely thought to encourage giving because it decreases the amount of other consumption people must forgo at the margin, the "tax price," for each additional dollar they give to charity.

To measure the incentive effects, empirical studies have modelled giving by individuals as a commodity. The key results are summarized in terms of elasticities of demand for giving with respect to changes in after-tax income and tax prices. Clotfelter (1985) surveyed more than a dozen empirical studies of individual giving. The studies typically found that giving is income inelastic, but highly price elastic. Steinberg (1990) surveyed at least twenty more recent studies, and found that the results were not very robust to changes in data and model design. In a recent study, Auten, Cilke, and Randolph (1992) compared the predictions of a standard model of charitable giving to observed changes in giving by people in different income groups following two major tax changes in the 1980's. They found that the predictions were very different from the actual changes. For many income groups, predicted changes actually had the wrong sign.

In this paper, I present evidence that the price and income elasticity estimates from previous studies were biased because they did not distinguish fully between direct and indirect effects of permanent and transitory income. Differences between the direct effects are implied by Friedman's (1957) permanent income model. If people smooth their consumption, giving would be less sensitive to transitory than permanent income. Some studies, including Schwartz (1970), Feldstein and Clotfelter (1976), Reece (1979), and Clotfelter (1980), have tried to separately measure the direct effects of permanent and transitory income, but the results have been weak. Previous studies have not, however, accounted for differences between the indirect price effects of permanent and transitory income. The effects are likely to differ because permanent and transitory income have different effects on the current and expected future tax prices of giving. Marginal tax rates increase with income, so a person with relatively high permanent income will tend to face a relatively low tax price both in current and future years. However, a person with a relatively high transitory income will tend to face a tax price that is currently low relative to future years, when transitory income is expected to be lower.

Casual observation and some econometric evidence suggests that people are willing to substitute giving between current and future years to take advantage of changes in relative current and future tax prices. For example, in studies of the 1980's changes in tax laws, Clotfelter (1990) and Auten, Cilke, and Randolph (1992) observed one-time increases in charitable giving during 1981 and 1986. During those years, people appeared to accelerate future giving to avoid the pending statutory increases in tax prices. Broman's (1989) econometric analysis of behavior surrounding the tax reductions passed in 1981 also suggests that people anticipated the changes by substituting current for future giving. As another example of substitution, charitable giving is sometimes used for end-of-year tax planning. In December, when people know whether taxable income for the past year is higher or lower than usual, they can either accelerate future giving to take advantage of a temporarily low tax price or defer giving to avoid paying a temporarily high tax price.

As I show in the first part of this paper, if part of the tax-price variation in data used for past studies resulted from transitory income variation, and if people smooth their consumption, but are willing to substitute between current and future giving in response to changes in relative tax prices, the existing elasticity estimates will tend to understate the effects of changes in permanent income and overstate the effects of permanent price changes. Likewise, the elasticity estimates will tend to overstate the effects of changes in transitory income and understate the effects of transitory price changes.

I first use a simple demand model to examine the basic empirical identification problem. I then estimate an empirical model of charitable giving based on a ten-year panel (1979-1988) of tax return data. The data allow me to separately estimate the direct income effects and indirect price effects of permanent and transitory income. I take advantage of the longitudinal aspect of the data and changes in the degree of marginal tax rate progressivity that followed the tax-law changes in 1981 and 1986. In contrast to previous studies, rather than depending on cross-sectional variation of income along a given nonlinear tax-price schedule, the parameters are identified by statutory changes in the tax schedule.[1] The estimation method is similar to the method that Burman and Randolph (1993) used to estimate the effects on capital gains realizations of permanent and transitory changes in marginal tax rates.

My results differ substantially from the results of previous studies. Giving appears to be much less sensitive to permanent price changes and much more sensitive to transitory price changes. Giving also appears to be much more sensitive to permanent income and less sensitive to transitory

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[1] Feenberg (1987) analyzed the potential problems caused by depending too heavily on nonlinearity of a particular tax schedule to identify charitable giving models.

income. These results suggest that previous studies have estimated the average effects of transitory and permanent price and income variations. The results also raise questions about the effectiveness of tax incentives in affecting the level, rather than just the timing, of charitable giving by individuals.

2. The Direct and Indirect Effects of Income

In this section, I use a simple demand model to show how permanent and transitory changes in income can affect individual charitable giving when marginal tax rates increase with income. Suppose that an individual chooses how much to consume personally and how much to give to charity in each of two periods. Income is exogenous and subject to tax, but giving is deductible. For simplicity, interest and discount rates are zero. The individual's decision problem is represented by equation (1),

$$\begin{aligned}&\text{Maximize} \quad U(g_1, g_2, x_1, x_2)\\&\text{subject to:}\\&g_1 + g_2 + x_1 + x_2 \le y_1 - T(y_1 - g_1) + y_2 - T(y_2 - g_2),\\&g_t,\ x_t,\ y_t \ge 0, \quad t = 1,2\end{aligned} \tag{1}$$

where g_t and x_t are the levels of charitable giving and personal consumption in period t, respectively. Exogenous levels of pre-tax income are given by y_1 and y_2. The tax function, $T(\cdot)$, is twice-differentiable, and marginal tax rates are assumed to be positive and non-decreasing, so that $T(y)$, $T'(y)$, and $T''(y) \ge 0$ for all y.[2]

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[2] Differentiability simplifies the analysis considerably. Neither it nor the assumption of non-decreasing marginal tax rates is necessary for the results of this section.

The problem can be expressed in a more standard form by rearranging the budget constraint:

$$
\begin{aligned}
& P_1 g_1 + P_2 g_2 + x_1 + x_2 \leq Y_1 + Y_2, \\
& \text{where:} \\
& Y_t = y_t - T(y_t) + [T(y_t) - T(y_t - g_t) - g_t T'(y_t - g_t)], \\
& P_t = 1 - T'(y_t - g_t), \quad t = 1,2.
\end{aligned} \tag{2}
$$

Although the budget constraint is a nonlinear function of giving in each period, the individual's decision has a standard form in terms of marginal tax prices, P_1 and P_2, and "modified" after-tax income, Y_1 and Y_2. Modified after-tax income equals after-tax income when giving is zero plus an implicit premium that results from the fact that inframarginal amounts of giving are deducted at higher rates than the marginal tax rate.

First ignoring nonlinearity of the budget constraint, demand exhibits Slutsky and other familiar properties in terms of P_t and Y_t for $t = 1, 2$. I use this fact along with the nonlinear dependence of the budget constraint on giving to derive the different effects of temporary and permanent changes in pre-tax income. The effects on giving can be decomposed into direct effects through changes in income and indirect effects through changes in tax prices.

First, consider a permanent change in income. Pre-tax income can be decomposed into permanent, y^*, and temporal, y_t^T, components, so that $y_t = y^* + y_t^T$ for $t = 1, 2$. The effect on g_1 of a change in the permanent component is given by equation (3).

$$
\frac{dg_1}{dy^*} = \frac{P_1 \cdot \dfrac{\partial G^1(P_1,P_2,Y^*)}{\partial Y^*} - \left(\dfrac{\partial H^1(P_1,P_2,u^*)}{\partial P_1} + \dfrac{\partial H^1(P_1,P_2,u^*)}{\partial P_2} \right) \cdot T''}{1 - \left(\dfrac{\partial H^1(P_1,P_2,u^*)}{\partial P_1} + \dfrac{\partial H^1(P_1,P_2,u^*)}{\partial P_2} \right) \cdot T''}, \tag{3}
$$

where $G^1(P_1,P_2,Y^*)$ and $H^1(P_1,P_2,u^*)$ are the ordinary and compensated demand functions for g_1, respectively, and Y^* is "permanent" modified after-tax income, i.e., $(Y_1+Y_2)/2$.[3]

The first term in the numerator, $P_1 \cdot \partial G^1/\partial Y^*$, accounts for the direct effect of a permanent change in income. The second term in the numerator appears because marginal tax rates change with income. It shows that a permanent change in income will affect giving indirectly by changing the tax prices in both periods. This second term, including the minus sign, is non-negative because $T'' \geq 0$ and $\partial H^1/\partial P_1 + \partial H^1/\partial P_2 \leq 0$ according to the Slutsky properties.[4] A permanent increase in income, for example, would increase giving by increasing resources and permanently decreasing the tax price.

