The Joy of Giving and the Greater Joy of Receiving: Estimating a Multiple-Discrete Choice Models of Philanthropic Behavior*

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Abstract

The objective of this paper is to a) develop and implement a new framework for estimating multiple discrete choice models; and b) provide new empirical evidence regarding the different motives that influence philanthropic behavior. The empirical analysis is based on a unique data set that we assembled using publicly available donor lists to the ten largest cultural organizations in the Pittsburgh metropolitan area. The (preliminary) finding suggests that private benefits that provide social status for donors are likely to have some influence on charitable giving.

1 Introduction

Most charitable organizations receive two main types of revenue. First, contributions from governments, businesses, and individuals are usually made in the form of yearly donations that go towards either the operating revenue or the endowment. The endowment is then invested in order to provide a sustainable source of yearly income. Second, some of these organizations provide services that are sold in the market place. This is especially true for large cultural organizations such as symphonic orchestras, public theaters, and museums that are the focus of this study. The direct revenue from ticket sales and other activities accounts for only a small fraction of the total revenue.[1] The net effect is that visitors are being charged a small fraction of the expenses necessary to provide the services of these organizations. As a consequence most of these charitable organizations rely heavily on private donations.

The economic literature on philanthropic behavior has focused on, at least, three main causes that motivate charitable giving. The first motivation is donating out of concern for public good provision (Bergstrom, Blume, and Varian, 1986). When individuals feel that their contribution is going to be pivotal in enabling the organization to continue in its mission, they donate so that it can provide this service in the future. In our application, we find that marginal contributions from individuals are small compared to the budgets of most of the large cultural organizations. To put things into perspective, the Pittsburgh Symphony had an endowment of approximately $110 million dollars and an annual budget of approximately $25 million in 2004. The value of the endowment of the Carnegie Museum has been fluctuating in recent year between 180 and 250 million dollars. The median donation in our sample for both charities is $1000. A single donor – with the exception of a handful of extremely wealthy patrons – is not critical for the vast majority of organizations. Almost every single individual donor is of negligible importance from the perspective of these large cultural organizations.

[1] For example, the Western Pennsylvania Conservancy received only 31% of its total revenue from the Fallingwater attraction in 2003.

The second cause is due to an intangible altruistic feeling that cares about other people's utilities. Closely related to this explanation is the *joy-of-giving* motive (Andreoni, 1989). By donating to causes where individuals receive no explicit benefit, they gain satisfaction from knowing that they contributed to a worthy cause. There are some indirect empirical tests of this motive in the literature. Most of these tests are based on the crowd-out hypothesis which claims that individuals are likely to donate less money if more funds are provided by the government. The empirical evidence regarding the validity of this hypothesis is mixed. Kingma (1989) analyzes donations to local public radio stations and finds support for the crowd-out hypothesis. Manzoor and Straub (2004) replicate the results of Kingma and find that the results are not robust to the use of newer data. Ribar and Wilhelm (2002) study donations to a large number of international relief organizations and find little evidence of a crowd-out effect.[2]

The third motive for charitable giving is due to Harbaugh (1998) who argues that donors receive tangible or intangible private benefits from their gifts. In the word of Thomas Hobbes: "no man giveth but with intention of good to himself" (Hobbs, 1651). One goal of this study is to attempt to document and measure the private motivations for giving. The benefits to oneself from donation can be broken down into a number of categories. Charitable donations are tax deductible. Thus donating to one's favorite cause effectively lowers the total tax burden of an individual. This benefit has been well documented in the past and higher marginal tax rates typically induce individuals to donate more money to charities.[3] Many of the websites for the organizations in our sample enumerate the potential tax benefits on their on-line contribution form.

Individuals also get material benefits from donating to these organizations.[4] Individuals who are thinking of donating are offered different perks associated with tiered levels of giving

[2]Anything that cannot be explained by other motives is typically attributed to the joy-of-giving motive, acknowledging the fact that we do not really understand why people behave as they do.

[3]There is a large empirical literature that has estimated the tax price elasticity of charitable giving. For surveys of the earlier literature see, for example, Clotfleter (1985) or Steinberg (1990). Recent studies include Randolph (1995) and Auten, Sieg, and Clotfelter (2002).

[4]Each organization in our sample provides a detailed description of the private benefits that are associated with different levels of giving. This allows to us to characterize the identify of the donors and their motives for giving in an unprecedented way.

for most organizations. Typical perks range from 10% discounts at the gift shop, to the performers' autographs, to premium seating, to free valet parking, to private tours, to exclusive dinners and parties. Moreover, individuals who donate receive a certain amount of social standing in the community. Judging from the way people chose to have their names listed in the brochures, they sought to make it clear who they are by using middle initials, suffixes, and professional titles. There are very recognizable names on this list of sports stars, politicians, and business leaders who have a great incentive to improve their reputation in the community.[5] Finally, individuals can effectively buy influence in an organization by being appointed to the boards of trustees. All ten organizations listed the board members and we can observe how much they donate yearly to maintain this designation.

To capture the different incentives for giving we develop a new theoretical model. Our approach differs from previous approaches for at least three reasons. First, we take a market approach and focus on giving to ten of the most important cultural institutions in Pittsburgh. One of the key features of our data set is that a significant number of individuals support multiple charities with their donations. We observe 495 individuals in our sample that give to three or more charities. Simple discrete or discrete-continuous choice models cannot be used to explain this type of behavior. Our empirical approach builds on the literature on multiple-discrete choice models that are notoriously difficult to estimate. We follow Hendel (1999) and model the observed behavior as a repeated discrete choice model with multiple choice occasions.[6]

Hendel's (1999) approach crucially depends on strong additive separability assumptions. As a consequence, there is no state dependence across choice occasions in Hendel's model. In our context, these strong separability assumptions are implausible since previous levels of charitable giving are likely to influence contemporary behavior. To capture this type of habit formation, we assume that past charitable behavior has a direct impact on current period utility. We therefore adopt a dynamic model to allow for state dependent choice

[5]Buraschi and Cornelli (2003) also document these private benefits for donors of the English National Opera.

