The Distribution of Charitable Giving, Income and Taxes: An Analysis of Panel Data*

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Abstract

This study develops and implements a new empirical framework for analyzing how persistent and transitory changes in incomes and prices affect charitable donations. In contrast to previous empirical research, our estimator treats both transitory and persistent components of income and prices as latent variables and hence avoids the strong assumptions necessary to decompose income and prices based on the limited information in the data set. We estimate the model using a 15-year panel of individual tax returns collected by the Internal Revenue Service. The empirical findings of this paper indicate that persistent income changes have substantially larger impacts on charitable behavior than transitory changes. Additionally, there are substantial effects of persistent changes in the tax prices, with elasticities ranging from -0.79 to -1.26. The effects of transitory price changes are small.

KEYWORDS: Charitable Donations, Incentive Effects of Taxation, Permanent Income Hypothesis, Distributional Analysis.

JEL classification: C33, D12, H24.

1 Introduction

As has been often noted, charitable organizations play an important role in American society, and one of their major sources of revenue is private donations. Given this quantitative importance, the continuing interest in tax reform, and the ready availability of data, it is not surprising that the empirical economics literature contains numerous studies of charitable giving, with special emphasis on the effect of taxes. The early empirical studies estimated both price and income elasticities based on cross sectional data and found the elasticity of giving with respect to the tax-defined price of giving was greater than one in absolute value.[1] Recently, however, several studies have challenged these findings.[2] In particular, Randolph (1995) argues that estimates of price and income elasticities based on the analysis of cross sectional data sets tend to be systematically biased since they incorrectly ascribe permanent significance to variations in prices that are in fact heavily influenced by transitory fluctuations in income. He suggests that, although people appear to smooth their giving in response to transitory variations in income, the effect of variations in price is just the opposite: they tend to increase their gifts in years when transitory income is the highest in order to take advantage of the unusually high tax rate in those years.

An obvious problem encountered in any attempt to separate permanent from transitory income and price effects is that data sets that are used only contain measures for current income and prices, not their transitory and persistent components. This creates a complicated latent variable problem in estimation. Empirical studies of charitable giving that

[1] For surveys of the earlier literature see, for example, Clotfelter (1985) or Steinberg (1990).

[2] See, for example, Barrett (1991), Ricketts and Westfall (1993), Randolph (1995), Barrett, McGuirk, and Steinberg (1997) and Bakija (1998).

include permanent income attempt to measure it by a weighted average of incomes in two or more years.[3] A similar procedure is used for prices. This approach not only presumes that researchers can decompose incomes and prices based on the limited information in the sample, but also that econometricians have for all practical purposes the same information set as individuals in the sample and hence use the same decompositions. As noted earlier by Muth (1960) and Lucas (1976), the validity of this procedure depends ultimately on the stochastic properties of income and prices. Using finite-lag averages is highly restrictive and typically leads to misspecification problems.

In light of these problems, we pursue a new approach for identifying and estimating transitory and persistent price and income effects. Imposing some modest assumptions on the distribution of prices and incomes allows us to decompose the sample variances and covariances into transitory and persistent components. We show that this decomposition of the sample variance-covariance matrix is sufficient to identify and estimate the parameters of interest.[4]

During the time period studied in this paper, tax reforms in 1981 and 1986 significantly altered the distribution of tax rates. These reforms not only lowered the level of tax rates for most individuals, they also broadened the income tax brackets, reduced the number and range of marginal tax rates, and hence created a strong trend towards more uniformity in

[3] An early study to adopt this approach is Feldstein and Clotfelter (1976), who employ a two-year average of income. More recently, Randolph (1995) approximates permanent income as a function of instruments, including a 10-year average of income.

[4] Our approach is related to the empirical literature on testing the Permanent Income Hypothesis. Following the seminal work by Hall (1978) and Hall and Mishkin (1982), there have been a number of papers which test the PIH under alternative assumptions. See, among others, Flavin (1981), Altonji and Siow (1987), Deaton (1987), Pischke (1995) and Blundell and Preston (1998). In comparison to this literature, our study focuses on one specific component of household expenditures and analyzes both price and income effects.

the distribution of tax rates. Most empirical studies have typically focused on the changes in the levels of the tax rates and ignored the fact that these tax reforms had equally large effects on the higher moments of the distribution of taxes. In contrast to almost all prior empirical work, the estimation procedure developed in this paper allows us to account for the changes in the underlying distributions of taxes, incomes and donations.

We estimate the model using an unusually rich panel data set of tax returns, with up to 15 years of annual data at the individual level and oversampling of affluent individuals. The empirical findings of this paper indicate that persistent price and income changes have substantially larger impacts on charitable behavior than their transitory counterparts. Furthermore, failure to control for deviations from stationarity results in estimates that are sensitive to the choice of the sampling period. Finally, the empirical findings document a rising variance of incomes and a declining variance of prices. The trend toward more inequality in income is stronger than the trend toward more uniformity in tax prices, which partially explains a trend towards more inequality in donations.