For comparison, consider the effect of a temporary change in y_1^T without a change in y_2^T. The effect on giving in period 1 is now expressed by equation (4).

$$\frac{dg_1}{dy_1^T} = \frac{\frac{P_1}{2}\cdot\frac{\partial G^1(P_1,P_2,Y^*)}{\partial Y^*} - \left(\frac{\partial H^1(P_1,P_2,u^*)}{\partial P_1} + \frac{\partial H^1(P_1,P_2,u^*)}{\partial P_2}\right)\cdot T''}{1 - \left(\frac{\partial H^1(P_1,P_2,u^*)}{\partial P_1} + \frac{\partial H^1(P_1,P_2,u^*)}{\partial P_2}\right)\cdot T''}$$

$$+ \frac{\frac{\partial H^1(P_1,P_2,u^*)}{\partial P_2}\cdot\left[1 - \left(\frac{\partial H^1(P_1,P_2,u^*)}{\partial P_1} - \frac{\partial H^1(P_1,P_2,u^*)}{\partial P_2}\right)\cdot T''\right]^{-1}\cdot T''}{1 - \left(\frac{\partial H^1(P_1,P_2,u^*)}{\partial P_1} + \frac{\partial H^1(P_1,P_2,u^*)}{\partial P_2}\right)\cdot T''} \tag{4}$$

[3] Equation (3) and the expressions in the rest of this section were simplified by assuming that y_1 equals y_2 initially, and preferences are weakly separable between giving and other consumption. Preferences are also symmetric in g_1 and g_2, i.e., $U(g_1,g_2,x_1,x_2) = U(g_2,g_1,x_1,x_2)$.

[4] The denominator in equation (3) is greater than or equal to 1 because marginal tax rates are increasing in income. It reduces all marginal effects in the numerator proportionally to account for curvature of the budget constraint.

Equation (4) differs from (3) in two significant ways. First, the direct effect in (3), $P_1 \cdot \partial G^1/\partial Y^*$, is reduced by half in (4) because the individual would choose to spread the change in y_1^T over two periods. Second, there is an additional term in (4) that accounts for the fact that a temporary change in income will have an additional indirect effect by changing the price of g_1 relative to g_2. This term has the same sign as $\partial H^1/\partial P_2$ because $T'' \geq 0$ and $\partial H^1/\partial P_1 - \partial H^1/\partial P_2 \leq 0$ according to the Slutsky properties. Thus, if g_1 and g_2 are demand substitutes, so that $\partial H^1/\partial P_2$ is positive, the indirect price effect will be larger in absolute magnitude if the change in y_1 is temporary, as in equation (4), than if the change is permanent, as in equation (3).

Such behavior may be important for empirical analysis, especially for the analysis of cross-section data, from which we can't easily tell whether observed income differences are permanent or transitory. To see this, first suppose we could observe giving in period 1 by two otherwise identical individuals who have a small difference between their levels of pre-tax permanent income. Based on the demand problem above, the difference between their levels of g_1 can be expressed as a function of differences in their period 1 levels of modified after-tax income and tax prices according to (5).

$$\frac{dg_1}{dy_1} = \frac{\partial G^1(P_1,P_2,Y^*)}{\partial Y^*} \cdot \frac{dY_1}{dy_1} + \left[\frac{\partial G^1(P_1,P_2,Y^*)}{\partial P_1} + \frac{\partial G^1(P_1,P_2,Y^*)}{\partial P_2}\right] \cdot \frac{dP_1}{dy_1} \tag{5}$$

when $dy_1 = dy^*$ and $dy_1^T = dy_2^T = 0$

According to (5), the marginal effect of the observed difference in Y_1 is $\partial G^1 / \partial Y^*$, which is the same as the marginal effect of a change in modified after-tax permanent income. The marginal effect of the observed difference in P_1 is $\partial G^1/\partial P_1 + \partial G^1/\partial P_2$, which is the same as the marginal effect of a proportional, "permanent", change in P_1 and P_2.

For comparison, suppose that the income difference is purely transitory, so that the two individuals have the same pre-tax lifetime wealth, i.e., $dy_1^T = -dy_2^T$ and $dy^*=0$. Now the observed difference in g_1 is given by equation (6).

$$\frac{dg_1}{dy_1} = 0 \cdot \frac{dY_1}{dy_1} + \left[\frac{\partial G^1(P_1,P_2,Y^*)}{\partial P_1} - \frac{\partial G^1(P_1,P_2,Y^*)}{\partial P_2} \right] \cdot \frac{dP_1}{dy_1}, \tag{6}$$

$$\text{when } dy_1 = dy_1^T = -dy_2^T \text{ and } dy^* = 0$$

Compared to equation (5), there will be no direct effect of the change in y_1 through its effect on Y_1 because the change in pre-tax income is purely transitory. The indirect effect of y_1 through its effect on P_1 will also differ from the corresponding effect in equation (5) because the intertemporal price effect, $\partial G^1 / \partial P_2$, is subtracted instead of added. This is because a purely transitory change in income changes P_1 and P_2 inverse proportionally, whereas a permanent change in income changes P_1 and P_2 in direct proportion. If g_1 and g_2 are substitutes and giving is a normal good, so that $\partial G^1 / \partial P_1$ is negative and $\partial G^1 / \partial P_2$ is positive, the marginal price effect in (6) will be larger in absolute value than the marginal price effect in (5). The observed effect of the price difference would therefore overstate the effect of a permanent change in tax prices. The observed effect of the income difference would understate the effect of a permanent change in income.

Suppose that we could observe a large number of such almost identical individuals in a cross-section sample, but the sample is a mixture of people who have differences in permanent and transitory income; we can't tell which. Based on such data, a linear regression of observations of g_1 on Y_1 and P_1 would yield regression coefficient estimates that would be weighted averages of the marginal income and price effects shown in equations (5) and (6).[5] The weights would be unknown, because they would be functions of the unknown extent to which cross-sectional income and price differences are permanent or transitory. We could not use the estimated coefficients to identify the permanent and transitory marginal effects. Used as they are, the estimates would produce biased policy predictions. They would understate the effect of tax-policy induced permanent changes in after-tax income and overstate the effect of tax-policy induced permanent changes in tax prices.

3. Empirical Model

I address these intertemporal issues empirically by using a ten-year panel of individual tax-return data that spans a period in which there were significant statutory changes in income tax rates and longitudinal variations in income for individuals in the sample. As an empirical strategy, I generalize the standard model of charitable giving, in which giving depends only on current income and prices, to include expected future income and prices. This allows me to examine whether there are differences between the effects of transitory and permanent changes in income and prices.

