Estimating Charitable Deductions in *Giving USA*

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Abstract

Giving USA's annual estimates of charitable giving in the United States are widely used by practitioners, policy-makers, academics, and the media. In addition, each edition's estimate of giving for the previous year is the first indication of generosity in that year, and, as such, generates much publicity. Over 60 percent of this estimate is based upon the amount claimed as charitable deductions on federal income taxes. However, this amount is not known prior to the publication of *Giving USA* and therefore must itself be estimated. Different time-series models have been used in past editions of *Giving USA* to generate this estimate, but the quality of the estimates from these models has never been systematically examined.

This paper describes the model used in *Giving USA 2002* to estimate charitable deductions in 2001 and explains the criteria by which that model was selected. The paper also presents a systematic comparison of this model to others previously used in *Giving USA*. Over the 1990s, the most recent period for which an evaluation of the models is possible, the three most recent *Giving USA* models would have performed well. However, of these, the model presented herein would have provided somewhat more accurate estimates.

1. Introduction

The various editions of *Giving USA* provide the only available estimates of total charitable giving—i.e., gifts from individuals, corporations, foundations, and estates—in the United States. These estimates are widely cited by academics (e.g., Auten, Clotfelter and Schmalbeck 2000; Blank 1997; Boris and Steuerle forthcoming; Clotfelter 1985; Crittenden 2000; Hodgkinson 1990; Keirouz, Grimm and Steinberg 1999; O'Neill 2001; Putnam 2000; Schervish and Havens 1998a; Steuerle 2002; Weisbrod 1988; Wolpert 1993), practitioners (e.g., Chronicle of Philanthropy 2002; Independent Sector 2002; *New Nonprofit Almanac and Desk Reference* 2002; NonProfit Times 2002; United Way 2001), and policy-makers (e.g., Council of Economic Advisors 2000; Statistical Abstract 2002). Moreover, they receive substantial media attention (e.g., Associated Press 2002; Business Week 2002; New York Times 2002).

Charitable deductions itemized on individual federal income tax forms are by far the largest single component of total giving, accounting for over 60 percent. In contrast, giving by individuals who do not itemize, corporations, foundations, and via bequests each account for between five and 14 percent (e.g., see American Association of Fundraising Counsel Trust for Philanthropy 2002, henceforth AAFRC Trust). Unfortunately, information about charitable deductions is not available soon enough to be used in *Giving USA*'s estimates of total giving in the most recent years. Therefore, for these years, it is necessary to use a time-series model to estimate charitable deductions themselves. To this end, *Giving USA* has employed five different models since the 1984 edition. While the transition to each new model has been based on sensible reasons, there has not been a systematic evaluation of which model provides the best performance according to some specified criteria. It also follows that there may well be another model that outperforms all those previously tried.

This paper proposes criteria by which different time-series models for estimating charitable deductions can be compared. Using these criteria, the paper reports the best model that was found in an extensive search of different candidate models. The performance of this model is then compared to those used in previous editions of *Giving USA*. The model described in this paper is used in the 2002 edition of *Giving USA*. As such, this paper makes the methodology used to estimate charitable deductions in *Giving USA* transparent to the wider research community and provides a benchmark against which future research to improve the estimation of charitable deductions can be evaluated.

2. Overview

The edition of *Giving USA* to be published in year T+1 seeks to estimate giving in the previous year, T. Direct information about charitable deductions in year T is never available. A preliminary figure for charitable deductions in year $T-1$ is sometimes, though not always, available from the Statistics of Income Division (SOI) of the Internal Revenue Service. Moreover, the history of these preliminary figures shows that they turn out to be systematically lower than SOI's final figures. Therefore, a central task confronting *Giving USA* is to estimate charitable deductions in year T when SOI final figures on charitable deductions are available only for years T!2 and earlier. Year T information on other explanatory variables thought to be correlated with giving, such as income and the stock market, is also available to assist with the estimation. Thus, in the 2002 edition, charitable deductions in 2001 must be estimated using information on charitable deductions in 1999 and earlier and other explanatory variables in year 2001 and earlier. We refer to this as a "two-step ahead" estimation problem.