[6]See also the discussion in Ackerberg, Benkard, Berry, and Pakes (2006) who point out the difficulties associated with estimating these types of models.

sequences using dynamic programing techniques along the lines suggested by Rust (1994).

Estimating our model is challenging and requires some significant departures from standard dynamic discrete choice estimators.[7] Recall that the main purpose of the dynamic specification is to generate a multiple-discrete choice model that is essentially a one-period model. Since we do not observe behavior at each choice occasion, we need to integrate over all feasible choice sequences to derive a well-specified likelihood function. To our knowledge our study is the first paper that combines DP techniques with repeated discrete choice techniques to derive an empirical model of multiple discrete choices. We face two types of computational problems in estimation. First, the state space in our model is large since we control for observed heterogeneity along many dimensions and the main state variable is continuous and cannot be easily approximated on a coarse grid. Second computing the likelihood function requires integration over all feasible choice sequences. To deal with the computational complexity, we use parallel programming techniques and implement our estimator on a supercomputer provided by the Pittsburgh Supercomputing Center.

Finally, our approach also differs from previous empirical studies that have focused on charitable donations since we adopt a differentiated product approach. In our model each tier or level of giving to a specific charity can be characterized by a vector of attributes.[8] These characteristics consist of the level of giving and the private perks that are associated with each choice. We observe 10 charities in our data with a total number of 76 different combinations of levels of giving and perks. Moreover, there is variation in private benefits holding giving constant. This variation arises because different charitable organization pursue different tactics to raise funds.[9] Organizations like the Opera and Symphony have

[7]Dynamic discrete choice estimation was first used by Wolpin (1984), Miller (1984), Pakes (1986) and Rust (1987). Methodological issues that are related to estimating these models are discussed, for example, in Hotz and Miller (1993), Rust (1994), Keane and Wolpin (1994), Eckstein and Wolpin (1999), Aguirregabiria and Mira (2002). Model selection and validation is discussed in Keane and Wolpin (1997, 2007), Tood and Wolpin (2006), and Arcidiacono, Sieg, and Sloan (2007).

[8]We thus adopt a characteristics approach based on Gorman (1980) and Lancaster (1966). Berry (1994) and Berry, Levinsohn, and Pakes (1995) highlight the importance of unobserved product characteristics. Our approach is consistent with unobserved characteristics associated with each charity. Conditional on each charity we assume that all relevant characteristics are observed which is a plausible assumption in our application.

[9]Vesterlund (2003) argues that fundraisers announce past contributions to signal the quality of the char-

much different reward structures than the Zoo or the Children's Museum. For example, the Opera and Symphony award explicit perks associated with each level of giving, whereas the Zoo and Children's Museum do not. It is this observed variation of perks at constant levels of giving that helps us separate the joy of giving from the joy of receiving motive.

The core of the empirical analysis is based on a truly unique data set that we assembled using publicly available donor lists to the ten largest cultural organizations in the Pittsburgh metropolitan area.[10] We use information from annual reports, playbills, and programs that identify the names of individual donors and the dollar range in which their gift fell. We have merged the donor lists and linked them with a variety of other publicly available data sources that allow us to measure personal characteristics of these donors. By analyzing donations to a large number of different charities, that adopt different strategies for rewarding donors, we can assess the importance of private benefits and rewards that are associated with charitable giving.

Our (preliminary) findings suggest that a large number of households donate money to these charities. Much of this giving is clearly unrelated to potential perks and rewards. However, we also find that households value perks that are affiliated with high social prestige such as invitations to dinner parties and special events. Small token gifts and extra tickets are not valued highly by most individuals. Moreover, we find that board membership is an important benefit. Individuals that are members of the board of a charity give substantially higher amounts and they seem to value the visibility and potential power that comes with these appointments.

The rest of the paper is organized as follows. Section 2 of the paper discusses the data set. Section 3 provides a formal model that can be used to analyze individual donations to multiple charities. Section 4 develops a new estimator for this class of models. This

ities, which could help worthwhile charities reveal their type and help them reduce free-rider problem. It assumes donor have imperfect information on charities' quality.

[10]It is well known that most cultural organizations publish the lists of their donors.Romano and Yildrim (2001) provide a theoretical model of giving that include warm-glow or snob appeal and show that it can be in the interest of the charity to announce donations. As we show below all charities in our sample announce donations and only a very small fraction of donors prefers to be listed anonymously.

estimator combines previous work on dynamic discrete choice estimation and multiple discrete choice estimators. Section 5 reports the results from this estimation exercise. The conclusions are offered in Section 6.

2 Charitable Donations in Pittsburgh

2.1 The Data Set

The data come from annual reports, playbills, and programs for ten Pittsburgh cultural organizations (Pittsburgh Ballet Theater, Carnegie Museums of Pittsburgh, Pittsburgh Children's Museum, City Theater, Pittsburgh Opera, Phipps Conservatory, Pittsburgh Public Theater, Pittsburgh Symphony, Western Pennsylvania Conservancy, and Pittsburgh Zoo & PPG Aquarium). These publications are from the 2004-2005 donation cycle, capturing a cross-sectional snapshot of giving patterns. To contrast these types of organizations, we also obtained data from the United Way which is a not a cultural organization, but a traditional charity. Moreover, the United Way does not offer any private perks to donors.

Most of the organizations choose to report only gifts above a certain amount by associating the names of donors with a range of the dollar amount of their donation. For the purposes of the data set, households are counted as individual donors, meaning two individuals listed on a single gift (most often husbands and wives) are lumped together. There were a total of 6,499 individuals listed in the programs of the ten organizations. The total giving amounted to $6,732,705 had the donors all given the minimum amount listed in their range of giving. The data are summarized in Table 1.[11]

The data do not determine the exact gift amount, instead they only allow us to identify the tier of giving, i.e. we know a lower and upper bound for the amount that was donated. For some calculation in this section we use the lower-bound on the giving ranges as the

[11]Note that our sample is strictly speaking a choice based sample, since we do not include individuals that made zero donations. We also created a random sample of 10,000 households in Allegheny County to analyze the decision to become a donor. The results are available upon request from the authors.