Rather than extending the Cobb-Douglas type demand function typically used in previous studies by simply adding regression terms for expected future income and prices, I extend the model

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[5] This assumes that the estimation method would account for the fact that Y_1 and P_1 are endogenous functions of g_1.

by using a more flexible demand specification based on the expenditure-share form of the flexible "almost ideal" demand (AID) model of Deaton and Muellbauer (1980).[6]

$$\omega_{it} = \frac{P_{it}\, g_{it}}{Y_{it}} = \delta_{0t} + \delta_{0i} + X_{it}\beta + \delta_1 \mathrm{Log}\left(\frac{P_{it}}{P_{it}^*}\right) + \delta_2 \mathrm{Log}(P_{it}^*) \tag{7}$$

$$+ \delta_3 \mathrm{Log}\left(\frac{Y_{it}}{Y_{it}^*}\right) + \delta_4 \log(Y_{it}^*) + \delta_5 \left[\mathrm{Log}\left(\frac{P_{it}}{P_{it}^*}\right)\right]^2 + \delta_6 \mathrm{Log}(P_{it}) \cdot \mathrm{Log}(P_{it}^*) + \epsilon_{it},$$

where $Y_{it} = y_{it} - T_{it} - (1 - P_{it}) g_{it}$

According to (7), individual i in year t decides how much to "spend" on charity. The dependent variable, ω_{it}, is the share of current income spent on charity. It equals the current tax price of giving, P_{it}, times the amount of giving, g_{it}, divided by current modified after-tax income, Y_{it}. As in Section 2, though expressed differently, modified after-tax income equals after-tax income before giving is deducted plus the implicit premium realized by givers when inframarginal giving is deductible at higher tax rates than the marginal tax rate.

The giving decision is affected by current income, Y_{it}, expected-future income, Y_{it}^*, the current tax price, P_{it}, and the expected-future tax price, P_{it}^*. The model thus allows people to base giving decisions on current income and tax prices, and whether current income and tax prices are high or low relative to future years.

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[6] Because other consumer expenditures are not observed in tax-return data, to derive (7) from an expenditure share equation, I substituted current income, Y, for total expenditure and added expected future income, Y*, to the right side in a way similar to Y. This implicitly assumes that total expenditure and giving may depend on both current and expected future income.

Following the analysis in Section 2, I expect a proportional change in Y and Y* to affect giving more than a change in Y only, and a proportional change in P and P* to affect giving less than a change in P only. The functional form, however, also allows the opposite. This flexibility is important because giving may be more, rather than less, sensitive to transitory income changes. For example, people may smooth their other consumption by adjusting charitable giving instead of borrowing or saving. Likewise, people may be less rather than more sensitive to temporary price changes because it takes them time to adjust to price changes, as suggested by Clotfelter (1980).

Other potentially important terms are also included in the model. Observed individual characteristics are included in the vector X_{it}. These include a person's age and age-squared, which allows for a life-cycle pattern of giving behavior unaccounted for by the other variables. A life-cycle pattern of giving might exist if people's discount rates differ from market interest rates, if people schedule consumption around raising children, or if there is a precautionary motive behind the schedule of life-cycle consumption or giving decisions. X_{it} also includes a dummy variable for marital status. An additional variable, the count of total tax exemptions, is also included to allow the size of a consumer unit to affect the level of giving.

To allow for unobserved individual characteristics that may affect giving, the model includes an individual-specific intercept, $\boldsymbol{\delta}_{0i}$. The intercept is also allowed to vary over time by including $\boldsymbol{\delta}_{0t}$, which is controlled for by including time dummy variables. This allows for the effects of aggregate changes in interest rates, other macroeconomic conditions, or government social policies that may affect individual charitable giving. For example, during a recession, the need for charity may increase, and those still doing well may respond by giving more. Giving may also change because people substitute privately for aggregate changes in government social programs (Kingma, 1989).

4. The Data

The data were selected from a ten-year panel of U.S. federal tax return data, from 1979 through 1988 (U.S. Department of the Treasury, 1979-1988). This panel follows the tax returns of more than 12,000 people who were listed as the primary tax-return filers in each year. The original panel sample was stratified to over-sample tax returns of people who reported relatively high incomes in 1981. This ensures that the sample includes a relatively large number of high-income taxpayers, who account for a substantial fraction of total giving by individuals. For example, about a third of all deductible contributions in 1990 were made by people with incomes exceeding $100,000 in 1991 dollars (Auten, Cilke, and Randolph, 1992).

One advantage of tax-return data is that it provides detailed information about many components of income. The detail provides a means for studying charitable giving, and allows precise measurement of marginal tax rates, total federal taxes, and tax prices of charitable giving. Another important advantage is that the panel is ten years long, and spans two major tax-law changes in 1981 and 1986. Ten years of annual income for each taxpayer allow me to estimate the effects of permanent and transitory income on giving. Combined with the tax law changes, the longitudinal income data also allow me to estimate the effects of current and future tax prices.

The sample for estimation includes only panel members who filed tax returns in all ten years. As in previous charity studies based on tax return data, the sample excludes people who did not report amounts of giving because they did not itemize deductions.[7] Observations for the years 1981, 1982, 1986, and 1987 were also excluded for estimation. They were the years the major tax changes were passed and the years immediately following. By excluding those years, I focus the estimation on measuring the degree to which the direct income effects and indirect price effects of permanent and transitory income differ during "normal" years like those covered by many past studies of charitable giving. This allows me to examine whether the previous results are biased.[8]

All dollar amounts were converted to constant 1991 dollars. Pre-tax income was measured by starting with each taxpayer's Adjusted Gross Income (AGI) for each year. AGI was then modified to adjust for changes in its legal definition over the years. The most important modification was to add the portion of net long term capital gains excluded from AGI before 1987.[9] One critical variable is the ten-year (real) average of pre-tax income, which is used to create instruments for estimation.

Total taxes and marginal tax rates were computed based on federal tax rates and taxable income in each year. The tax price is defined, as in Section 2, as the value of other consumption forgone at the margin per dollar of charitable giving. However, the price measure is complicated

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[7] This may cause selection bias if, for example, people who are more likely to itemize deductions are also likely to give more than others, conditional on all other variables in the model. However, this potential problem is probably not serious because other unrelated decisions, especially whether to own and mortgage a home, are the main determinants of whether people itemize tax deductions.

[8] As a sensitivity test, discussed in Section 8, the model was re-estimated using all ten years, but it made little difference in the results.

[9] Many other modifications were made to AGI to measure pre-tax income. The modifications are the same as those described in detail in Auten, Cilke, and Randolph (1992).

by the fact that cash and non-cash gifts have different prices, and the panel data do not report separate amounts for cash and non-cash gifts. For cash gifts, the price equals 1 minus the marginal tax rate for ordinary income. For gifts of appreciated assets such as corporate shares, the tax price is reduced further to account for taxes not paid on the unrealized appreciation. To account for these price differences, following Feldstein (1975) and other studies, I calculate the tax price as follows.

$$P_{it} = 1 - T_{it}' - f_{it} \cdot a \cdot \iota_t \cdot T_{it}', \tag{8}$$

where T_{it}' is the marginal tax rate on ordinary income, ι_t is the fraction of net long term capital gains included in AGI, f_{it} is the fraction of total giving made up of appreciated assets, and "a" is the gain-to-value ratio for gifts of appreciated assets, multiplied by the expected present value of capital gains tax payments that would have been made in the future had the donated assets been sold instead. The constant, a, was set equal to 0.5, which was estimated by Feldstein (1975) and Feldstein and Clotfelter (1976), and has been used in several studies since (Clotfelter, 1985). I estimated the appreciated assets fraction, f_{it}, for six different income classes in each year based on analysis in Auten, Cilke, and Randolph (1992). For years included in the panel, its value ranged from 0.05 in 1980 for incomes below \$20,000 to 0.48 in 1980 for incomes exceeding \$1 million (1991 dollars).