The rest of the paper is organized as follows. Section 2 of the paper presents a dynamic model of charitable giving that serves as a motivation for our empirical analysis. We then provide an intuitive explanation of the basic ideas behind our estimation approach and discuss in detail how our approach differs from those used in the previous literature. Section 3 describes the data used in the empirical analysis. Section 4 presents the estimation results. There is a brief concluding section.

2 Estimating a Dynamic Model of Charitable Donations

A reasonable starting point for analyzing charitable donations is a dynamic model of individual behavior in the presence of income taxation.[5] We assume that each individual has preferences defined over current and future levels of consumption, C_t, and charitable donations, G_t. The preferences of an individual are represented by a time-separable (expected) utility function with constant discount factor, β, of the form:

$$E_t \left\{ \sum_{s=t}^{\infty} \beta^{s-t} \, U(G_s, C_s) \right\} \tag{2.1}$$

where $U(G_t, C_t)$ denotes the within-period utility function which satisfies the standard regularity assumptions and E_t denotes the expectation operator conditional on information available at time t. Each individual faces a sequence of budget constraints which can be expressed as:

$$C_t \; + \; G_t \; + \; W_{t+1} \quad = \quad (1 + r_t)\, W_t \; + \; Y_t \; - \; T_t(r_t\, W_t,\; Y_t,\; G_t) \tag{2.2}$$

where W_t denotes wealth at the beginning of period t and r_t is the interest rate. Taxes $T_t(\cdot)$ are a function of income from capital, $r_t\, W_t$, earnings Y_t and charitable contributions. Individuals maximize expected utility subject to a sequence of budget constraints. We obtain two sets of optimality conditions. The first set governs the optimal allocation of

[5] We follow the empirical literature on charitable donations and analyze the decision problem of the individuals treating donations as a private consumption good. We are hence abstracting from the public good component of donations. For a theoretical treatment of equilibrium models of charitable donations see, for example, Bergstrom, Blume, and Varian (1986), Steinberg (1987), Andreoni (1989, 1998), Glazer and Konrad (1996) and Harbaugh (1998).

resources within periods:

$$(1-\tau_t)\,\frac{\partial U}{\partial C_t} \;=\; \frac{\partial U}{\partial G_t} \tag{2.3}$$

Individuals equate their marginal rate of substitution of donations and consumption to the tax price of donations $P_t = 1 - \tau_t$ (assuming an interior solution). Additionally, optimal intertemporal allocations must satisfy the following Euler Equation:

$$\lambda_t \;=\; E_t(R_{t+1}\,\lambda_{t+1}) \tag{2.4}$$

where $R_t \;=\; (1 + (1-\tau_t)r_t)$ and λ_t is the Lagrange multiplier associated with the budget constraint of period t. Equation (2.4) equates the relative shadow prices of wealth across time periods.

The first order conditions and budget constraints implicitly define consumption and charitable giving of individuals across time. One of the main problems encountered in empirical analysis is that optimal decision rules generated by these types of models typically do not have nice closed-form solutions. In principle, optimal decision rules can be derived using numerical dynamic programming techniques. This approach is computationally intensive, since it is often easier to estimate linear approximation of the decision rules. Most earlier empirical studies on charitable donations can thus be interpreted as estimating different versions of linear approximation of decision rule of the following type:

$$g_t \;=\; b_0 \;+\; b_1\,p_t \;+\; b_2\,y_t \;+\; u \;+\; \epsilon_t \tag{2.5}$$

where ϵ_t captures the time varying error term and u is a time invariant fixed effect which captures unobserved heterogeneity (state variables).[6] To keep the notation simple we suppress the individual specific index i and also the vector x_t, which is typically included in all estimated equations to account for observed heterogeneity among individuals. In the current paper we follow common practice and use the logarithms of incomes, prices and donations in the empirical analysis. We denote the logarithm of these variables by lower case letters. Since individuals surely differ in generosity for a host of reasons unrelated to income and taxes, we take first differences to control for unobserved heterogeneity (fixed effects) in the panel, allowing the equation above to be rewritten as:

$$\Delta g_t \quad = \quad b_1 \, \Delta p_t \; + \; b_2 \, \Delta y_t \; + \; \Delta \epsilon_t \tag{2.6}$$

The parameters of this model can be estimated using least squares or IV estimators which control for potential endogeneity of prices.

One of the main drawbacks of the theoretical model presented above is that it does not distinguish between transitory and persistent components of incomes and prices. Randolph (1995) argues that estimates of price and income elasticities based on equation (2.6) tend to be systematically biased since they incorrectly ascribe permanent significance to variations in prices and incomes that are in fact heavily influenced by transitory fluctuations. Therefore we need to decompose income and price into a transitory and persistent component:

$$y_t \quad = \quad y_t^p \; + \; y_t^t \tag{2.7}$$

$$p_t \quad = \quad p_t^p \; + \; p_t^t \tag{2.8}$$

[6]Ideally, we would like to add wealth as a state variable to our decision rule. Unfortunately, our data set does not allow us approximate wealth in any reliable way. This drawback of our analysis is shared with almost all previous empirical work in the area.