Table 1: Summary Statistics for Total Donations by Organization

	# of Donors	Total Donations	Range	Median	Average	Standard Deviation
Ballet	559	$399,750	$250 - $5,000	$250	$715.12	$1,069
Carnegie Museums	1,236	$2,303,005	$500 - $25,000	$1,000	$1,863.27	$3,678
Children's Museum	185	$79,350	$50 - $10,000	$100	$428.92	$1,396
City Theater	170	$185,200	$50 - $3,500	$100	$1,089.41	$638
Opera	556	$1,125,000	$120 - $50,000	$250	$2,023.38	$5,552
Phipps Conservatory	984	$189,200	$25 - $10,000	$100	$192.28	$463
Public Theater	1,082	$410,200	$50 - $10,000	$50	$379.11	$1,019
Symphony	668	$1,361,500	$500 - $50,000	$1,000	$2,038.17	$3,882
WPC	2,082	$523,350	$100 - $20,000	$100	$251.37	$875
Zoo	649	$155,650	$50 - $5,000	$50	$239.83	$531
United Way	4,180	$16,383,500	$1,000 - $1,000,000	$1,000	$3,919.50	$40,999

amount of giving since most individuals tend to give at those lower levels as reported by Glazer and Konrad (1996).[12] We find that the median gift size for all organizations is close to the lowest tier, suggesting that the bulk of donors give in the lowest or second-lowest range that these organizations provide.

The number of donors listed as anonymous does not constitute a large percentage for any of the organizations in the sample. We, therefore, exclude these donors from our sample. Given that there so few anonymous donors we can safely conclude that donors do not mind being listed in the official publications. Only a small fraction of the donors prefers anonymity to publicity. This result is consistent with other evidence reported below that social prestige and private benefits are powerful explanations for the observed behavior.

Since a fair number of individuals give to multiple causes, we consolidated the donor lists and matched up names that appeared to be the same. This proved to be a challenging task because organizations list individuals' names in slightly different ways. Some appear

[12]In our structural analysis, we adopt a multiple discrete choice framework to account for this feature of our data set.

more formally printed (Mr. & Mrs. John A. Doe, Jr.), while others are more casual (John and Jane Doe). The matching was done by hand with the help of programs in Microsoft Excel that suggested the most likely matches based on the parsed elements of the names. These names were then cross-referenced with data from the Allegheny County Real Estate database, the U.S. Census, Federal Election Commission database, and the United Way donor list. We managed to match a large number of individuals, except those individuals with extremely common first and last names.

2.2 A Characterization of Donors

One interesting attribute of these individuals who donate to cultural organizations is their profession. While it is nearly impossible to ascertain the profession of all of the donors, we obtained a list of the names of every physician and lawyer who practices in Allegheny County from the Allegheny County Medical Society and the Allegheny County Bar Association. Using the same name matching technique as before, we find that 391 physicians and 500 lawyers gave money to at least one of the ten Pittsburgh cultural organizations. Table 2 shows the number of each profession who gave to each organization and the average total giving for each individual and standard deviation.

Next we seek to determine how wealthy the individuals are that give to these cultural organizations. To investigate this question, individuals from the cultural organization lists were matched up with the Allegheny County Real Estate Assessment website. The site was established to provide transparency to the assessment of property taxes and thus has every residential property listed with the deeded owner's name. A subset of individuals (54 %) could be identified as owning property in Allegheny County. It is certain that individuals donate to these organizations from surrounding counties and the WPC's Fallingwater attraction is located outside of Allegheny County. The remainder of the analysis focuses on households in Allegheny County that could be matched to the real estate data base.[13] We

[13]When we matched households to home properties, we found that a small fraction of households owned multiple properties. These households typically rent out houses for commercial purposes. For these households we only used the most expensive residential property value.

Table 2: Contributions from Professionals

	Lawyers	Physicians
Ballet	44	46
Carnegie Museums	128	95
Children's Museum	18	12
City Theater	57	30
Opera	54	44
Phipps Conservatory	79	65
Public Theater	113	86
Symphony	66	51
WPC	120	88
Zoo	53	39
Average Total Giving	$1,385.26	$970.74
Standard Deviation	$3,187.30	$3,010.19

report descriptive statistics in Table 3 that summarizes the distribution of housing values by charity in our sample.

We find that each organization has donors with a mean property value of about $300,000. The Carnegie Museum and the Pittsburgh Symphony attracts donor with the highest average housing values. Maybe more surprising is the finding the Children's Museum is also among the top three charities. The Western Pennsylvania Conservancy and the City Theater have less wealthy donors. Since the Real Estate Data base contains the address of the house, we can match each observation in the sample to a Census Block Group and assign a (neighborhood) income level to each observation. Moreover, we can distinguish among households that live in the City of Pittsburgh and households that live in one of the surrounding suburbs. Finally, we know how long the household has owned the property. This allows us to construct a variable which measures the "attachment" to the Pittsburgh metropolitan area.

More information about these individual donors can be gleaned from their contributions of other sorts. It is unlikely that a person who does not enjoy the ballet will give money to such an organization. The United Way is a charity that provides a public service by

Table 3: Property Values of Donors

	Number	Average	Median	Standard Deviation
Ballet	327	$322,450	$243,600	$280,154
Carnegie Museums	806	$389,524	$323,350	$325,356
Children's Museum	126	$383,075	$311,700	$311,661
City Theater	383	$295,484	$236,100	$283,174
Opera	373	$331,953	$260,000	$264,489
Phipps	631	$327,004	$265,000	$280,950
Public Theater	730	$287,289	$230,450	$218,276
Symphony	444	$363,339	$281,500	$312,028
WPC	850	$263,428	$190,650	$242,911
Zoo	419	$292,641	$218,800	$262,995

helping children via community outreach projects. The perks associated with this cause are of a different kind than the cultural organizations. In examining the United Way donor list in the same time period, 551 people who gave to one of the cultural charities also gave to the United Way as well. The minimum amount to be listed in its publication was $1,000, so the number could in fact be much higher. The maximum gift was $1,000,000 with an average gift among these individuals was $10,282 with a standard deviation $73,615. Table 4 summarizes the number of individuals who gave both the charity listed and the United Way.