Means of selected variables are shown in Table 1. The total of 53,703 observations represents six years of data (1979, 1980, 1983, 1984, 1985, and 1988) for the 75 percent of the original sample of 12,000 taxpayers who itemize tax deductions. Differences between unweighted and sample-weighted means result from the original sample stratification. As shown, the sample over-represents people with high incomes, who also tend to be older and give more than others on average.[10]

5. Estimation

The main challenges for estimation are that Y and P are endogenous functions of giving and Y* and P* are unobserved. I use an instrumental variables method, similar to that used by Burman and Randolph (1994), to decompose the observed variation in Y and P into exogenous transitory and permanent components. To simplify the discussion, equation (7) is rewritten as (9).

$$\begin{aligned} \omega_{it} = \; & \delta_1\left[\mathrm{Log}(P_{it}) - \mathrm{Log}(P_{it}^*)\right] + \delta_2 \mathrm{Log}(P_{it}^*) \\ & + \delta_3\left[\mathrm{Log}(Y_{it}) - \mathrm{Log}(Y_{it}^*)\right] + \delta_4 \log(Y_{it}^*) + \ldots \end{aligned} \tag{9}$$

I call $\mathrm{Log}(P_{it}^*)$ and $\mathrm{Log}(Y_{it}^*)$ the "permanent" components of prices and income as a convenient shorthand, but they are really not permanent. They are expectations that can change over time when tax laws change or other information is acquired. Similarly, I call the differences of current levels from expected future levels of incomes and prices the "transitory" components.

To estimate the model, I need at least four exogenous instruments: at least two that are correlated with the permanent components, but not with the transitory components, and at least two that are correlated with the transitory components, but not with the permanent components.[11] As

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[10] An extensive descriptive data analysis of essentially the same data can be found in Auten, Cilke, and Randolph (1992).

[11] When the individual-specific effect, δ_{0i}, is treated as a random effect for estimation, i.e., part of the error structure, the instruments must not be correlated with it. When δ_{0i} is treated as a fixed effect, the requirement is weaker, but the instruments for the permanent components

instruments that should satisfy these requirements, I use the logarithm of current pre-tax income, the logarithm of its ten-year average, and the products of these two variables with two dummy variables that indicate major statutory changes in tax rates. The first dummy variable indicates whether the year of an observation is between the tax-law changes in 1981 and 1986. The second dummy variable indicates whether the year is after the tax reform in 1986. These dummy-variable interactions allow future expectations of after-tax income and tax prices to be different under different tax laws for particular levels of current and average pre-tax income.

Conditional on other variables in the model, I expect the ten-year average of pre-tax income to be correlated with expectations because it is correlated with individual characteristics that would cause persistent differences between incomes and, therefore, after-tax incomes and tax prices. Further, I expect interactions of the tax-period dummy variables with average pre-tax income to be correlated with expected future after-tax incomes and tax prices because the changes in tax laws should change how the expectations depend on average pre-tax income. Likewise, the differences between current and average pre-tax income, and its interactions with the tax-period dummy variables, should be correlated with the transitory components of after-tax incomes and tax prices.

These instruments might not separate perfectly the permanent and transitory components. For example, the instrument based on differences between current and average pre-tax incomes may be correlated over time for each individual, conditional on the other variables. In that case, the instruments for the transitory components would have persistent components that are correlated with expected future incomes and tax prices. If so, results in Burman and Randolph (1994) imply that

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must have some variation independent of the fixed effect over the sample period.

the estimates of transitory income and price effects would be biased toward the corresponding permanent effects. My tests would therefore be conservative because they would be biased (if at all) against rejecting the hypothesis maintained in previous studies that the permanent and transitory effects are equal.[12]

Details of the estimation method are in the Appendix. I use a two-stage least squares algorithm in which there are four first-stage regressions: one for each of the permanent and transitory components of income and prices. Current values of income and prices are used as dependent variables in first stage regressions for permanent and transitory components, but the regressions for the permanent income and permanent price components are estimated by excluding any instruments that depend on the difference between current and average pre-tax income. This decomposes the observed variations in after-tax incomes and prices into two parts. One part is determined by variation in the instruments that results from variation in average pre-tax income and its interactions with changes in tax laws. The other part is determined by variation in the instruments that results from longitudinal variation of individuals' differences between current and average income and its interactions with changes in tax laws.

6. Estimated Effects of Income and Prices

The estimated parameters for equation (7) are shown in Table 2. These estimates are based on the random-effects model, in which the individual-specific effect, $\boldsymbol{\delta}_{0i}$, is assumed to be random

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[12] Under the null hypothesis that the permanent and transitory effects are equal, there would be no bias even if the instruments do not fully separate permanent from transitory components.

and uncorrelated with the other regressors. According to the results, the hypothesis that permanent and transitory income have equal effects on giving can be confidently rejected. Permanent and transitory income would have equal effects if the coefficients of Log(Y*) and Log(Y/Y*) were equal. However, the coefficients differ by 0.049, which is about ten times the standard error of the difference (0.0048, not shown). Likewise, the coefficients of all price terms are significantly different from zero. This implies that the effects of current and expected future tax prices are significantly different. The importance of these differences can be measured by comparing elasticities.

The elasticities of giving with respect to permanent and transitory income are given by equation (10).

$$
\begin{aligned}
e_{g,Y^*} &= \frac{Y^*}{g}\frac{\partial g}{\partial Y^*}\bigg|_{d(Y/Y^*)=0} = \frac{\delta_4}{\omega} + 1 \\
e_{g,Y} &= \frac{Y}{g}\frac{\partial g}{\partial Y}\bigg|_{dY^*=0} = \frac{\delta_3}{\omega} + 1
\end{aligned}
\qquad \textbf{(10)}
$$

The permanent income elasticity, e_{g,Y^*}, is the elasticity of giving with respect to a change in income when Y and Y* are changed proportionally. The transitory income elasticity, $e_{g,Y}$, is the elasticity of giving with respect to a change in current modified after-tax income, Y, holding permanent modified after-tax income, Y*, constant.

The elasticities of giving with respect to permanent and transitory changes in tax prices are expressed as follows, evaluated at P = P*.

$$e_{g,P^*} = \left.\frac{P^*}{g}\frac{\partial g}{\partial P^*}\right|_{d(P/P^*)=0} = \frac{\delta_2 + 2\,\delta_6 \operatorname{Log} P}{\omega} - 1$$

$$e_{g,P} = \left.\frac{P}{g}\frac{\partial g}{\partial P}\right|_{dP^*=0} = \frac{\delta_1 + \delta_6 \operatorname{Log} P}{\omega} - 1 \qquad \textbf{(11)}$$

The permanent price elasticity, $e_{g,P*}$, is the elasticity of giving with respect to a proportional change in current and expected future tax prices. The transitory price elasticity, $e_{g,P}$, is the elasticity with respect to a change in the current tax price, holding the expected future tax price constant.[13] The permanent price elasticity and permanent income elasticities could be used, for example, to make long term predictions about the effects of statutory tax policy changes that permanently affect tax prices and modified after-tax income.

The first two columns in Table 3 show the income and price elasticities that are implied by estimates from Table 2. Column 1 shows the estimated elasticities evaluated at the unweighted sample means of the dependent variable (0.04) and tax price (0.56) over all years of the sample. Column 2 shows the estimated elasticities evaluated at means weighted by population weights and (real) dollars of giving by each taxpayer.[14] Elasticities evaluated at the weighted means are more appropriate than those at the unweighted means for making predictions about changes in aggregate giving following changes in incomes or prices.

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[13] The 2 appears before δ_6 for the permanent price elasticity because both P and P^* are changed proportionally, whereas only P changes for the transitory price elasticity.

[14] The weighted means over all years were 0.089 for the dependent variable and 0.66 for the tax price.