Optimal decision rules of the modified model depend on the new state variables y_t^p, y_t^t, p_t^p and p_t^t. Consequently, the model we would like to estimate is given by the following equation:

$$\Delta g_t \;=\; b_1\, \Delta p_t^p \;+\; b_2\, \Delta p_t^t \;+\; b_3\, \Delta y_t^p \;+\; b_4\, \Delta y_t^t \;+\; \Delta \epsilon_t \tag{2.9}$$

Estimates for both price and income elasticities of charitable givings based on equation (2.6) will be inconsistent if (2.9) is the correct model specification.

Estimating a model which differentiates between transitory and persistent components of income and prices creates significant additional problems. An obvious problem encountered in estimating equation (2.9) is that none of the variables on the right hand side of the equation are directly observed by the econometrician. Researchers, in contrast to individuals, only observe current incomes and prices and not their persistent and transitory components. Data sets only contain measures of the left hand side of equations (2.7) and (2.8) and not the right hand side. This gives rise to a complicated latent variable problem in estimation. All prior empirical studies that have attempted to distinguish between persistent and transitory effects of any kind on charitable donations share the feature that they avoid this latent variable problem by attempting to decompose observed price and income variables into their unobserved components for each individual in the sample. Given the information available in most data sets, the commonly applied algorithms do not necessarily yield reliable decompositions. For example, Randolph (1995) approximates permanent income by a weighted average of income in different periods. A similar procedure is used for prices. This approach not only presumes that the researcher can decompose income and prices based on the limited information in the sample, but also that he or she has, for all practical purposes, the same information set as the individuals in the sample and hence use the same decompositions. As noted by Muth (1960) and Lucas (1976), the validity of this procedure depends ultimately on the stochastic properties of incomes and prices. In particular, using finite-lag averages is highly restrictive.

Another problem associated with the commonly used decomposition techniques is that they yield proxies for permanent income and prices which are time-invariant in the sample. This makes it impossible to control for fixed effects in estimation since the coefficients for permanent income and prices are not identified. Time-invariant measures of permanent income also seem to be odds with most findings in the empirical literature on earnings profiles, which are typically estimated to be hump-shaped. In the case of permanent prices, using time-invariant measures ignores the impact of tax reforms on tax prices.[7]

The main insight of recent research on the Permanent Income Hypothesis is that it is not necessary to decompose income and prices for every single individual to identify and estimate the parameters of interest. Rather, a much less restrictive approach is to impose some plausible assumptions on the distribution of income and prices. This makes it possible to decompose the sample variance-covariance matrix, the components of which are sufficient statistics in the estimation algorithm.

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[7] Permanent changes of tax prices arise in some cases due to major revisions of the tax law. The 1981 and 1986 tax reforms were both of this sort. Transitory changes affect prices only in the short run. One example would be the 1985 and 1986 partial and complete deductions of charitable givings for nonitemizers. Other examples include the Economic Recovery Tax Act of 1981 which phased in a series of reductions in marginal tax rates starting with a 1.25 percent tax credit in 1981 and then phasing in with 10, 10 and 5 percent rate cuts for 1982-84. Tax Reform Act of 1986 had a set of transition tax rates for 1987. The top rates were 50, 38.5 and 28 for 1986-88. Both of these created transitory price changes if one views the fully phased in rate as the permanent rate.

To illustrate the basic idea behind the estimation procedure, consider the problem of decomposing the observed variance of income into its two components. The key insight is that any shock causing a persistent change in income, by definition, affects the levels of income in all succeeding time periods. In other words, it reflects a shift in the lifetime profile of income. If we difference the data, this property of persistent income changes implies that these shocks affect only the variance of the growth rate of income, not its autocovariances. In contrast, a transitory change in income affects only the levels of income in the short run. Transitory shocks induce variation of income around its lifetime path. One can show that such a shock will affect both the variance and the autocovariances of the growth rate of income. By analyzing the observed variance and autocovariance of the change in income, we can therefore decompose the observed variance of income into the two components of interest. This idea can be easily extended to study the multivariate distribution of incomes, prices and donations. In the remainder of this section we formalize these ideas and derive the estimator for the underlying parameters of interest.

Following Hall and Mishkin (1982), we assume that the persistent component of income follows a random walk, $y_t^p = y_{t-1}^p + \xi_t$, where the ξ_t's are i.i.d. random variables. By virtue of this shock the path of lifetime income undergoes a permanent shift. Changes exogenous to the individual, such as promotions or lasting changes in business fortunes, would affect y_t^p. The transitory component of income is given by $y_t^t = \eta_t$. The transitory component hence captures variations around the lifetime path of income. The change in income is given by:

$$\Delta y_t = \Delta y_t^p + \Delta y_t^t = \xi_t + \eta_t - \eta_{t-1} \tag{2.10}$$

This specification yields exactly the decomposition of the variance of income discussed above. One can easily show that autocovariances of the change of income are given by:

$$\sigma_{\Delta y_t,\, \Delta y_{t-s}} \quad = \quad \begin{cases} \sigma_\xi^2 \;+\; 2\,\sigma_\eta^2 & s = 0 \\ -\sigma_\eta^2 & |s| = 1 \\ 0 & |s| > 1 \end{cases} \tag{2.11}$$

Hence the variance of the change in income is the sum of the permanent component plus twice the transitory component. The covariance between the change of income and the lagged change of income equals in absolute value the variance of the transitory component. A persistent shock affects only the variance of the change in income while a transitory shock also affects its autocovariances.