Table 4: United Way Donors

	United Way
Carnegie Museums	200
Phipps Conservatory	108
Opera	69
WPC	137
Zoo	69
Public Theater	126
City Theater	67
Symphony	123
Ballet	70
Children's Museum	34

The individuals in our sample also contributed heavily to political candidates in the 2004 elections. Of the 6,499 individual donors, 736 contributed to either the presidential campaigns of George W. Bush and John Kerry, the senatorial campaigns of Arlen Specter and Joe Hoeffel, congressional campaigns in nearby districts, or the Republican and Democratic parties. The data set for Allegheny County from the FEC was matched up against the names of individuals who contributed to cultural organizations in Pittsburgh in the same way as before. Note that the FEC only requires that political contributions of $200 or more to be reported, so that is reflected in the data. Table 5 captures the number of individuals who gave money to both the cultural organization listed and the presidential campaigns of either Bush or Kerry.

Table 5: Giving to Presidential Candidates

	Bush number of donors	Kerry number of donors	Bush total amount	Kerry total amount
Ballet	12 (33.3%)	24 (66.7%)	$19,250	$46,550
Carnegie Museums	69 (41.1%)	99 (58.9%)	$118,025	$147,350
Children's Museum	13 (41.9%)	18 (58.1%)	$18,000	$34,350
City Theater	5 (7.0%)	66 (93%)	$8,500	$99,400
Opera	15 (30.0%)	35 (70.0%)	$29,000	$60,100
Phipps Conservatory	31 (36.0%)	55 (64.0%)	$54,375	$97,620
Public Theater	23 (28.0%)	59 (72.0%)	$46,950	$89,224
Symphony	31 (38.8%)	49 (61.3%)	$58,650	$77,420
WPC	40 (35.1%)	74 (64.9%)	$67,475	$115,420
Zoo	20 (54.1%)	17 (45.9%)	$46,200	$39,550

From this analysis, it seems that the majority of individuals who give money to cultural organizations prefer to give money to Democrats. Kerry "won" every organization except for the Pittsburgh Zoo both in number of contributors and total amount contributed, the City Theater overwhelmingly so.[14]

[14]An analysis of the political contributions to the both parties as well as Senate and House candidates shows that donors in Pittsburgh are more balanced. These results are available upon request from the authors.

2.3 Donations to Multiple Causes

One of the striking features of our data is that we observe a large number of individuals that donate money to multiple causes. For example, 495 of the 6,499 individual donors could be identified as giving to 3 or more of our 10 organizations. Table 6 provides a detailed analysis of the distribution of donor types.

Table 6: Spread of Giving to Multiple Organizations

# of Organizations	# of Donors	% of Individuals	Sum of Donations	% of Total Donations
1	5264	81.00%	$3,076,945	45.70%
2	740	11.39%	$1,363,360	20.25%
3	304	4.68%	$1,034,195	15.36%
4	118	1.82%	$569,485	8.46%
5	44	0.68%	$327,205	4.86%
6	13	0.20%	$141,160	2.10%
7	11	0.17%	$115,160	1.71%
8	2	0.03%	$10,095	0.15%
9	3	0.05%	$94,600	1.41%
10	0	0.00%	$0	0.00%

We find that the 495 individuals who contributed to 3 or more organizations have different characteristics than the average donor. Of the 392 who were found in the Allegheny County Real Estate Registry, their average property value was $425,659, larger than the $292,417 of an average donor. Of the 392 with Allegheny County housing entries, 327 of them live in the city of Pittsburgh. Their average combined giving amounted to $4,630 compared to $739 for those donors who gave to only 1 or 2 of the organizations. They were also much more likely than average to donate to a political candidate, 44% for the donors who gave to 3 or more places compared to 17% for all donors. Of the 495 individuals who contributed to 3 or more of the organizations, there were clear preferences of which ones they contributed the most money to. Table 7 summarizes the organizations that received the first, second, or third largest amounts with ties counted on the same level.

There seems to be some ascription of objective worth of an organization by looking at

Table 7: Gift Size Ordering among Multiple Donors

	Carnegie Museums	Phipps	Opera	WPC	Zoo	Public Theater	City Theater	PSO	Ballet	Children's Museum
#1	180	22	88	34	11	48	18	142	50	6
#2	78	104	47	103	36	101	77	60	52	18
#3	7	76	18	83	40	76	46	14	11	15

these numbers. If individuals had random ordinal preferences, accounting for the relative sizes of the organizations, there would not be such clear rankings. Organizations that are "top-heavy" are the largest source of a donor's total contribution and are the second or third choice less often like the Carnegie Museums, Opera, and Symphony. The "bottom-heavy" organizations like Phipps Conservatory, WPC, Zoo, Public Theater, City Theater, and the Children's Museum tend not to receive the largest share of a given donor's bankroll, but instead tend get less than another target organization. The Ballet seems to be somewhere in between these two classifications. The data thus suggest that individuals strategically decide how to allocate funds among the available charitable organization. Nobody in our sample gave, for example, equal amounts to a large subset of these organizations.

Table 8 shows the percentage of the 495 multiple donors who gave any money to each organization. We find that Phipps, WPC, and the Public Theater captured about the same number of donations from these people as the Carnegie Museums and the Symphony, but were clearly the second-choice destinations for charitable giving because they often received less money. It could be possible that there is a "snob-appeal" motivation for giving the largest amount to select organizations to maximize social standing. Socialites may tend to donate the most money to organizations with the highest visibility, ensuring that their name is in the booklet distributed to all their friends. It is difficult, however, to separate this out from people's objective classifications of worthiness.