The estimated permanent income elasticities are 1.27, unweighted, and 1.12, weighted. In comparison, the estimated transitory income elasticities are only 0.05, unweighted, and 0.57, weighted. Whether weighted or unweighted, the hypothesis that the permanent income elasticity equals the transitory income elasticity can be rejected at less than the 1 percent level. Unweighted, the difference between permanent and transitory income elasticities is 1.22 with a standard error of 0.12. Weighted, the difference is 0.55 with a standard error of 0.05. The fact that the permanent income elasticity is larger than the transitory income elasticity suggests that people smooth their giving relative to transitory changes in income.

These income elasticity estimates are much different from the results typical of previous studies. For example, Clotfelter (1990) reports that an income elasticity of 0.78 is representative of previous results. The fact that 0.78 falls between the estimated permanent and transitory income elasticities is consistent with the hypothesis that previous studies have estimated an average of the permanent and transitory income elasticities because observed income variation results from a mixture of permanent and transitory variation.

The differences between permanent and transitory price elasticity estimates in Table 3 are just as striking. At the unweighted sample means, the estimated permanent price elasticity is -0.06, and is not significantly different from zero. At weighted means, the permanent price elasticity is -0.49 with a standard error of 0.06. This estimate is substantially smaller in absolute value than the price elasticity of -1.27 reported by Clotfelter (1990) as being representative of previous studies.

The transitory price elasticity estimate, which equals -2.35, unweighted, and -1.57, weighted, is substantially larger in absolute value than the permanent price elasticity. The hypothesis that the transitory price elasticity equals the permanent price elasticity can be rejected at less than the 1 percent level. Unweighted, the difference between permanent and transitory price elasticities is 2.29 with a standard error of 0.17. Weighted, the difference is 1.07 with a standard error of 0.08. This provides strong evidence against the assumption made in past studies that transitory and permanent price effects are equal. People are apparently willing to substitute their giving between current and future years to take advantage of changes in relative current and future tax prices that occur when transitory changes in income temporarily move them up or down the marginal tax-rate schedule.

To measure how these results can affect policy predictions compared to previous results, consider the effects of a proportional change in all marginal tax rates. According to my estimates and those from previous studies, a decrease in marginal tax rates would tend to decrease giving because tax prices would increase, and the price elasticity is negative. However, after-tax income would also increase, which would tend to increase giving because income elasticities are positive. The net effect would depend on the relative permanent price and permanent income elasticities, the marginal tax rates, and the degree of progressivity of marginal tax-rates. The importance of these factors is summarized by the following expression for the elasticity of giving with respect to a permanent proportional change in all marginal tax rates, the "surtax" elasticity.

$$e_{g,\lambda} = e_{g,P^*} \cdot e_{P^*,\lambda} + e_{g,Y^*} \cdot e_{Y^*,\lambda}$$

where: **(12)**

$$e_{P^*,\lambda} = -\tau(1-\tau)^{-1}, \quad e_{Y^*,\lambda} = -\left[\frac{\omega(\tau-\bar{\tau}) + \bar{\tau}(1-\tau)}{(1-\tau)(1-\bar{\tau})}\right],$$

where τ and $\bar{\tau}$ are the marginal and average tax rates, respectively, and λ is the proportional change in tax rates.

Under different assumptions about marginal and average tax rates, Table 4 compares surtax elasticities based on price and income elasticity estimates typical of previous studies with surtax elasticities based on parameter estimates from Table 2.[15] In the first panel, which is based on price and income elasticities typical of previous studies, for all values of marginal and average tax rates, a proportional decrease in marginal tax rates is predicted to decrease giving. For example, a 1.0 percent decrease in marginal tax rates would decrease giving by 0.54 percent when the marginal tax rate is 40 percent and the average tax rate is 20 percent. Note that the surtax elasticity increases as marginal tax rates increase and as marginal tax rates become more progressive.

The second panel shows surtax elasticities based on my estimation results. For many values of the marginal and average tax rates, the sign of the surtax elasticity actually changes relative to the top panel. At higher marginal tax rates and degrees of progressivity, the tax elasticities have the same sign, but are substantially smaller than the corresponding elasticities in the top panel. These large differences in policy predictions relative to the top panel are the combined results of a larger permanent income elasticity and smaller permanent price elasticities implied by the parameter estimates in Table 2. They demonstrate that failure to distinguish between transitory and permanent income and price effects can lead to substantially biased policy predictions.

[15] For the simulations, ω was held constant at its giving-weighted mean of 0.089.

7. Estimated Effects of Other Variables

The estimated coefficients for other variables are shown in Table 2. The estimated coefficients of age and age-squared imply that people increase their giving expenditure as they grow older, and at an increasing rate, other things constant. Evaluated at the unweighted sample mean of the dependent variable, the relationship between giving and age is not statistically different from zero before age 50. After that, an extra year adds about 1 percent to the amount of giving at age 50, 3 percent at age 60, 4 percent at age 70, and 6 percent by age 90.[16] Figure 1 illustrates the age pattern. The thickest solid line shows the implied pattern for a hypothetical person for which the dependent variable equals 0.04 at age 50, other variables constant.[17]

Giving may increase with age because age may proxy for life-cycle wealth accumulation. However, the simplest life-cycle hypothesis implies a wealth profile that increases and then decreases, whereas the life-cycle pattern of giving increases monotonically, and at an increasing rate. Such an age pattern of giving is consistent with the precautionary savings behavior that would occur if people are risk averse and uncertain about future income or how long they will live. If people are uncertain about their own ability to consume in the future and they can't perfectly insure by purchasing annuities, for example, it may be prudent to defer charitable contributions toward the end of the life cycle. Charitable giving, in contrast to food, housing, children, and transportation, might

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[16] These estimated percentages are all significantly different from zero at less than the 1 percent level.

[17] The step function in Figure 1 is the pattern implied by alternative estimates for a model that was specified in terms of ten-year age brackets instead of age and age-squared. The result suggests that the estimated age pattern is not the forced result of using a quadratic function to summarize the profile. All other estimation results were essentially unaffected by this experiment.

be relatively easy to defer. Another possible explanation of the age pattern is that there is a vintage effect that occurs because the age variable has both longitudinal and cohort-based sources of variation. For example, older cohorts may be more generous than younger cohorts. It is not possible, however, to separate the life-cycle pattern from cohort differences from these data.

Marital status apparently makes no difference, regardless of whether the person is married filing separately with no other dependents (Married=1, Exemptions=1) or married filing jointly with no other dependents (Married=1, Exemptions=2). Giving apparently increases with the addition of exemptions, but at a rate substantially less than proportional to the increase in exemptions. For example, following an increase in exemptions, the estimated percentage increase in giving is only about 5 percent of the percentage increase in exemptions when there are 2 exemptions. The corresponding increase is still only about 10 percent when there are 4 exemptions.[18] This less than proportional increase would result, for example, if giving is a quasi-public good within a household.[19]

The coefficients of the year dummy variables show that there was a significant increase in giving during the middle years of the panel (1983 through 1985) followed by a decline, holding all other variables constant. For the middle years, the average increase in the dependent variable was

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[18] These are evaluated at the sample mean of 0.04 for the dependent variable. The estimated percentage change equals the coefficients of Exemptions, multiplied by the number of exemptions, divided by 0.04.

[19] Economic inferences should be made cautiously because the information on a tax return does not necessarily represent the finances of a household. Further, extra exemptions are not necessarily children. Throughout the first part of the sample period, people could claim an extra exemption if they were over age 65 or blind. I conducted a sensitivity test using an alternative variable that excluded the blind and over-65 exemptions. The results were unchanged.

about 0.012, which is a 30 percent increase relative to the unweighted sample mean of the dependent variable over all years. Although the exact cause of this increase can not be identified, it may have resulted from a behavioral response to the recession of the early 1980s, or aggregate reductions in certain government social programs during the middle years. An increase in private giving to offset reductions in social programs would, for example, be consistent with the crowding-out behavior studied by Kingma (1989) and others.