Appealing to a similar argument, we assume that the transitory and the persistent components of prices are given by the following specification:

$$p_t^p \quad = \quad p_{t-1}^p \;+\; \omega_t \;+\; a_1\,\xi_t \tag{2.12}$$

$$p_t^t \quad = \quad \zeta_t \;+\; a_2\,\eta_t \tag{2.13}$$

where a_1 and a_2 capture the fact most changes in prices are induced by changes in income. The change in prices is hence given by the following expression:

$$\Delta p_t \quad = \quad \Delta p_t^p \;+\; \Delta p_t^t \;=\; \omega_t \;+\; a_1\,\xi_t \;+\; \zeta_t \;-\; \zeta_{t-1} \;+\; a_2\,(\eta_t - \eta_{t-1}) \tag{2.14}$$

Using a similar approach to that in the case of income, we can decompose the variance of Δp_t into its components by analyzing the variances and autocovariances of prices as well as the covariances between income and prices. This specification nests the case in which all variation in prices is to due to income, which is obtained by setting $\sigma_\omega = 0 = \sigma_\zeta$. In this limiting case, we cannot identify the coefficients b_3 and b_4. Identification of the tax price effects hence rests on the nonlinearity of the tax system, a feature common to the literature on charitable giving and income taxation. One of the attractive features of our estimation approach is that it produces estimates of σ_ω and σ_ζ, which allows us to evaluate the identifying assumptions for the price effects. Drawing on the specifications for income and price above, equation (2.9) can be rewritten using equations (2.10) and (2.14) as follows:

$$\begin{aligned}\Delta g_t \;&=\; b_1\,(\omega_t \,+\, a_1\,\xi_t) \,+\, b_2\,(\zeta_t \,-\, \zeta_{t-1} \,+\, a_2(\eta_t \,-\, \eta_{t-1})) \\ &\quad + b_3\,\xi_t \,+\, b_4\,(\eta_t \,-\, \eta_{t-1}) \,+\, \psi_t \,+\, \epsilon_t \,-\, \epsilon_{t-1}\end{aligned}$$

Notice that we have added a persistent shock, ψ_t, to the donations equation. This term reflects persistent shocks of donations which are unrelated to income and prices. The basic econometric model used in the present study is completely characterized by equations (2.10), (2.14) and (2.15). The structural parameters of the three equations are:

$$\theta \;=\; (\sigma_\xi, \sigma_\omega, \sigma_\eta, \sigma_\zeta, \sigma_\psi, \sigma_\epsilon, a_1, a_2, b_1, b_2, b_3, b_4) \tag{2.15}$$

In the basic model we assume that all shocks are i.i.d. with mean zero and constant variance. In the empirical analysis, we relax this assumption and include time-varying variances of the persistent and transitory shocks. This allows us to control for the fact that the distribution of taxes, incomes and donations changed substantially during the sample period.

Estimation of the model proceeds sequentially. First, we regress the changes of incomes, prices and donations on a number of demographic characteristics, including age, number of children and marital status as well as year dummies. The purpose of these regressions is to control for observed heterogeneity in the sample. The basic idea of the second stage of the estimation procedure is to investigate whether the econometric model described above can replicate the observed variance-covariance structure of the changes in incomes, prices and donations.[8] The data set used in this paper covers the period 1979 through 1993 and hence consists of 15 consecutive time periods. We can show that our econometric model imposes 15 non-zero restrictions on the covariance matrix in each period. If our model is correctly specified, the difference between the observed and the predicted covariance structure should be small if it is evaluated at the true parameter values. We can, therefore, estimate θ using a Minimum Distance Estimator (Chamberlain, 1984).[9]

3 The Data Set

The data used in the present paper are taken from an Internal Revenue Service 15-year panel of tax returns, that covers the time period 1979 to 1993. The panel contains information taken from federal income tax returns of more than 20,000 individuals. The original sample was stratified to over-sample individuals who reported high incomes in 1981. These high-income individuals are of particular interest in any study of charitable giving because they contribute large amounts to charity and hence account for a disproportionate fraction

[8] The same approach is taken by MaCurdy (1982), Abowd and Card (1989), Pischke (1995) and Moffitt and Gottschalk (1995) in studies of earnings, wages and consumption.

[9] An appendix is available upon request from the authors in which we show how to compute the variance-covariance matrix of the three variables as predicted by the baseline econometric model and discuss the estimator above in detail.

of total contributions. The sample is generally restricted to those taxpayers who itemized deductions, since information on donations for nonitemizers is typically not available. Non-itemizers are included in 1985 and 1986, when they were allowed to deduct, respectively, half and all of their contributions.