Table 8: Gift Frequency among Multiple Donors

Carnegie Museums	Phipps	Opera	WPC	Zoo	Public Theater	City Theater	PSO	Ballet	Children's Museum
53.7%	49.1%	32.3%	48.7%	22.0%	48.9%	31.5%	43.6%	23.4%	10.5%

2.4 Private Perks and Board Membership

In addition to the private good motive of prestige that comes with being listed in a playbill or annual report, these organizations tend to provide substantial perks to reward donations. The organizations grant additional perks to the higher levels of giving and also offer all perks associated with levels of giving below your current level. Only 3 of the 10 organizations did not have these tiered privileges listed in their programs, annual reports, or websites. Table 9 summarizes the number of offerings in each category that donors at the top level were given.

Table 9: Number of Perks Explicitly Offered to Potential Donors

	Exclusive Party	Special Tickets	Events	Token Gifts	Autographs	Free Parking
Ballet	2	3	3	3	1	
Carnegie Museums	5	7	5	3		1
Children's Museum						
City Theater	2	2			1	1
Opera	2	3	6	1		1
Phipps Conservatory	1	3	1	5		
Public Theater						
Symphony	1	4	7	3	1	1
WPC		3		2		
Zoo						

Another potential perk associated with giving is the possibility of being appointed to the Board of Trustees. These individuals can gain the prestige of being appointed to the Board as well as a degree of influence in the organization. All of these organizations have a Board

of Trustees and listed their names in the same piece of literature as the names of donors. The Board members who were also listed in the donation section are characterized in Table 10 with the minimum, maximum, median, and average donation of a Board Member along with the standard deviations.

Table 10: Summary of Donations from Current Board Members

	# of Contributing Board Members	Range	Median	Average	Standard Deviation
Ballet	44	$250 - $5,000	$5,000	$3,494	$1,762
Carnegie Museums	99	$500 - $25,000	$2,500	$7,449	$8,691
Children's Museum	33	$50 - $10,000	$500	$1,782	$2,961
City Theater	39	$250 - $2,500	$2,500	$1,878	$858
Opera	69	$250 - $50,000	$5,000	$8,272	$9,359
Phipps Conservatory	44	$50 - $5,000	$475	$722	$867
Public Theater	41	$150 - $10,000	$2,500	$3,662	$2,488
Symphony	29	$500 - $25,000	$1,000	$4,345	$6,835
WPC	28	$100 - $10,000	$1,000	$2,461	$3,383
Zoo	49	$100 - $5,000	$1,000	$980	$1,031

3 A Multiple Discrete Choice Model of Charitable Giving

In this section we formalize the main ideas discussed in this paper and provide a model of individual behavior that can explain donations to multiple organizations. In this model there is a finite number of charitable organizations to which a donor can potentially give money.[15] Each donor makes decisions over the course of a year. The year consists of T time periods. We assume that each person gets solicited in every time period. This is a plausible yet somewhat specific assumption as it supposes that each agent will be exposed to one of the organizations per period (be it a billboard, performance, website, etc.). When they are exposed to the organization, it triggers the idea of giving and a decision is made.

[15]The model of charitable donations that is a dynamic extension of the static model developed by (Hendel, 1999). It also includes the error term using methods outlined in Rust (1994) and Arcidiacono et al. (2007).

Each donor is a characterized by a time invariant vector of observed characteristics. The characteristics include housing wealth, professional indicator variables, party affiliation, and others.

We treat each tier of giving to each charity as a separate differentiated product. There are I charities and an outside option denoted by 0. Each charity has L_i tiers of giving that are associated with an amount of giving g_{il} and private benefits p_{il}.

Let d_{ilt} denote an indicator function that is equal to one if a donor chooses to give to charity i at level l at time t. At each point of time choices are mutually exclusive:

$$\sum_{i=0}^{I} \sum_{l=1}^{L_i} d_{ilt} \;=\; 1 \tag{1}$$

To convert the donor's decision into a truly dynamic model, we need to introduce some state dependence. We assume that the willingness to donate is influenced by the total amount of previous giving. Define the total amount of giving up to time t as

$$tg_t \;=\; \sum_{k=1}^{t-1} \sum_{i=0}^{I} \sum_{l=1}^{L_i} d_{ilk}\, g_{il} \tag{2}$$

We thus treat tg_t as a sufficient statistic that characterizes the history of giving.[16]

We assume that the utility of giving at level l to charity i in period t is given by

$$u_{ilt}(x, tg_t) \;=\; \alpha_i \;+\; \beta(x)\, g_{il} \;+\; \gamma(x) p_{il} + \delta(x) tg_t \tag{3}$$

where α_i denotes a charity specific fixed effect, g_{il} denoted the level of giving associated with the level l of charity i. p_{il} denotes the private benefits associated with giving at level l to charity i. This p_{il} is a vector of perks. γ and β are coefficients of level of giving and private benefits respectively. These coefficients are dependent on x, the individuals observed heterogeneity. δ is also dependent on x. It represents the utility (or dis-utility) of having

[16] It is also possible to treat the total amount of giving to each charity as a state variable.

giving before i.e. donors that have given much in the past maybe less more or less willing to give in the future. Utility of the outside option is normalized to be just the error, i.e. $\alpha_0 = 0$.

The per-period utility at time t is then given by:

$$U_t(d_t, x, tg_t, \epsilon_t) = \sum_{i=0}^{I} \sum_{l=1}^{L_i} d_{ilt}(u_{ilt}(x, tg_t) + \epsilon_{ilt}) \tag{4}$$

where $\epsilon_t = (\epsilon_{11t}, ...\epsilon_{ILt})$ denotes a vector of idiosyncratic shocks. We thus assume that the error enters the utility function in an additively separable manner.

Let $s = (tg, x, \epsilon)$ denote the vector of state variable. Note that x is being observed by the econometrician while tg and ϵ are unobserved by the econometrician. Individuals are rational and forward looking and behave according to an optimal decision rule which solves the following maximization problem:

$$\max_{d_1, d_T} \sum_{t=0}^{T} \beta^t \, U_t(d_t, s_t) \tag{5}$$

From the perspective of the individual this is a simple decision problem without uncertainty and only one time dependent state variable (tg_t). In summary, we have developed a model that can explain multiple donations to different charities in the same year. This is the central feature of the data that needs to be explained. Moreover, it acknowledges the fact that the amount that a person is willing to donate to an organization depends on the level of donations, the private perks associated with each level of giving, and his previous decisions to donate to other organizations.