Of course, charitable deductions are not equivalent to all giving by individuals, and it is an estimate of the latter that *Giving USA* ultimately desires. To arrive at that, *Giving USA* begins with charitable deductions and adds to it an estimate of giving by households that do not itemize. The resulting amount is referred to as "total personal giving" (TPG). The precise details of how TPG was formed changed over time (see AAFRC Trust 1995, pp. 196-197 and 1998, pp. 173-176; Nelson, 1986, 1993), but what is important to note for present purposes is that through the 2000 edition, *Giving USA* used a time-series model to estimate TPG in year T. In the 2001 edition, a time-series model was used to estimate charitable deductions instead.

The different time-series models used to estimate TPG and charitable deductions are summarized in Table 1. The table shows that in the 1992 edition, a time-series regression model was used to estimate the historical relationship between TPG and the explanatory variables listed in column 4, assuming a double-log functional form (i.e., logarithmic transformations of TPG, Personal income, the S&P index, and the age variable were taken prior to estimation). The economic variables were not adjusted for inflation. The estimated historical relationship was then used with 1991 information on the explanatory variables to estimate 1991 TPG.[1]

There are several potential difficulties with this methodology. First, the historical relationship between TPG and the explanatory variables will shift if there is a change in the methodology used to create TPG, and the regression model must be revised to account for that methodologically-induced shift. Second, the double-log regression model generates an estimate of the logarithm of TPG, but the necessary transformation of this into the desired level of TPG raises several technical issues. Third, and most importantly, time-series regression models in levels are especially prone to indicating spurious relationships between variables (see Wooldridge 2000, pp. 584-586 for a discussion). Therefore, estimates based on such models can be unreliable.

A standard way to deal with spurious relationships in levels is to work with changes in variables rather than the levels. The methods used in the 1993 edition did just that, as well as abandoning the logarithmic transformation. At the same time a new methodology for creating TPG was implemented. Although this new methodology promised several advantages, data did not exist to implement it for the years 1983 and earlier. Thus, TPG was constructed differently

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1. This model was first used in *Giving USA 1985*, and is fully documented in Nelson (1986).

in the periods pre- and post- 1983 periods. Consequently, the time-series regression model had to be revised to account for the methodologically-induced shift in TPG, or an alternative estimation procedure had to be used. The 1993 edition did the latter and based its estimate of the 1991-1992 change in TPG on a weighted average of the seven previous changes in TPG (see Nelson 1993). The disadvantage to this approach is that the selection of weights, though not unreasonable, was arbitrary. Therefore, the 1994 edition returned to the time-series regression model used before, but revised it to include a dummy variable for the years 1984 and after to capture the methodologically-induced shift in TPG.

Of course, that procedure has the potential difficulties that were discussed earlier. The 1997 edition sought to address these difficulties by using a time-series regression model to estimate the historical relationship between changes in TPG and changes in income and the S&P index. The new methodology used to create TPG was dropped, implying that there was no longer an induced shift in the structure of the regression model. The number of persons aged 35-64, the presence of a Republican president, and the time trend were dropped as explanatory variables. Indeed, theoretical reasons to suppose they are predictive of changes in TPG are not obvious.

The 2001 edition estimated the historical relationship between changes in inflation-adjusted charitable deductions and changes in the explanatory variables listed in Table 1. By using the regression model to estimate changes in charitable deductions instead of TPG, improvements in the methodology by which giving by non-itemizers is determined can be implemented without causing structural problems in the regression model. We, too, adopt this approach. Inflation adjustments were used because changes in current dollar amounts are often not enough to mitigate spurious regression relationships.[2] The use of dummy variables for 1986 and 1987 effects from the 1986 Tax Reform Act and for recessions improves the fit of the regression model, though in principle it is not clear how such variables are to be used in the estimation of year *T* charitable deductions.[3]

While the transitions to each of these models has had reasonable a priori justifications, there has never been a systematic evaluation of which model provides the best performance according to some specified criteria. Hence, it is not known how well these models perform relative to each other. More importantly, it may well be that another model outperforms all of those previously tried.

3. Methodology and Data

To estimate c_T, our notation for charitable deductions in year *T*, we first estimate the parameters β_0 through β_5 in the following model (also summarized in the last row of Table 1):

$$\Delta c_t = \beta_0 + \beta_1(\Delta c_{t-1}) + \beta_2(\Delta income_t) + \beta_3(\Delta income_{t-1}) + \beta_4(\Delta S\&P_t) + \beta_5(\Delta taxprice_t) + \varepsilon_t$$

where Δc_t is the change in charitable deductions from year $t-1$ to year t, $\Delta income_t$ is the change in personal income, $\Delta income_{t-1}$ is the change in income from t-2 to $t-1$, $\Delta S\&P_t$ is the change in

2. The technical reason is that changes in current dollar variables involve changes due to inflation and indices of inflation have second-order unit roots (for an example, see Greene 2000, pp. 777-779). Such variables often must be differenced twice to eliminate that source of spurious regression results.