The variances of the individual-specific intercept and the regression error imply that the unobserved individual-specific differences account for a substantial portion of the observed variation in giving. The total variance of the dependent variable is 0.0071. Almost 50 percent (0.0035) of this variance is explained by the unobserved individual-specific differences. In contrast, all other regressors together account for only about 10 percent of the total variance of the dependent variable. This demonstrates that the unobserved differences are important. It is not possible, however, to infer from these results whether the unmeasured differences result from innate taste differences or some other variables not included in the regression, such as education, unmeasured wealth, or family background.[20]

8. Sensitivity Experiments.

Columns 3 and 4 in Table 3 show the results of two sensitivity experiments designed to examine, further, how my price and income elasticity estimates differ from previous studies. The experiments allow me to determine how much of the difference from previous results is caused by

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[20] Section 9, which presents fixed-effects estimates for reduced models, addresses the possibility that the unobserved differences are correlated with other regressors.

the distinction I make between permanent and transitory incomes and prices, and how much of the change is caused by differences in data, functional form, and estimation methods.

In the first experiment, shown in column 3, the expected future price, Log(P*), was omitted from the estimated model. The only tax price variables included were Log(P) and Log(P)-squared. Otherwise, the estimation method was the same as for the full model. As shown, the income elasticity estimates are about the same as those for the full model in column 2, but the current price elasticity estimate is between the permanent and transitory price elasticity estimates from the full model and close to the results from previous studies. This results because variation in the current tax price is a mixture of permanent and transitory price variation.

For the experiment shown in column 4, all expected future tax price and permanent income terms were excluded from the model. This restricted model is closest to the standard model from previous studies. The restricted estimates are very close to the income elasticity of 0.78 and price elasticity of -1.27 that Clotfelter (1990) characterized as representative of estimates from previous studies. Such closeness is remarkable, partly because the source of tax price variation for my study is almost entirely different from the source of tax price variation in previous studies. In the past, the main source of tax price variation in microdata studies has been cross-sectional variations along the nonlinear marginal tax rate schedule caused by cross-section variations in taxable income. Here, by construction of my estimation method, the tax price instruments only exhibit variation independent of income variation because there were statutory tax changes after 1981 and 1986. Without the tax-period dummy variable interactions as instruments, the income and tax-price parameters would not be separately identified.

The results of these experiments strongly suggest that the full-model estimates differ from the results of previous studies because the full model distinguishes between permanent and transitory income and tax price variations. The differences in estimates do not appear to have resulted from other differences in the empirical model, data, or estimation method.

The results from additional sensitivity experiments are shown in Table 5. For each experiment, the top panel shows the implied elasticities evaluated at the giving-weighted means. To diagnose whether any sensitivity or robustness carries over to values away from the mean, the bottom panel also shows elasticities evaluated at a tax price of 0.4. The first row of each panel shows the estimates based on the full-model parameter estimates from Table 2 for comparison.

Experiment 1 shows the estimates based on two-stage least squares when the unobserved individual-specific effects are ignored.[21] Experiment 2 also ignores the unobserved individual-specific effects, but uses a Tobit method to account for the 4 percent of observations that had zero amounts of charitable giving. Note that use of the Tobit method makes little difference. In both experiments, however, the sign of the permanent price elasticity changes relative to the full model when evaluated at the giving-weighted means, although the elasticity changes very little when evaluated at the lower tax price, as in the bottom panel. The sensitivity at the mean, but not at a lower tax price, suggests that the functional form might not be flexible enough. Any potential problem, however, appears to be of second-order importance. The results at the mean are still

[21] These estimates are actually from an intermediate stage of estimation for the generalized two-stage least squares estimation method used for the full-model results in Table 2. The parameter estimates are shown in Appendix Table A.2.

consistent with my central results that giving by individuals is most responsive to transitory rather than permanent variation in tax prices.

Experiment 3 replaces the quadratic function in age with a step function that changes at ten-year intervals. The estimated step function is shown in Figure 1. Experiment 4 uses an alternative exemptions variable that excludes exemptions that could be taken by taxpayers for being blind or over age 65 in the first part of the sample period. Neither of these experiments affects the key estimation results.

The fifth experiment included all years in the sample for estimation. For this experiment, I made no attempt to properly model expectations of future statutory tax changes that were known by people at the ends of 1981 and 1986. Surprisingly, the elasticity estimates change very little relative to the estimates based on fewer years, in spite of the fact that future expectations are measured incorrectly in 1981 and 1986. This robustness probably results from the fact that the model includes annual time-dummy variables, which would partly control for the effects of one-time shifts in expectations. Consistent with this explanation, the dummy variable coefficient for 1986 (not shown) indicates there was a 14 percent increase in giving during 1986 relative to 1985, other things constant. This suggests that people accelerated giving during 1986 in anticipation of the pending increases in the tax prices of giving.

For all estimates reported so far, the instruments based on pre-tax income include capital gains. If capital gains and charitable giving are simultaneously determined, conditional on the other variables, there may be an endogeneity bias in the parameter estimates. To test for this possibility, in experiment 6, capital gains were excluded from the instrument based on current pre-tax income. As shown, when evaluated at the giving-weighted mean, only the permanent price elasticity estimate is changed. However, at the lower tax price in the bottom panel, there is virtually no difference from the full model results. The results of experiment 6 suggest that if capital-gains endogeneity is a problem for the estimates, it is only of second-order importance, influencing only the shape of the permanent price elasticity as a function of tax prices.

9. Random-Effects Versus Fixed-Effects Estimates

The estimates presented so far were produced under an assumption that the unobserved individual- specific effect in (7) is random and not correlated with the other right-hand variables and instruments. In principle, this assumption can be tested by comparing the random-effects estimates with fixed-effects estimates. To do this, fixed effects can be removed by first-differencing the data over time, or by subtracting individual-specific means from all variables before estimation. For the full model in (7), unfortunately, this estimation strategy also eliminates important variation in the instruments for Y^* and P^*. The instruments for Y^* and P^* are nearly collinear over the sample period after the individual-specific means are removed. As a result, I can not estimate or control separately the effects of Y^* and P^* using a fixed-effects method.

Nevertheless, it is important to examine the fixed- versus random-effects issue because studies by Clotfelter (1980) and Broman (1989) used panel data to show that current-year price elasticity estimate becomes substantially smaller when the panel data are first-differenced., which would remove fixed effects from the model. Clotfelter's (1980) analysis suggested that the elasticity estimate is smaller because people adjust to price changes slowly. Broman (1989), however, provided evidence that people actually adjust to price changes quickly. Her study implies that the price elasticity estimates for the first-differenced model are smaller because first-differencing eliminates a bias caused by unobserved fixed effects. According to Broman's results, not only did the unobserved fixed effects bias previous price elasticity estimates, but they also biased the estimated adjustment parameter in Clotfelter's (1980) model.

Table 6 shows random-effects and fixed-effects estimates for two reduced models. The first model, shown in columns 1 and 2, excludes Y^* and P^*, similar to previous panel studies.[22] The second model, shown in columns 3 and 4, includes Y^* but excludes P^*. Consistent with results of the previous panel studies, the price elasticity estimate changes from -1.29 for the random-effects model in column 1 to -0.76 for the fixed-effects model in column 2. This result suggests that there is an omitted-variables bias in the reduced model. The bias is caused by correlation of the unobserved individual-specific effect with other variables in the model. According to the full model in (7), the random effects estimates in column 1 are biased because the individual-specific means of Y^* and P^* are part of the unobserved individual-specific effect in the reduced regressions. The individual-specific means of Y^* and P^* are correlated with the instruments used to estimate the effects of Y and P.