4 Estimation

The parameters of our model consist of the fixed effects and the other parameters of the utility function, $\theta = (\alpha_1, .., \alpha_I, \beta, \gamma, \delta)$. Since this decision process yields deterministic decision rules, we need to rely on unobserved state variables to generate a properly defined

econometric model. Rust (1987) shows that if the unobserved state variables satisfy the assumptions of additive separability (AS) and conditional independence (CI), conditional choice probabilities are well defined. If we additionally assume that the unobservables in preferences follow a Type I extreme value distribution, we obtain Rust's multinomial dynamic logit specification:

$$P_t(d_{ilt} = 1|tg_t, x) \quad = \quad \frac{\exp(v_{ilt}(tg_t, x, \theta))}{\sum_{j=0}^{I} \sum_{k=1}^{L_j} \exp(v_{jkt}(tg_t, x, \theta))} \tag{6}$$

To evaluate these conditional choice probabilities we must compute the value functions. We can solve this model recursively using backward induction. To see how that works consider the decision problem in the last period T. In the last period the donor solves a static decision problem and the last period conditional value function is simply given by:

$$v_{ilT}(tg_T, x) \quad = \quad u_{ilT}(tg_T, x) \tag{7}$$

For all other periods the conditional value function is defined as:

$$v_{ilt}(tg_t, x) \quad = \quad u_{ilt}(x, tg_t) \; + \; \log(\sum_{m=0}^{I} \sum_{n=1}^{L_m} \exp(v_{mnt}(tg_t + \; g_{il}, x, \theta))) \tag{8}$$

The conditional value functions can thus be computed recursively.

To estimate the model, note that we do not observe choices at each point of time. Instead we observe for each charity i whether an individual donates at a given level l, i.e. foe each donor n we observe

$$d_{il} \quad = \quad \sum_{t=1}^{T} d_{ilt} \tag{9}$$

As a consequence a standard dynamic discrete choice estimator that is based on the choice probabilities in equation (6) is not feasible.[17]

[17] We also do not observe tg.

A feasible maximum likelihood estimator for this model must be based on the probability of observing the outcomes $d = (d_{11}, ..., d_{LI})$ conditional on the observed time-invariant characteristics x. Let these probabilities be denoted by $P_t(d \mid x)$. These probabilities can be computed from the standard conditional probabilities in equation (6) by integration over all possible choice sequences. To illustrate this procedure consider the following simple example.

Example: Assume that there are three choice occasions, i.e. $T = 3$, three charities $I = 3$ and each charity has two tiers of giving $L = 2$. Suppose we observe that an individual donates to the first charity at level 2, to the second charity at level 1 and the not to the third charity. So in our notation, we observe

$$\begin{aligned} d_{12} = d_{21} = 1 \qquad (10) \\ d_{11} = d_{22} = d_{31} = d_{32} = 0 \end{aligned}$$

We assume that the individual faced three choice occasions. The following six sequences of choices are consistent with observed behavior: The probability of observing the behavior

Table 11: Feasible Choice Sequences

t=1	t=2	t=3
12	21	0
12	0	21
0	12	21
21	12	0
0	21	12
21	0	12

in equation (10) is then obtained by computing the probability of each of the six feasible choice sequences and summing over all possible sequences:

$$\begin{aligned} & Pr\{d_{12} = d_{21} = 1 \mid x\} \qquad (11) \\ = \; & P_1(d_{121} = 1 \mid tg_1 = 0, x)\; P_2(d_{212} = 1 \mid tg_2 = g_{12}, x)\; P_3(d_{003} = 1 \mid tg_3 = g_{12} + g_{12}, x) \end{aligned}$$

$$
\begin{aligned}
+ \quad & P_1(d_{121}=1 \mid tg_1=0,x)\; P_2(d_{002}=1 \mid tg_2=g_{12},x)\; P_3(d_{213}=1 \mid tg_3=g_{12},x) \\
+ \quad & P_1(d_{001}=1 \mid tg_1=0,x)\; P_2(d_{122}=1 \mid tg_2=0,x)\; P_3(d_{213}=1 \mid tg_3=g_{12},x) \\
+ \quad & P_1(d_{211}=1 \mid tg_1=0,x)\; P_2(d_{122}=1 \mid tg_2=g_{21},x)\; P_3(d_{003}=1 \mid tg_3=g_{21}+g_{12},x) \\
+ \quad & P_1(d_{001}=1 \mid tg_1=0,x)\; P_2(d_{212}=1 \mid tg_2=0,x)\; P_3(d_{123}=1 \mid tg_3=g_{21},x) \\
+ \quad & P_1(d_{211}=1 \mid tg_1=0,x)\; P_2(d_{002}=1 \mid tg_2=g_{21},x)\; P_3(d_{123}=1 \mid tg_3=g_{21},x)
\end{aligned}
$$

End of Example

The simple algorithm in the example above can be easily generalized to deal with arbitrary number of T, I and L.

Using this algorithm, we can thus characterize the conditional choice probabilities by integrating over all feasible choice sequences. The parameters of the model can then be consistently estimated using a MLE based on equation (6). The likelihood function is thus given by:

$$
L \quad = \quad \Pi_{n=1}^{N} P(d_n \mid x_n) \tag{12}
$$

There are ten charities in our applications with 77 different levels of giving (including the outside option.) We set $T = 4$ in estimation, i.e. each choice occasion thus corresponds to one quarter of a year. We restrict our attention to four choice occasions for computational reasons. As we explained before, one of the computationally expensive parts of the estimation procedure arises from the fact that we need to characterize all feasible choice sequences in the estimation procedure and then integrate over all feasible paths to compute the likelihood function. The main disadvantage for setting $t = 4$ is that we loose information on individuals that decide to donate to more than four charities. Fortunately, we only have a small number of observations in our sample choosing donation to more than four charities in a year. We treat those individuals as if they had just donated money to their four most preferred charities.