3. For instance, it is not clear how similar to the 1986 tax law another tax law in year *T* should be to merit setting the tax law dummy to "1" in year *T*. In addition, it would seem that not all recessions have similar effects on the change in giving, as the use of the dummy variable for recessions would imply.

the year-end S&P 500 index, $\Delta taxprice_t$ is the change in price of giving one dollar to charity which is less than one because of the tax deduction[4], and γ_t represents factors that influence the change in charitable deductions which we do not observe. The parameters β_0 through β_5 are estimated by ordinary least-squares using data from t = 1948,..., T–2. These parameter estimates are used to first estimate Δc_{T-1} (the one-step ahead estimate) and then used again along with this one-step ahead estimate to estimate Δc_T, the two-step ahead estimate. Finally, we add the estimates of Δc_{T-1} and Δc_T to the SOI's final report of c_{T-2} to arrive at an estimate of c_T.

Model (1) is, essentially, a "demand curve" for giving. It assumes that giving is affected by income, wealth, and the price of giving induced by tax deductibility. In addition to cotemporaneous income, lagged income is also included to capture the notion that changes in income are not translated into changes in giving all within the same year. The S&P index is used as a measure of wealth primarily because it reflects resources accruing to high income people and high income people provide a disproportionate share of total charitable contributions (e.g., see Schervish and Havens 1998b). The maximum tax rate is used to form the *taxprice* because it, like the S&P index, influences the decisions of high income people. Lagged charitable deductions are also included as an explanatory variable to model a persistence in giving apart from economic factors. This makes the model dynamic in changes in charitable deductions. Along with the presence of lagged income, the dynamic aspect of (1) is a noticeable difference relative to models previously used in *Giving USA*. The model is estimated in changes in the

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4. The *taxprice* is one minus the federal income tax rate. So, for example, when the top marginal tax rate rose from 31 percent to 39.6 percent in 1992-1993, the out-of-pocket cost of giving a dollar to charity fell from 69 cents to 60.4 cents for those in the top bracket. Such a fall in the out-of-pocket costs of giving, theoretically, should increase contributions. See Steinberg (1990) for a review of the empirical evidence and Auten, Sieg and Clotfelter (2002) for a recent analysis.

variables, rather than levels, to mitigate the chances that the parameter estimates will pick up spurious relationships between the explanatory variables and charitable deductions. We use inflation-adjusted variables to estimate (1) because tests indicate that $\Delta income_t$ in current dollars has a greater chance of producing spurious regression results. The adjustment is to 2000 dollars using the implicit GDP deflator for personal consumption expenditures.[5]

All of the data are from standard sources (see the Data Bibliography). Figure 1 shows charitable deductions, personal income, and the S&P 500 index, each of which are inflation-adjusted. Although there is a certainly an upward trend in both charitable deductions and personal income, it is clearly changes in the S&P index that seem to be coincident with changes in charitable deductions. The index fell in the 1970s and so did charitable deductions, both the index and deductions rose during the 1980s and early 1990s, and the index accelerated in the second half of the 1990s and so did charitable deductions. Over the 1990s, the average annual change in charitable deductions was about $5.5 billion, in personal income was about $200 billion, and in the S&P index was about 100 points. Figure 2 shows that these changes, which we use to estimate model (1), also move together. The lower growth in income and the negative growth in the stock market in 2001 suggest that (1) will likely estimate charitable deductions in that year to have lower growth, or possibly a decline.

5. *Giving USA 2002* and all earlier editions use the Consumer Price Index (CPI) to adjust for inflation. Our use of the implicit GDP deflator for personal consumption expenditures is not in conflict with this because we restore all of our predictions to current dollars, which can then be converted back to inflation-adjusted dollars using the CPI, the implicit GDP deflator, or any other inflation adjustment.