Following previous studies, we measure charitable donations as the amount of charitable deduction claimed on the tax return. The tax price is obtained by computing the tax first with charitable contributions set to zero and then after adding an increment of "predicted" charitable giving. In order to reflect the effects of the tax law on gifts of appreciated property, the price is computed as a weighted average of the price of giving cash and the price of giving appreciated property. Income is defined as constant law adjusted disposable income.[10]

Table 1: Weighted Sample Means

	1980	1981	1982	1983	1984	1985	1986
Income	68,744	65,871	64,940	65,926	67,377	66,425	70,394
Price	0.686	0.678	0.705	0.728	0.732	0.744	0.740
Donations	1,750	1,705	1,635	1,712	1,730	1,854	1,903
	1987	1988	1989	1990	1991	1992	1993
Income	74,094	88,020	82,622	85,923	81,039	84,758	85,803
Price	0.753	0.762	0.761	0.761	0.764	0.766	0.761
Donations	1,829	2,119	2,204	2,155	2,078	2,196	2,255

The average age of individuals is approximately 49 years at the beginning of the sample

[10] An extended discussion of our data set, the exact definitions of the variables used in the analysis are given in an appendix, which is available upon request from the authors. To facilitate comparison to previous studies, definitions and sample restrictions generally follow standard practices for charitable giving studies, such as excluding low-income and dependent filers, excluding endogenous itemizers who would not have itemized in the absence of charitable contributions.

in 1980. On average, 86 percent of the sample are married, 29 percent are retired, 26 percent report income from self-employment in any given year of the sample. Table 1 reports the weighted means of the three most important variables in the data set across time.

A number broad generalizations can be made about individual giving behavior, each of which invites explanation. First, and most obviously, the amount that individuals contribute tends to rise with income. Of course, because of the progressive rate structure in the individual income tax, this also means that giving tends to be inversely related to the price of giving. Price differences among individuals declined throughout the observation period, reflecting tax reforms in 1981 and 1986 that reduced marginal tax rates faced by upper income taxpayers, and increased slightly in 1993 due to the tax increases in the Deficit Reduction Act. The second regularity about charitable giving is that, even among those with similar incomes, the level of contributions differs significantly, with the result that a relatively small number of individuals at each income level account for the bulk of all giving. For example, consider the 14 million itemizers with incomes between $50,000 and $100,000 in 1995. While these tax payers made contributions averaging 2.6 percent of their income, the median percentage was only 1.4 percent (Auten, Clotfelter, and Schmalbeck (1997), Table 1). In contrast to the previous literature, our estimation approach not only controls for fixed effects, but also for the trend toward more inequality in the distribution of income and giving observed during the 1980's.

4 Estimation Results

The estimation proceeds in two steps. First, we control for differences in observed heterogeneity among individuals and regress the changes in incomes, prices and donations (in logarithms) on a number of exogenous characteristics. In the regressions we use dummy variables indicating whether an individual received wage income, is self-employed, retired, married, a household head, or has children as regressors, variables which previous studies have found to affect contributions. We also control for age by specifying the conditional expectation as cubic in age and use dummy variables to capture time effects. We pool the observations across time periods and estimate the parameters of the simple regression models using OLS. Next we compute the covariance matrix of the residuals of these regressions, which is reported in Table 2.

The first section of the table gives correlations for contemporaneous changes in the three variables. For income and prices, the correlations range from -0.17 to -0.45 reflecting the progressive rate structure of the income tax. The corresponding correlations between income and donations are positive, as expected, with a median value of 0.32. The correlations between changes in price and donations range from -0.13 to -0.27 throughout the observation period. The remainder of the table shows correlations of each variable to the next year's value of each of the three. Particularly noteworthy are the first-order autocorrelations of income, prices and donations. They are negative without exception, indicating a large transitory component in the variances of incomes, prices and donations. The stationary econometric model also implicitly assumes that the growth rates of the three variables of interest follow a multivariate moving average (MA) process, and that all correlations