The fixed-effects method used for column 2, however, does not eliminate all omitted-variables bias because Y^* and P^* also change over time in a way that is positively correlated with changes in Y and P. Evidence of the bias can be seen by comparing columns 2 and 3. Column 3 shows that when changes in Y^* are added to the reduced fixed-effects model from column 2, the current-year price elasticity increases in absolute value from -0.76 to -1.39. Further, the income

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[22] Broman (1989) included an expected future price term, but only to capture the effect of expected statutory changes after 1981. Otherwise, current values of Y and P were assumed to equal expected future values.

elasticity estimate changes from 0.70 for current income to 1.66 for permanent income and 0.56 for transitory income.

The fixed-effects estimates are biased in these reduced models because there were statutory changes in tax rates during the sample period. In the absence of statutory changes, Y^* and P^* tend to be negatively correlated because marginal tax rates increase with income. During the sample period, however, both Y^* and P^* increased because marginal tax rates were reduced. Once the individual-specific means are removed from the data for fixed-effects estimates in columns 2 and 3, the positive correlation between changes in Y^* and P^* remains. Because the changes in Y^* and P^* are also positively correlated with changes in P, the price elasticity estimate in column 2 has a positive bias. For these same reasons, the permanent income elasticity estimate in column 3 is biased upward because P^* is excluded from the model. For the random-effects method in column 4, which also excludes P^*, most of the positive bias in the permanent income elasticity estimate in column 3 disappears because Y^* and P^* are not positively correlated when there are no statutory changes, and individual-specific means are not removed before estimation.

10. Conclusions:

My results imply that intertemporal income variations combine with progressive marginal tax rates to affect the way people plan their charitable contributions. Consistent with the permanent income hypothesis about consumption in general, people appear to smooth their annual giving relative to transitory changes in income. For price variation, however, the effect is just the opposite. Because marginal tax rates increase with income, transitory income variations change the relative current and future tax prices of giving. People appear to respond by substituting between current and future giving. In other words, they time their contributions to take advantage of transitory price changes, treating current and future giving as substitutes.

The results imply that by ignoring the separate effects of permanent and transitory income, previous studies have typically underestimated the effect of changes in permanent income and overestimated the effect of permanent changes in tax prices. Compared to the previous studies, I find that giving is a substantially less price elastic and more income elastic in terms of permanent changes in prices and income. Giving also appears to be more price elastic and less income elastic than past studies in terms of transitory changes in prices and income.

For tax policy predictions, it is often the permanent behavioral effects that matter most. Except during a transition period, the effects of a permanent change in tax policy are determined by the behavioral effects of permanent changes in incomes and tax prices. As I have shown, the policy predictions can differ substantially when based on estimates of the permanent elasticities rather than the elasticities from previous studies, which only predict the effects of changes in current income and prices.

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Appendix

Estimation steps for the full model are described as follows, where $Z = (\mathrm{Log}(y), d_2\mathrm{Log}(y), d_3\mathrm{Log}(y))$ and $Z^* = (\mathrm{Log}(\bar{y}), d_2\mathrm{Log}(\bar{y}), d_3\mathrm{Log}(\bar{y}))$. Current pre-tax income is y, and $\bar{y}$ is its ten-year average for each individual. The tax-law period dummy variables, d_2 and d_3, indicate whether the year is between 1982 and 1986 (inclusive) or after 1986, respectively.

First step: First, regress Log(Y) and Log(P) on X, the dummy variables for years, and Z*. Use this regression to create fitted values to be used in place of Log(Y*) and Log(P*). Second, regress Log(Y) and Log(P) on X, the dummy variables for years, Z*, and Z - Z*. Use this regression to create fitted values to be used in place of Log(Y) and Log(P). Estimates from the first step appear in Table A.1.

Second step (2SLS): Use 2SLS to estimate the share equation parameters. The endogenous right hand variables are Log(P/P*), Log(Y/Y*), $[\mathrm{Log}(P/P^*)]^2$, and Log(P) Log(P*), which are constructed by substituting fitted values of Log(Y*) and Log(P*) from the first step, above. The excluded exogenous variables are constructed by substituting the fitted values of Log(Y), Log(P), Log(Y*), and Log(P*) from the first step into Log(P/P*), Log(Y/Y*), $[\mathrm{Log}(P/P^*)]^2$, and Log(P) Log(P*). Estimates from the second step appear in Table A.2.

Third step (G2SLS): Estimated share equation residuals from the second step are used to estimate the variances of the noise error term, ϵ_{it}, and the individual-specific random effect, δ_{0i}. For this step, each variable that was used in the second step is first transformed by subtracting a fraction of each panel member's mean across years. The transformed variables are then used to repeat the 2SLS step and obtain operational G2SLS estimates.[23]

[23] The estimates are "operational" because they use consistent estimates of the variance terms in place of actual values. The data transformation was originally derived by Fuller and Battese (1973) for the two-way variance components regression model.

Table 1: Means of Selected Variables

Variable	Unweighted means	Sample-population weighted means
Charitable giving	44,842	1,694
After-tax income (before giving)	472,183	52,551
Tax price of giving	0.60	0.73
Age	52	44
Marital status	0.86	0.82
Exemptions	3.3	3.2
Total observations	53,703	53,703

Table 2: Charity Share Equation Parameter Estimates
(standard errors in parentheses) /a

Variable	Coefficient	Variable	Coefficient
Intercept	-0.075 (0.01)	Log(Y*)	0.011 (0.0007)
Age	-0.0011 (0.0003)	Log(Y/Y*)	-0.038 (0.001)
Age squared	2.0E-05 (2.3E-06)	Log(P*)	0.066 (0.009)
Married	-0.0019 (0.0014)	Log(P/P*)	-0.040 (0.006)
Exemptions	0.00097 (0.0003)	Log(P/P*) ^2	0.087 (0.008)
Dummy, 1980	0.0067 (0.001)	Log(P) Log(P*)	0.024 (0.004)
Dummy, 1983	0.013 (0.001)	Var(delta) /b	0.0035
Dummy, 1984	0.012 (0.001)	Var(epsilon)	0.0029
		Total error variance	0.0064
Dummy, 1985	0.012 (0.001)	Var(dependent variable)	0.0071
Dummy, 1988	-0.0012 (0.0019)	Observations	53,703

Notes:
/a Estimates from generalized two-stage least squares
/b Variance of individual-specific random effect

Table 3: Estimated Income and Tax Price Elasticities
(based on parameter estimates from Table 2; standard errors in parentheses)

	Unweighted means /a	Giving-weighted means /b		
	Full model (1)	Full model (2)	Excluding P* (3)	Excluding P*, Y* (4)
Income (point elasticities)				
Permanent, d(Y/Y*) = 0	1.27 (0.02)	1.12 (0.01)	1.17 (0.02)	
Current				0.82 (0.09)
Transitory, dY* = 0	0.05 (0.03)	0.57 (0.01)	0.60 (0.01)	
Tax price (point elasticities)				
Permanent, d(P/P*) = 0	-0.06 (0.10)	-0.49 (0.06)		
Current			-1.37 (0.09)	-1.29 (0.07)
Transitory, dP* = 0	-2.35 (0.13)	-1.57 (0.06)		

Notes:
/a Mean share = 0.04; mean tax price = 0.56
/a Mean share = 0.089; mean tax price = 0.66

Table 4: Comparison of Elasticities of Giving With Respect to a Proportional Change in all Marginal Tax Rates

Progressivity of marginal tax rates /a	Marginal tax rate 20%	40%	60%
Based on typical results from previous studies /b			
1.0	0.12	0.33	0.73
1.5	0.19	0.54	1.33
2.0	0.22	0.62	1.50
Based on full-model parameter estimates /c			
1.0	-0.19	-0.39	-0.55
1.5	-0.09	-0.08	0.30
2.0	-0.04	0.03	0.54