We chose model (1) after an extensive study of alternative models to estimate c_T. In brief, we compared alternative models according to their ability to estimate c_T over the 1990s as if they had been in use by *Giving USA* during the entire decade. Each model was judged by comparing its estimates of c_T with the actual c_T s (both in current dollars) according to the mean error (ME) of the estimates, the root mean square error (RMSE), and the mean of the absolute values (MAE) of the estimation errors. The ME is a measure of bias (ideally zero) and the RMSE and MAE are measures of year-to-year deviation of the errors (ideally small) around that bias. Current dollar measures of the errors are used because that is how the estimates are judged, at least by more casual analysts. However, such errors occurring at the end of the period are implicitly weighted more heavily than errors at the beginning of the period. Therefore, we also calculate the annual errors in percentage terms and examine the ME, RMSE and MAE of those percentage errors. Note that both current dollar and percentage criteria are "out-of-sample" in the sense that the estimation errors from the 1990s were not used to adjust the estimates of the parameters β_0 through β_5. Because the task we face is an "out-of-sample" estimation problem, it is better to use such "out-of-sample" criteria for model selection, as opposed to "in sample" criteria such as adjusted R^2 or other goodness-of-fit indicators (for further discussion see Wooldridge 1999, pp. 599-600). Additional details of this procedure, including the alternative models we examined, are described in a working paper which is available upon request.

4. Results

To begin our evaluation of (1) we first estimate β_0 through β_5 using data from 1948 through 1988 and then use these parameter estimates to form a one-step ahead estimate of Δc_{1989} and a two-step ahead estimate of Δc_{1990}. These parameter estimates are presented in column 1 of Table 2.[6] The estimates make intuitive sense: changes in charitable deductions are positively correlated with last year's change in deductions, changes in income and the stock market, and negatively correlated with the tax price. The strongest predictor is the S&P index. The point estimate suggests that a 100 point increase in the index is associated with a $1.7 billion increase in charitable deductions. The personal income coefficient indicates that a $200 billion increase in income produces a $1 billion increase in deductions. If such an increase in personal income also occurred in the previous year, charitable deductions are predicted to increase by a further $800 million. Hence, given the average changes in income and the stock market over the 1990s, the two income coefficients have the same combined effect as the single stock market coefficient. Using these parameter estimates, the estimates of Δc_{1989} and Δc_{1990} are $3.3 and $1.3 billion, respectively (not shown in Table 2). Adding these to charitable deductions in 1988 ($69.8 billion) produces a two-step ahead estimate of c_{1990} equal to $74.5 (2000 dollars) or $59.3 (current dollars).

Next, data from 1989 are added and (1) re-estimated to form the two-step ahead estimate of c_{1991}. This process continues until all of the two-step ahead estimates are generated, through c_{1999}. At each stage, of course, there are slight changes in the estimates of the parameters β_0

6. Although the residuals from the models are not autocorrelated, they do indicate the presence of heteroskedasticity. Therefore, we report the heteroskedasticity-consistent standard errors.

through β_5. Table 2 does not display all of these parameter estimates, but it does present those obtained when using the data through 1999; that is, those used to estimate charitable deductions in 2001. Comparing these last parameter estimates to those based on the data through only 1988, it is clear that over the 1990s the estimated relationship between lagged deductions, income, the stock market, and charitable deductions becomes stronger. The income coefficients are jointly significant (p-value = 0.02), the S&P index is significant at the 0.01 level, the price coefficient just misses statistical significance (p-value = 0.12), and the adjusted R^2 rises to 0.61. Nevertheless, it must be remembered that the selection of model (1) was not based on these features but rather on the accuracy of its two-step ahead estimates of charitable deductions. Indeed, several models perform better in terms of the former features (e.g., more highly significant point estimates and larger adjusted R^2) but not as well in terms of the latter.

Table 3 presents our evaluation of the two-step ahead estimates of c_{1990} through c_{1999}. The final SOI figures for charitable deductions are in column 2 and model (1)'s two-step ahead estimates are in column 3. For example, for 1990, the SOI reported \$57.2 billion in charitable deductions and the two-step ahead estimate (discussed above) is \$59.3 billion. The error in the estimate is \$2.09 billion. The fifth and sixth columns present the square and the absolute value of that error, respectively. Row 11 contains the averages of these errors. The ME over the ten-year period was −\$377 million, the RMSE just under \$4 billion and the MAE just over \$2.5 billion. The ME in percentage terms was 0.1 percent, the RMSE 4.4 percent, and the MAE 3.2 percent (row 12). As discussed at the end of section 3, model (1) was selected over alternative models because of its superior ME, RMSE, and MAE.