Table 2: Contemporaneous and First-Order Correlation Coefficients

	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	median
$\Delta y_t,\ \Delta p_t$	-0.32	-0.24	-0.17	-0.29	-0.32	-0.32	-0.29	-0.30	-0.35	-0.45	-0.43	-0.38	-0.34	-0.32
$\Delta y_t,\ \Delta g_t$	0.30	0.28	0.16	0.30	0.32	0.28	0.32	0.26	0.39	0.42	0.35	0.43	0.36	0.32
$\Delta p_t,\ \Delta g_t$	-0.18	-0.17	-0.15	-0.24	-0.23	-0.19	-0.23	-0.27	-0.19	-0.20	-0.15	-0.16	-0.13	-0.18
$\Delta y_t,\ \Delta y_{t+1}$	-0.18	-0.53	-0.22	-0.28	-0.31	-0.28	-0.39	-0.25	-0.34	-0.24	-0.27	-0.22	-0.30	-0.28
$\Delta y_t,\ \Delta p_{t+1}$	0.08	0.16	0.03	0.07	0.11	0.10	0.12	0.19	0.09	0.10	0.08	0.09	0.01	0.09
$\Delta y_t,\ \Delta g_{t+1}$	-0.03	-0.09	-0.01	-0.05	-0.05	-0.03	-0.08	-0.08	-0.08	-0.08	-0.05	-0.03	-0.06	-0.05
$\Delta p_t,\ \Delta y_{t+1}$	0.04	0.11	0.02	0.04	0.09	0.07	0.0	0.11	0.03	0.13	0.11	0.06	0.08	0.07
$\Delta p_t,\ \Delta p_{t+1}$	-0.32	-0.43	-0.24	-0.32	-0.37	-0.36	-0.39	-0.10	-0.22	-0.35	-0.29	-0.37	-0.23	-0.32
$\Delta p_t,\ \Delta g_{t+1}$	0.02	0.04	0.00	0.01	0.04	0.04	0.02	0.03	0.04	0.03	0.02	0.02	0.01	0.02
$\Delta g_t,\ \Delta y_{t+1}$	-0.01	-0.12	-0.03	-0.04	-0.03	-0.03	-0.11	0.00	-0.05	-0.06	-0.01	0.00	-0.06	-0.03
$\Delta g_t,\ \Delta p_{t+1}$	0.01	0.09	0.01	0.02	0.00	0.02	0.00	-0.07	0.01	0.01	0.00	0.02	0.02	0.01
$\Delta g_t,\ \Delta g_{t+1}$	-0.27	-0.37	-0.33	-0.31	-0.32	-0.31	-0.31	-0.27	-0.31	-0.34	-0.31	-0.29	-0.36	-0.31

Almost all estimates are significantly different from zero at the 99 percent confidence level.

are constant across time periods. An inspection of Table 2 shows, however, that the data do not exhibit this property. There is a substantial amount of variation in the estimated correlations across time, which suggests that a nonstationary version of our model is more appropriate. The MA(1) framework also implies that all second- and higher-order correlations should be equal to zero. In our sample, we do find that most of these correlations are small and in many cases not significantly different from zero.[11]

These findings have a number of interesting implications for modeling charitable behavior. First of all, they suggest that habit formation is probably not very important in charitable behavior. If habit formation were important, we would expect that higher order autocorrelations of donations would be significantly different from zero. However, we find little support for that in our sample. Second, it has been argued in the literature that agents' decisions depend on past or future prices. These dependencies, if important, would be captured in the correlations between donations and lagged changes in prices or lagged donations and current prices. We also find little supporting evidence for that hypothesis.

We estimate two different model specifications. The parameter estimates of the price and income coefficients and the estimated standard errors are shown in Table 3. The results in columns I through III are based on a stationary model which assumes that the covariance structure is constant during the time period. Our preferred model is the nonstationary model, which relaxes this assumption and allows for time-varying variances of persistent

[11] This result is quite in line with previous research using similar models in other applications. MaCurdy (1982), Abowd and Card (1989) and Pischke (1995) find that changes in earnings follow an MA(2) process. The estimates for the first-order correlations are between -0.25 and -0.4. The second-order correlations are close to zero, which suggests that the gains from including a second order component are negligible. This implies that the nonstationary MA(1) specification captures the most important features of the covariance structure.

and transitory income and prices. The estimation results for this specification are shown in columns IV through VI. We estimate each model for three subsamples, which allows us to investigate the impact of the two main tax reforms in 1981 and 1986 in detail.[12]

Table 3: Parameter Estimates

	I	II	III	IV	V	VI
	80-83	80-87	80-92	80-83	80-87	80-92
	Stationary	Stationary	Stationary	Nonstationary	Nonstationary	Nonstationary
Persistent price	-1.74	-2.13	-0.31	-0.79	-1.26	-1.26
	(0.09)	(1.17)	(0.15)	(0.04)	(0.04)	(0.04)
Transitory price	-0.04	-0.14	-0.02	-0.52	-0.61	-0.40
	(0.08)	(0.20)	(0.10)	(0.04)	(0.04)	(0.04)
Persistent income	0.48	0.74	0.91	0.40	0.49	0.87
	(0.03)	(0.11)	(0.02)	(0.02)	(0.01)	(0.01)
Transitory income	0.31	0.29	0.30	0.45	0.49	0.29
	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)

Estimated standard errors are given in parentheses.

When estimating the stationary model (columns I through III), we find that estimates of the price elasticity of giving are sensitive with respect to the sample period. Since we do not believe that the underlying behavioral parameters which characterize the price elasticity of giving changed so much during the time period, we interpret this finding as evidence against stationary models. The main reason for the problems encountered in estimating price and income elasticities is that tax reforms passed during this time period significantly altered the distribution of tax rates. While most empirical studies have typically focused on the changes in the levels of the tax rates, they have typically ignored the fact that these tax reforms

[12] We also estimated pooled regression models using OLS (Fixed Effects, Random Effects). We find that the estimated price elasticity is -0.69 (-0.46, -0.68) and the estimated income elasticity is 0.89 (0.36 , 0.90). When we estimate a simple cross-section model for 1980, a year in which the maximum tax rate was 70 percent, the price elasticity was -1.16 and the income elasticity was 0.80, which corresponds with the results of many cross-section studies under this tax regime.