Notes:
/a Ratio of marginal tax rate to average tax rate
/b Income elasticity = 0.78; Price elasticity = -1.27
/c Permanent income elasticity = 1.12; Price elasticities are -0.38, -0.53, and -0.75 at marginal tax rates of 20, 40, and 60 percent, respectively

Table 5: Additional Sensitivity Experiments, Elasticity Estimates

Sensitivity experiment	Income elasticities		Price elasticities	
	Permanent	Transitory	Permanent	Transitory
		Evaluated at giving-weighted means /a		
Full model (for comparison)	1.12	0.57	-0.49	-1.57
1. Two-stage least squares	1.19	0.60	0.39	-1.55
2. Tobit (otherwise same as 1)	1.20	0.60	0.36	-1.56
3. Age pattern as a step function	1.14	0.57	-0.46	-1.55
4. Alternative definition of exemptions	1.12	0.57	-0.50	-1.56
5. Include all years of panel	1.16	0.53	-0.28	-1.63
6. Capital gains excluded	1.09	0.58	-0.83	-1.65
		Evaluated at a lower tax price /b		
Full model (for comparison)	1.12	0.57	-0.76	-1.70
1. Two-stage least squares	1.19	0.60	-0.66	-2.07
2. Tobit (otherwise same as 1)	1.20	0.60	-0.66	-2.07
3. Age pattern as a step function	1.14	0.57	-0.75	-1.70
4. Alternative definition of exemptions	1.12	0.57	-0.76	-1.69
5. Include all years of panel	1.16	0.53	-0.62	-1.80
6. Capital gains excluded	1.09	0.58	-0.81	-1.64

Notes:
/a share = 0.089; tax price = 0.66
/b share = 0.089; tax price = 0.40

Table 6: Random vs. Fixed Effects Estimates
(reduced models; standard errors in parentheses)

Variable	Random effects (1)	Fixed effects (2)	Fixed effects (3)	Random effects (4)
Intercept	0.16			-0.14
	(0.01)			(0.02)
Age /a	-0.00044	0.00062	0.0016	-0.0015
	(2.6E-04)	(3.5E-04)	(3.5E-04)	(2.6E-05)
Age squared	2.1E-05	8.5E-06	1.2E-05	2.4E-05
	(2.4E-06)	(3.4E-06)	(3.4E-06)	(2.4E-06)
Married	0.0004	0.0029	-0.0021	-0.0021
	(0.001)	(0.002)	(0.002)	(0.001)
Exemptions	0.0020	0.00062	4.8E-05	0.0010
	(0.0003)	(0.0004)	(0.0004)	(0.0003)
Dummy, 1980	0.0032	0.0026	0.0099	0.0071
	(0.001)	(0.001)	(0.001)	(0.001)
Dummy, 1983	0.0091	0.0048	0.022	0.020
	(0.001)	(0.001)	(0.001)	(0.001)
Dummy, 1984	0.009	0.0040	0.020	0.020
	(0.001)	0.001	(0.001)	(0.001)
Dummy, 1985	0.0084	0.0040	0.018	0.020
	(0.001)	(0.001)	(0.001)	(0.001)
Dummy, 1988 /a	0.0097			0.017
	(0.002)			(0.002)
Log(Y*)			0.098	0.050
			(0.006)	(0.003)
Log(Y)	-0.016	-0.027	-0.039	-0.035
	(0.001)	(0.001)	(0.001)	(0.001)
Log(P)	-0.057	0.012	-0.034	-0.054
	(0.01)	(0.01)	(0.005)	(0.01)
Log(P) squared	-0.038	-0.011	-0.00021	-0.025
	(0.005)	(0.005)	(0.0005)	(0.005)
Elasticities /b				
Current tax price	-1.29	-0.76	-1.39	-1.37
	(0.07)	(0.06)	(0.06)	(0.09)
Current income	0.82	0.70		
	(0.09)	(0.01)		
Permanent income			1.66	1.17
			(0.06)	(0.02)
Transitory income			0.56	0.60
			(0.01)	(0.01)

/a Age and time dummies not separately identified in fixed-effects model
/b Evaluated at giving-weighted means;

Table A.1: Estimates from First Step of Estimation
(standard errors in parentheses)

Regressors	Dependent variable			
	Log modified income (Y)		Log tax price (P)	
	(1)	(2)	(3)	(4)
Intercept	2.7 (0.04)	1.3 (0.01)	2.5 (0.01)	3.0 (0.01)
Age	8.5E-03 (1.1E-03)	3.4E-03 (3.1E-04)	-5.9E-03 (3.7E-04)	-3.1E-03 (2.8E-04)
Age ^2	-9.2E-05 (1.0E-05)	-4.8E-05 (2.9E-06)	3.7E-05 (3.4E-06)	1.9E-05 (2.6E-06)
Married	0.082 (0.008)	0.027 (0.002)	0.022 (0.003)	0.032 (0.002)
Exemptions	0.0043 (0.002)	0.0066 (0.0005)	0.0034 (0.0006)	0.0040 (0.0005)
Dummy, 1980	-0.14 (0.008)	-0.15 (0.002)	-0.044 (0.003)	-0.039 (0.002)
Dummy, 1983	-1.6 (0.05)	-0.53 (0.01)	-1.5 (0.01)	-1.9 (0.01)
Dummy, 1984	-1.6 (0.05)	-0.52 (0.01)	-1.4 (0.01)	-1.9 (0.01)
Dummy, 1985	-1.6 (0.05)	-0.50 (0.01)	-1.4 (0.01)	-1.9 (0.01)
Dummy, 1988	-2.6 (0.06)	-1.2 (0.02)	-2.4 (0.02)	-3.0 (0.02)
Log(mean y)	0.72 (0.003)	0.86 (0.001)	-0.25 (0.001)	-0.31 (0.001)
Log(mean y) x period 2	0.13 (0.004)	0.038 (0.001)	0.14 (0.001)	0.18 (0.001)
Log(mean y) x period 3	0.23 (0.005)	0.10 (0.001)	0.23 (0.002)	0.28 (0.001)
Log(y / mean y)		0.82 (0.002)		-0.30 (0.002)
Log(y / mean y) x period 2		0.058 (0.003)		0.15 (0.002)
Log(y / mean y) x period 3		0.13 (0.003)		0.25 (0.003)
Observations	53,703	53,703	53,703	53,703
R-square (Adj.)	0.84	0.99	0.76	0.86

Table A.2: Share Equation Estimates from the Second Step
(nominal standard errors in parentheses) /a

Variable	Coefficient	Variable	Coefficient
Intercept	-0.092	Log(Y*)	0.017
	(0.01)		(0.0007)
Age	-0.0013	Log(Y/Y*)	-0.036
	(0.0002)		(0.001)
Age squared	2.4E-05	Log(P*)	0.20
	(1.6E-06)		(0.01)
Married	-0.0059	Log(P/P*)	-0.010
	(0.0011)		(0.005)
Exemptions	0.0015	Log(P/P*) ^2	0.16
	(0.0003)		(0.009)
Dummy, 1980	0.0068	Log(P) Log(P*)	0.093
	(0.001)		(0.005)
Dummy, 1983	0.011		
	(0.001)	Var(delta) /b	0.0035
Dummy, 1984	0.008	Var(epsilon)	0.0029
	(0.002)		
		Total error variance	0.0064
Dummy, 1985	0.007		
	(0.002)	Var(dependent variable)	0.0071
Dummy, 1988	-0.017	Observations	53,703
	(0.002)		

Notes:

/a Estimates from two-stage least squares; Standard errors uncorrected fo error-term correlations caused by individual-specific random effects.

/b Variance of individual-specific random effect

Figure 1. Age Pattern of Giving as a Fraction of Modified Income (Pg/Y)