Figure 3 presents the SOI final figures and the two-step ahead estimates for the 1990s. The only year in which model (1) does very poorly is 1997. The late 1990s stock market expansion actually occurred in two stages: tremendous growth in 1995-1996 and even faster growth in 1997-1999 (see Figure 2). The first stage was right at the limit of any stock market growth historically experienced. The second stage was well beyond that. Model (1) handled the first stage well, but under-predicted the second. However, by 1998, model (1) had re-captured the faster growth in charitable deductions.

Table 4 compares model (1)'s performance with those of models used in previous editions of *Giving USA*. Recall from Table 1 that none of these models were in use over the entire 1990-1999 period, so our evaluation is again based on each model's performance as if it had been used over those ten years. Table 4 is split in two parts: the top part contains the ME, RMSE, and MAE in current dollars and the bottom contains the same criteria, but in percentage terms. The first row in each part repeats model (1)'s measures from Table 3.

The second row describes the double-log model.[7] It performs satisfactorily as far as mean error is concerned ($1.6 billion), but its RMSE and MAE are more than twice model (1)'s. In addition, the model is extremely sensitive to changes in the stock market, and would have

7. The model used in the 1994-1996 editions of *Giving USA* is the double-log model with an explanatory variable added to control for the structural shift in TPG described in section 2. Because there is no structural shift in our dependent variable, for our purposes the 1994-1996 model is identical to the 1992 model.

predicted a 50 percent fall in giving in 2000 followed by more than a full recovery in 2001 (recall that 2000-2001 data are not used in the Table 4 comparison).[8]

The third row shows the results from using the weighted average of the seven previous changes in the SOI final figures to form the two-step ahead estimates. This model was used in *Giving USA 1993*. The bias is similar in magnitude to the double-log model, though in the opposite direction, but worse in percentage terms. Its RMSE and MAE are better, but still large compared to model (1). Because this method does not use stock market information, it not surprisingly under-predicts charitable deductions after the stock market expansion, not catching up even by 1999.

Row 4 presents results from the model of changes in the dependent variable regressed on changes in income and the S&P year-end index. This model first appeared in the 1997 edition and would have done well over the 1990s. At −1.1 percent, its bias is low, though not as low as model (1)'s. However, its RMSE and MAE are marginally better. Like model (1), its worse year is 1997, following the second surge in the stock market. As discussed above a model in changes but estimated with inflation-adjusted variables would be less subject to spurious regression results. However, the 1997 edition's model estimated with inflation-adjusted does

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8. The model we have just described is the one developed in Nelson (1986). However, when we use Nelson's functional form with our data we are unable to mimic the regression results in *Giving USA 1992*. Moreover, the description of the model in *Giving USA 1992* is somewhat different from that in Nelson (1986) in that the former dependent variable was actually the logarithm of a "TPG index" which appears to be TPG in year t divided by TPG in year $t-1$. The logarithm of this index is approximately the percentage change in TPG. Thus, this model specifies the <u>change</u> in TPG as a function of the <u>levels</u> of the explanatory variables, a non-standard time series specification. However, using this model with our data produces regression results similar to those published in *Giving USA 1992*. We evaluated that model over the 1990s, and its performance is similar to that of the Nelson model, except that it does not predict an extreme drop in giving in 2000. That is, levels derived from a model in changes are less sensitive to stock market shifts.

not do as well (row 5). The primary reason is that it is slower to catch up to the increased charitable deductions that followed the stock market expansion.

The model in the 2001 edition was estimated using inflation-adjusted variables. Also, it included the S&P index measured at two points in the year (May-June and November-December) and added two dummy variables. One of these was for the years 1986 and 1987 to capture the large shift in charitable deductions from 1987 to 1986 which occurred as donors anticipated the Tax Relief Act of 1986 coming into effect. The other dummy variable is an indicator for recession years. When measured in current dollars this model's performance is slightly worse compared to model (1), but in percentage terms, the two models are very close. Recall, that while dummy variables for certain years can improve the goodness of fit of the model, they are harder to justify when using that model to estimate charitable deductions. However, when the tax law and recession dummies are removed from the model, its performance noticeably worsens. The performance of model (1) is better than this, in part, because its tax price variable allows it to pick up some of the effect of the increase in tax prices in 1986-1987 even though it does not include a tax law dummy.

The results in Table 4 show that model (1) would have performed better over the 1990s than the other models actually used during that period. It could be argued that the models in the 1997 and 2001 editions performed as well, but as argued above, these models are less attractive on the basis of a priori modeling reasons.