In our application almost all donation amounts can be expressed in increments of \$50.

This imposes a natural way to discretize the choice space. As a consequence we can avoid interpolating the state space as suggested by Keane and Wolpin (1994, 1997). We, therefore, compute the value function for every possible state of the world using a backward recursion algorithm.

We use the Simulated Annealing Method to compute the MLE. The main advantage of the Simulated Annealing Method is that its performance dominates simpler algorithms such as the Simplex algorithm. The main drawback is that it is computationally more intensive than the Simplex. The simulated annealing code was obtained from Goffe, Ferrier, and Rogers (1994) which we translated into FORTRAN 90.[18] To test code for the likelihood function, we have conducted a number of Monte Carlo experiments. We set up these problems so that the simulated choice data captured some of the main characteristics of the field data. The results from these experiments are encouraging and show that our programs can recover the true parameter values. We use numerical derivatives to calculate the standard error, based on the score vector.

Finally, we use parallel processing techniques so that we can use the full computational power of the Pittsburgh Supercomputing Center to estimate the model. We estimate the model using 300 processors. Estimating the model for the full sample of 3512 observations takes approximately 12 hours of computing time. One advantage of using a super computer is that we can also check for global convergence. Conducting these test would be prohibitively expensive on an ordinary machine. Following Goffe et al. (1994) we change the starting point and random number generators, and investigate whether the algorithm converges to the same estimates. These experiments show that our estimates are robust, which means we are reasonably certain that we have obtained the global maximum of the likelihood function.

[18]The sample code is available upon request from the authors.

5 (Preliminary) Empirical Results

5.1 Parameter Estimates

We have estimated two versions of the model described above. To obtain our benchmark model, we make the following additional assumptions. First, we assume that the parameters on giving, perks and total past giving are constant and do not depend on observed characteristics of the household. Second, we assume that donor characteristics enter the utility function in a linear fashion. These two assumptions imply the following utility function:

$$u_{ilt}(x, tg_t) \quad = \quad \alpha_i \; + \; \beta \, g_{il} \; + \; \gamma \, p_{il} + \delta \, tg_t \; + \; \psi' \, x \tag{13}$$

To capture heterogeneity among donors we use five dummy variables indicating physician, lawyer, Republican or Democratic affiliation, and city residence. We also use three continuous variables: house value, household neighborhood income, and years lived in the house. Perks are measured by five indicator variables which measure invitations to exclusive dinner parties, special tickets, invitations to special events, as well token gifts. Finally, we have an indicator variable that measures whether the person is a member of the board of the charity. We have estimated the model using our sample of 3512 observations. The maximum likelihood estimates and corresponding standard errors for this model are shown in the following table.

We find that fixed effects of all charities are negative. That is not surprising. Everything else equal, individual prefer not to donate in any given time period. We also find that more popular charities such as the Carnegie Museum and the Pittsburgh Symphony have higher fixed effects than most other charities. We also find that the total amount associated with a donation has a negative coefficient. Everything else equal household prefer to donate lower amounts to higher amounts. This result is primarily driven by the fact that we observe most households donating a lower tiers. More surprising is the the result that total past donations has a positive and highly significant coefficient indicating that previous giving encourages more current giving. This result also helps to explain why some individuals give

Table 12: Estimation Results: Baseline Model

Parameter	Estimate	Standard Error
Ballet	-5.4147	0.13871
Symphony	-4.6357	0.18126
City Theater	-5.2838	0.10774
WPC	-3.7890	0.11997
Opera	-5.2797	0.13957
Phipps	-4.4299	0.13271
Carnegie M	-3.3083	0.14176
Children M	-6.4624	0.13678
Public Theater	-4.6816	0.10178
Zoo	-5.2482	0.10750
Donation	-0.46570	0.00943
Total Giving	0.13546	0.00475
Exclusive Dinner/Party	0.19304	0.03897
Special Tickets	-0.28366	0.02738
Events	0.15556	0.02690
Token Gift	-0.05394	0.03467
Board Membership	0.34007	0.06693
Lawyer	-0.06731	0.07228
Physician	-0.04747	0.07949
Rep	0.19925	0.06433
Dem	0.26938	0.06069
House value	0.47166	0.08925
Mean income	-0.00426	0.08190
Married	0.16173	0.05548
City Resident	0.10261	0.06123
Years in House	0.00644	0.00274

to a large number of charities.

Table 13: Estimation Results: Baseline Model + UW

Parameter	Estimate	Standard Error
Ballet	-5.5302	0.13599
Symphony	-4.7683	0.18045
City Theater	-5.3669	0.10270
WPC	-3.9061	0.11552
Opera	-5.1875	0.13631
Phipps	-4.4975	0.12894
Carnegie M	-3.0659	0.13911
Children M	-6.5816	0.13241
Public Theater	-4.8091	0.09671
Zoo	-5.3754	0.10239
United Way	-4.2028	0.10282
Giving Amounts	-0.36180	0.00793
Total Giving	0.12048	0.00381
Exclusive Dinner/Party	0.09758	0.03684
Special Tickets	-0.37262	0.02777
Events	0.13048	0.02683
Token Gift	0.00481	0 03479
Membership	0.34878	0.06326
Lawyer	0.05715	0.06547
Physician	-0.09542	0.07624
Rep	0.30464	0.06257
Dem	0.31912	0.06007
House value	0.52466	0.08128
Mean income	0.04715	0.07796
Married	0.18538	0.05100
Pitt. Resident	0.07790	0.05637
Years House	0.00496	0.00255

Most household characteristics have the expected sign. House value which we use as a proxy for wealth is positive. Moreover we find that residents of the city of Pittsburgh give higher amounts. So do married couples. Our professional dummies are insignificant. However, the variables measuring political affiliation are positive and significant. This result indicates that households that are politically active are also actively supporting the local charities. Finally consider the estimates that measure the perks. We find that households

like invitations to dinner parties as well as special events. Special tickets and token gift do not seem to be useful perks. Our finding thus indicate that private benefits that are associated with social status are valued by donors. This finding is also consistent with the result that board membership is value highly. Members on the board are more likely to be active donors and give as we have seen in the previous section more that average donors.