had even larger effects on the higher moments of the distribution of taxes. In particular, the variation in tax prices decreased significantly after 1982 because of the reduction in tax rates under the Economic Recovery Tax Act of 1981 (ERTA) and TRA of 1986.[13] The empirical findings reported in Column I through III indicate that failing to control for these changes in the distribution of taxes may lead to price elasticity estimates that are unusually sensitive to the choice of the sample period.[14]

The nonstationary specification of our model overcomes most the drawbacks associated with previous estimators and controls for the changes in the covariance structure of prices, incomes and giving. The estimates of the persistent price elasticity reported in columns IV through VI range from -0.79 to -1.26. Although the former is smaller in absolute value than most of the conventional estimates based on cross-section analyses, they are all larger in absolute value than recent estimates of the elasticity with respect to the permanent price based on analyses of panel data.[15] The elasticity of giving with respect to transitory price changes is much smaller in magnitude than its permanent counterpart and ranges from -0.40 to -0.61. These rather small estimated transitory price effects contrast sharply with previous estimates from panel studies.[16] The point estimates of the elasticity of donations with respect to persistent income shocks range between 0.40 and 0.87. These estimates are certainly within the range of most estimates of both traditional studies using cross-section data and more recent studies employing panel data; they imply that the tax code exerts

[13]For 1979 and 1980, income tax rates ranged from 20 to 70 percent. For 1981, ERTA reduced these rates through a 1.25 percent tax credit. For 1982, tax rates were reduced to a range of 12 to 50 percent.

[14]OLS, fixed and random effects estimators also seem to suffer from this problem.

[15]Comparable point estimates from this latter group are -0.51 (Randolph 1995, p. 724), -0.47 (Barrett, McGuire, and Steinberg (1997, p. 328), and -0.29 and -0.40 (Bakija 1998, pp. 25-26, 28).

[16]Randolph's basic specification yields a point estimate of -1.55, and Bakija's (1998, pp. 25-26, 28) equations imply values of -1.15 and -1.96, respectively.

an impact on donations by affecting disposable income.[17] The estimated elasticity with respect to transitory income ranges from 0.29 to 0.45, making the ratio between permanent and transitory effects roughly two to one. These elasticities are smaller than comparable point estimates from panel studies, but not significantly so.[18]

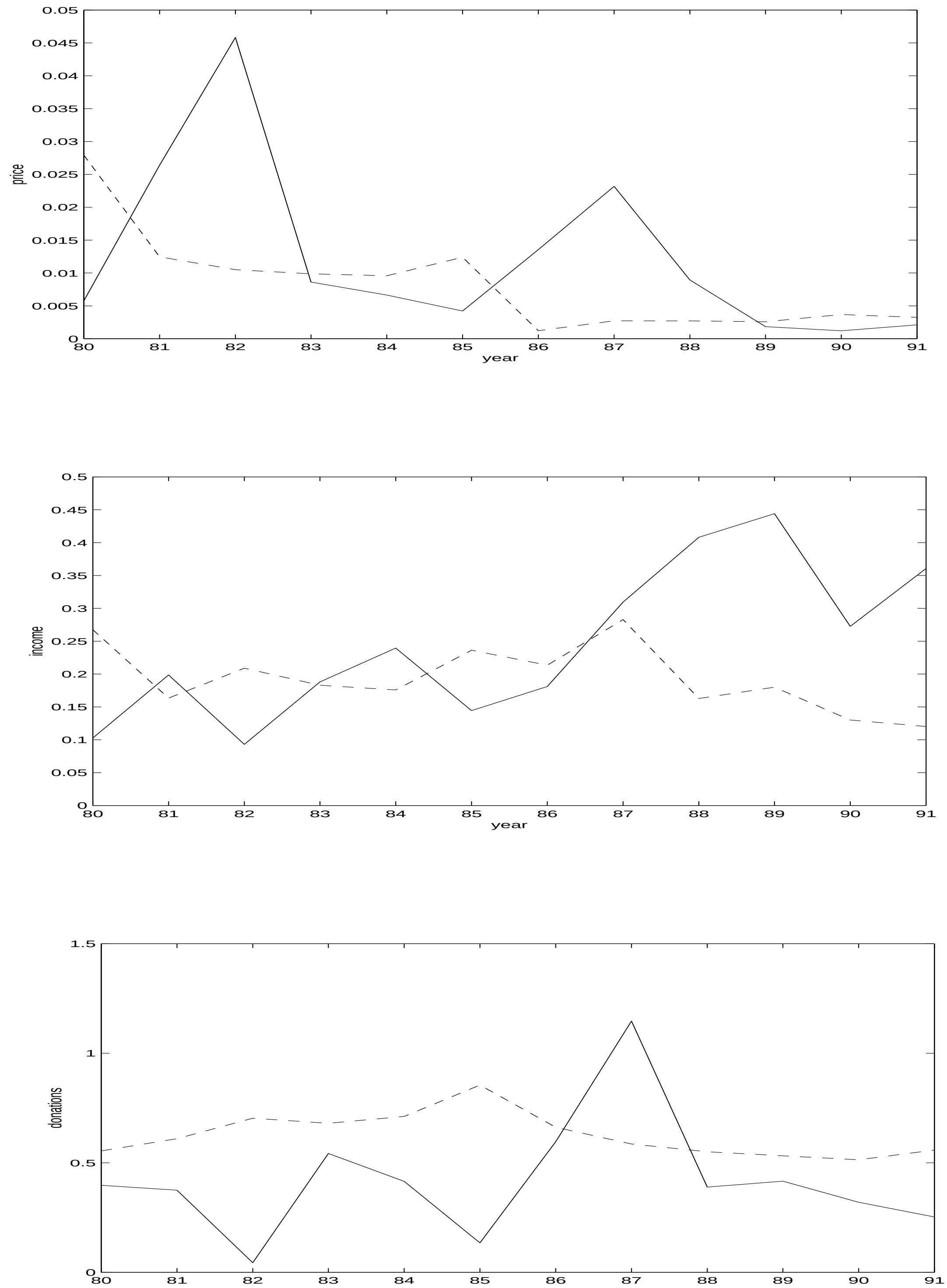
To investigate the nature of the changes in the distribution of prices, incomes and donations more carefully, we plot the estimated variances of the persistent and transitory components of each variable based on the estimation results shown in column VI. The first graph in Figure 1 plots the estimated variances of the transitory and the persistent component of prices during the 1980's. The estimated variance of the persistent component of tax prices shows two spikes which are due to two major tax reforms enacted in the 1980's. These tax reforms permanently changed the tax code. It is reassuring that our estimates of the persistent component of the variances pick up these changes very well. This lends strong additional support to our framework. Furthermore, we find that tax prices showed a significantly lower dispersion at the end of the 1980's than at the beginning of the decade. This trend toward more uniformity in tax rates is reflected in both the transitory and the persistent components. This finding is, at least partially, a direct result of tax reforms that broadened the income tax brackets and reduced the number and range of marginal tax rates.