Next, Table 5 presents the one- and two-step ahead estimates that would have been generated by model (1) had it been in use since the 1992 edition of *Giving USA*. Each column shows the latest final figure from SOI on charitable deductions that would have been available for use in each edition (underlined), model (1)'s one-step ahead estimate (*italics*), and its two-step ahead estimate (**bold**). The years in the first column refer to calendar time. For example, in the 1992 edition (column 2), the latest available final charitable deductions figure from SOI was $55.5 billion for 1989. Using model (1) that edition's one-step ahead estimate for 1990 would have been $*59.0* billion, and the two-step ahead forecast for 1991 would have been $**63.8** billion.

Reading across the row for a given calendar year, one can see the one- and two-step ahead estimates and the final figure for charitable deductions that would have been released subsequently by SOI. For example, in the 1995 calendar year row, there is the two-step ahead estimate of $**77.6** forecast (from the 1996 edition), the one-step ahead forecast of $*76.5* billion (from the 1997 edition), and the final figure of $75.0 billion (available for the 1998 edition). The differences between the estimates and the final figure are the estimation errors. The errors in the two-step ahead estimates were already discussed in Table 3. Although model (1) was not selected based on its performance in one-step ahead estimation, its one-step estimates are nevertheless quite good.[9]

The final column of Table 5 shows the estimates contained in *Giving USA 2002* for 2000 and 2001 based on the model estimated through 1999 (Table 2, column 2). Using those parameter estimates, the one-step ahead estimate of charitable deductions is $131.5 billion for 2000 and the two-step ahead estimate is $133.2 billion for 2001, a modest 1.3 percent growth (in current dollars). The estimates are shown as the last two points in Figure 3. Of course, the error in these estimates cannot be determined until the final SOI figures are released.

9. The ME, RMSE, and MAE of the one-step ahead estimates are -$0.411 billion, $2.924 billion, and $2.228 billion, respectively. The corresponding errors in percentage terms are !0.1, 3.1, and 2.5 percent. Like the two-step ahead errors, these are essentially unbiased, but because the estimation procedure extends only one step beyond the most recently available final charitable deductions figure from SOI, the RMSE and MAE are lower.

5. Conclusions

The estimate of total charitable contributions annually published in *Giving USA* is one of the most widely cited indicators of American philanthropy. The largest single component of this figure is an estimate of itemized charitable deductions. In this paper we present the model used to generate this estimate in the 2002 edition of *Giving USA* and show that it would have performed better over the 1990s than models used in previous editions. As such, the paper contains the first systematic evaluation of these models based on a uniform set of criteria. It also provides a benchmark for others who may be interested in examining their ideas to improve the estimation of charitable deductions.

The model we present is the "best" (according to our criteria and among the alternatives we tried) in terms of its two-step ahead estimation. Its one-step ahead estimates are good, but we did not examine whether there may be a model that generates better one-step ahead estimates. As discussed in section 2, the final SOI figures on charitable deductions are not available in time to make practical use of such a model. Moreover, we found in other work available upon request that using the preliminary SOI figures which often were available in time to form one-step ahead estimates over the 1990s would have led to worse estimation results because the SOI preliminary figures themselves turned out to be negatively biased estimates of their final figures. However, should the final SOI figures become available sooner, or the preliminary SOI figures become better estimates of the final figures, research on models based on one-step ahead estimation performance should be conducted. The model presented herein would serve as a fitting starting point for such an investigation.

Table 1. Models for Estimating Charitable Deductions in *Giving USA*.

Giving USA Edition	Dependent variable	Functional form	Explanatory variables	Inflation adjusted variables?
1992	TPG in levels	Log-log	Personal income, S&P Nov./Dec., age 35-64, Republican, time trend	No
1993	TPG in changes	Linear	Seven previous changes in TPG	No
1994	TPG in levels	Log-log	Personal income, S&P Nov./Dec., age 35-64, Republican, time trend, post-1983 indicator	No
1997	TPG in changes	Linear	Changes in personal income, S&P year-end	No
2001	Charitable deductions in changes	Linear	Changes in personal income, S&P (May-June and November-December), tax law, recessions	Yes
2002	Charitable deductions in changes	Linear	Changes in personal income, S&P year-end, and tax price. Lagged changes in charitable deductions and personal income.	Yes

Definition of variables:

Personal income - income accruing to persons (from the National Income and Product Accounts).

S&P Nov./Dec. - the average of the S&P 500 index for the months of November and December.

S&P year end - the index at the end of the year.

Age 35-64 - the number of persons in this age range.

Republican - equal to one in the years in which there was a Republican president.

Post-1983 - equal to one in 1984 and the years thereafter.

Tax law - equal to one in 1986 and 1987 (years following major changes in tax laws).

Recessions - equal to one in recession years.

Table 2. Determinants of the Change in Charitable Deductions.

	Last year used to estimate the model	
Variables[a]	1988	1999
Charitable deductions, lagged	0.192 (0.243)	0.241 (0.174)
Personal income	0.005 (0.004)	0.004 (0.004)
Personal income, lagged	0.004 (0.005)	0.007* (0.004)
S&P 500 year end index	0.017** (0.007)	0.023*** (0.006)
Tax price	−0.193 (0.136)	−0.190 (0.120)
constant	0.321 (0.728)	!0.148 (0.513)
Adjusted R^2	0.251	0.608
Number of observations	41	52

Notes: All variables are adjusted to 2000 dollars using the implicit GDP deflator for personal consumption expenditures. Heteroskedastically-consistent standard errors are reported in parentheses.

[a] All explanatory variables are in changes.

* Significant at the 0.10 level. ** Significant at the 0.05 level. *** Significant at the 0.01 level.

Table 3. Two-step Ahead Estimates in the 1990s ($ billions).

Calendar year	Charitable deductions	Estimate	Error	Error squared	Error absolute value
1990	57.2	59.3	2.090	4.370	2.090
1991	60.6	63.8	3.258	10.612	3.258
1992	63.8	65.1	1.218	1.484	1.218
1993	68.4	68.5	0.148	0.022	0.148
1994	70.5	71.6	1.101	1.213	1.101
1995	75.0	77.6	2.651	7.027	2.651
1996	86.2	82.8	–3.328	11.078	3.328
1997	99.2	88.4	–10.803	116.700	10.803
1998	109.2	108.8	-0.446	0.199	0.446
1999	125.8	126.1	0.341	0.116	0.341
Mean errors	.	.	–0.377	3.909[a]	2.538
Mean errors (pct.)[b]	.	.	0.001	0.044	0.032

Note: All amounts in current dollars. Due to rounding the estimation error may not appear to be exactly the forecast minus charitable deductions.

[a] The square root of the mean of the column.
[b] Each year's error is expressed as a percentage of actual charitable deductions, and then the average percentage error taken.

Table 4. Baseline Estimation Performance Compared with Previous Giving USA Models.

Model	Mean Error	Root Mean Square Error	Mean Absolute Error
	Errors in amounts of nominal dollars		
Dynamic, model (1)	–0.377	3.909	2.538
Giving USA 1992, 1994-96 (nominal dollars)	1.555	8.438	6.799
Giving USA 1993 (nominal dollars)	–4.075	6.663	4.558
Giving USA 1997 (nominal dollars)	–1.244	3.833	2.500
Giving USA 1997, but in real dollars	–2.568	4.967	3.553
Giving USA 2001	–0.883	4.286	3.152
Giving USA 2001, without tax law and recession dummies	–2.567	5.260	3.771
	Errors as a percentage of the actual nominal level		
Dynamic, model (1)	0.001	0.044	0.032
Giving USA 1992, 1994-96 (nominal dollars)	0.042	0.128	0.096
Giving USA 1993 (nominal dollars)	–0.041	0.068	0.048
Giving USA 1997 (nominal dollars)	–0.011	0.041	0.030
Giving USA 1997, but in real dollars[a]	–0.024	0.051	0.039
Giving USA 2001 (inflation-adjusted)	–0.005	0.045	0.035
Giving USA 2001, without tax law and recession dummies (inflation-adjusted)[a]	–0.022	0.051	0.038

Notes: Dollars are converted back to nominal before calculating forecast errors.
[a] These models are similar to those used in the corresponding editions of *Giving USA*, but were never actually implemented.

Table 5. Using the Two-Step-Ahead Model to Generate One- and Two-Step Ahead Estimates for *Giving USA* Editions 1992-2002 ($billions).