The second graph in Figure 1 plots the estimated variances of the two components of income. We find that the estimated variance of the persistent income shocks increased during most of the 1980's, which reflects the well-documented trend toward increasing

[17] An exception is Randolph (1995) estimated permanent income elasticity of 1.14.

[18] Randolph (1995, p. 724) produces a point estimate of 0.58 and Bakija (1998, p.25-26) one of 0.79.

Figure 1: Estimated Variances of Persistent Shocks



— permanent, - - transitory.

income inequality during that time period. In particular, there was a significant increase in the variance of the persistent component of income in the second half of the 1980's. There were also significant changes in the variation of donations that were unrelated to changes in the distribution of prices and income; these are illustrated in the third graph of Figure 1. The variances of the persistent component of donations increased through most of the 1980's, peaking in 1987, after which they fell markedly. The transitory component was relatively constant throughout the 1980's. The increase in inequality in donations was, therefore, primarily driven by the permanent component.

5 Conclusions

This study implies that taxes affect the level of contributions by way of a price effect and an income effect, each of which has two components, a transitory one and a persistent one. Of these, the most important behavioral aspect for considerations of tax policy is the persistent price effect, since transitory effects are, by their nature, passing and permanent income effects are likely to be minimal since most proposed tax reforms tend to leave undisturbed the distributional impact of taxes. Since there continues to be serious debate about tax proposals that could permanently change the price of giving, the effect of persistent price changes on charitable giving is therefore of great practical importance. The findings of this study suggest that persistent shocks in incomes have a substantially larger impact on charitable donations than do their transitory counterparts. These findings also imply that tax reforms can have long-lasting effects on charitable giving. Consider an itemizer facing a marginal tax rate of 30 percent under the present tax regime. A major tax reform that eliminates the deduction for contributions, such as the Armey-Shelby flat tax, would raise this taxpayer's price of giving from 0.70 to 1.00. The range of point estimates of the persistent price effect reported in the present paper, -0.79 to -1.26, would imply that this representative taxpayer's contributions would eventually settle at a level some 24 to 38 percent lower than it otherwise would have been had the tax code not been changed. While these reductions are smaller than what would have been implied by conventional price elasticities derived from cross-section data, they are nonetheless substantial in magnitude.

The empirical findings of this paper provide ample scope for future research to improve our understanding of the impact of income taxation on individual behavior and the design of tax policies. In particular, our analysis is implicitly based on the assumption that individuals know the realizations of all past and current taxes and incomes and hold expectations of future taxes and incomes. However, we do not model and estimate these beliefs directly. Hence, our analysis does not allow us to address the question of how changes in expectations of future tax policies affect charitable behavior. This question, which remains an important area for future research, is almost impossible to answer using reduced form estimation. The only feasible approach would be to follow a structural approach and model explicitly the evolution of individuals' beliefs over future tax policies. One could then derive the decision rules of a well-specified dynamic choice problem and evaluate how changes in the beliefs affect individual behavior. Combining our approach of modeling transitory and persistent components of income with a more structural approach of modeling beliefs over over future tax rates would provide the next step in our understanding of how uncertainty in taxes and incomes affects charitable behavior.

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