	Giving USA Edition										
Calendar year	1992 Edition	1993 Edition	1994 Edition	1995 Edition	1996 Edition	1997 Edition	1998 Edition	1999 Edition	2000 Edition	2001 Edition	2002 Edition
1989	55.5										
1990	*59.0*	57.2									
1991	**63.8**	*61.6*	60.6								
1992		**65.1**	*63.8*	63.8							
1993			**68.5**	*68.5*	68.4						
1994				**71.6**	*71.5*	70.5					
1995					**77.6**	*76.5*	75.0				
1996						**82.8**	80.6	86.2			
1997							**88.4**	*96.9*	99.2		
1998								**108.9**	*112.9*	109.2	
1999									**126.1**	*120.4*	125.8
2000										**124.9**	*131.5*
2001											**133.2**

Note: The years in the first column refer to calendar time. The other columns each represent an edition of *Giving USA*. For a particular edition, read down a column to see the most recent final figure on charitable deductions that would have been available from SOI at the time of that edition (underlined), the one-step ahead forecast (*italics*) that would have been made in that edition, and the two-step ahead forecast (**bold**). Looking across a row provides a comparison of the two-step ahead forecast with the one-step ahead forecast made the next year and with the "hard" estimate from the SOI made in the following year.

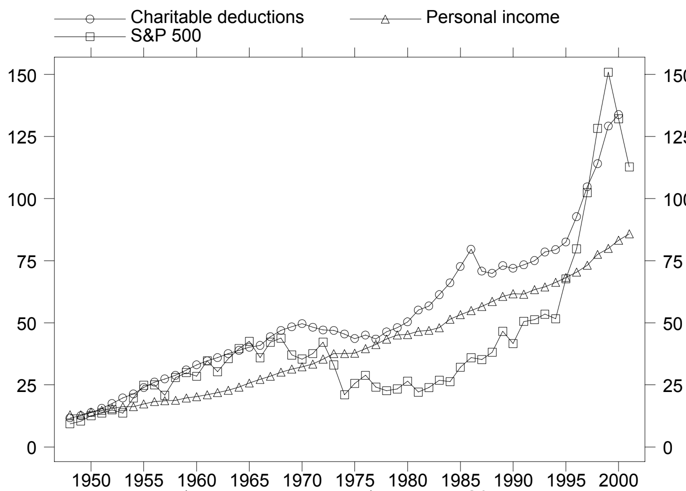

Figure 1. Charitable Deductions, Income and the Stock Market.

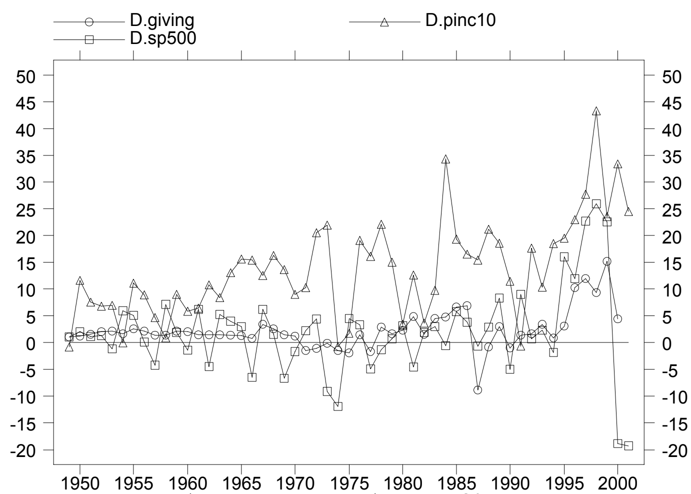

Figure 2. Changes in Charitable Deduct., Income and the Stock Market

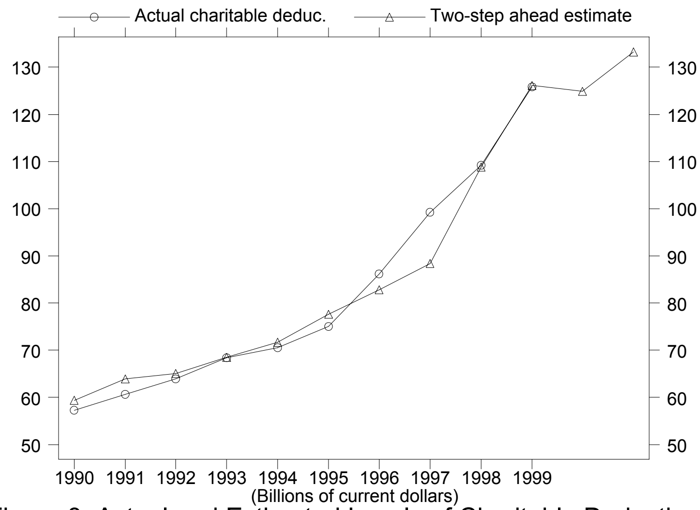

Figure 3. Actual and Estimated Levels of Charitable Deductions.

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