As a sensitivity check, we add the United Way as another choice to our model. We estimate the model and the results are shown in Table 13. Overall we find that the results are qualitatively the same.

5.2 Goodness of Fit

Next we consider the within sample fit of the model. Table 14 reports compares selected moments from the data with moments predicted by the baseline model. Table 14 reports number of donors, median and average donation levels for the data and a simualted sample of the same size.

We find that our model fits the distribution of donors among charities very well. Fitting the median and average donations is, of course, a lot more difficult for a number of reasons. First, there are a number of charities such as the Zoo and the Public Theater for which the median level of donation occurs at the lowest tier, i.e. a majority donors give at the lowest possible level. Second, Table 14 reveals that there is typically a large difference between the median and average level of donation indicating that the distribution is rather skewed. Despite these challanges, we find that the baseline model fits the data reasonably well.

5.3 Policy Analysis

To get some additional insights into the rule that private benefits play in attracting charitable donations, we conduct a number of policy experiments. First, we consider the case in which one of the charities stops holding exclusive parties. What would that do to the number of contributors at each level and to total contributions?

Table 14: Estimated and Simulated Moments

Charity	Number of Donors	Median Donations	Average Donations
Ballet	323	250	818.11
	326	468	685.46
Symphony	443	1000	2161.40
	460	550	1567.30
City Theater	374	100	363.64
	376	250	484.62
WPC	832	100	343.99
	820	250	767.67
Opera	369	500	2029.13
	360	500	1148.01
Phipps	608	100	176.89
	606	147	373.97
Carnegie M	804	1000	1930.97
	795	950	1502.82
Children M	112	100	610.27
	110	235	563.40
Public Theater	718	50	402.09
	728	290	736.03
Zoo	406	50	234.24
	415	250	653.80

Note: The simulated median is the average over twenty samples.

– to be continued –

6 Conclusions

Charitable giving is an important way for individuals to support the mission of many cultural organization. To maintain these institutions, there needs to be a significant amount of private support from individual donors. Our findings indicate that private motivations and benefits for giving are certainly important incentives to donate to large cultural organizations. Few individuals donate anonymously and these organizations continue to reward their sponsors by printing their names in brochures, playbills, and annual reports. The idea that social status matters is supported by the fact that people list their names with middle initials, suffixes, and professional titles and the fact that many high-visibility individuals in the Pittsburgh community choose to contribute.

Offering up private benefits for tiered donation amounts is a good way of convincing people to give to their favorite charities. People are willing to pay extra money for an event which may tie back into the social status motive since additional affluent people are also likely to be in attendance. These perks are notoriously popular in political donations where campaign contributors pay large amounts of money per plate at a fund-raising dinner for access to the candidate. The prospect of influence in an organization through board membership is also good way to secure reliably high yearly contributions.

Individuals have a long list of causes to which they can choose to donate money. It is vitally important for these cultural organizations to court potential donors. Knowing as much as possible about their donor constituencies will allow them to personalize the fund-raising process. Large cultural organizations seem to understand the private motivations very well. Organizations point out potential tax breaks, provide perks in proportion to the level of giving, publish and distribute the names of donors, and offer board membership to reliable contributors.

While the joy-of-receiving private benefits may partially explain the behavior of some

donors, it does not appear to be the sole motivation for most peoples' behavior. It must be reassuring for donors to know that most charitable organizations are liquidity constrained and heavily rely on private donations to cover large parts of their operating budgets. Thus the joy-of-giving is indeed a substantial motivation for most donors.

References

Ackerberg, D., Benkard, L., Berry, S., and Pakes, A. (2006). Econometric Tools for Analyzing Market Outcomes. In *Handbook of Econometrics VI*. Elsevier North Holland.

Aguirregabiria, V. and Mira, P. (2002). Swapping the Nested Fixed Point Algorithm: A Class of Estimators for Discrete Markov Decision Models. *Econometrica*, *70 (4)*, 1519–1544.

Andreoni, J. (1989). Giving with Impure Altruism: Applications to Charity and Ricardian Equivalence. *Journal of Political Economy*, *97*, 1447–58.

Arcidiacono, P., Sieg, H., and Sloan, F. (2007). Living Rationally Under the Volcano? Heavy Drinking and Smoking Among the Elderly. *International Economic Review*, *48 (1)*, 37–65.

Auten, J., Sieg, H., and Clotfelter, C. (2002). Charitable Giving, Income and Taxes: An Analysis of Panel Data. *American Economic Review*, *92 (1)*, 371–382.

Bergstrom, T., Blume, A., and Varian, H. (1986). On the Private Provision of Public Goods. *Journal of Public Economics*, *29*, 25–49.

Berry, S. (1994). Estimating Discrete-Choice Models of Product Differentiation. *Rand Journal of Economics*, *25(2)*, 242–262.

Berry, S., Levinsohn, J., and Pakes, A. (1995). Automobile Prices in Market Equilibrium. *Econometrica*, *63 (4)*, 841–890.

Buraschi, A. and Cornelli, F. (2003). Donnations. Working Paper.

Clotfleter, C. (1985). *Federal Tax Policy and Charitable giving*. Chicago University Press. Chicago.

Eckstein, Z. and Wolpin, K. (1999). Why Youth Drop out of High School: The Impact of Preferences, Opportunities and Abilities. *Econometrica*, *67*, 1295–1340.

Glazer, A. and Konrad, K. (1996). A Signaling Explanation for Charity. *American Economic Review*, *86*(4), 1019–1028.

Goffe, W., Ferrier, G., and Rogers, J. (1994). Global Optimization of Statistical Functions with Simulated Annealing. *Journal of Econometrics*, *60*, 65–99.

Gorman, W. (1980). A Possible Procedure for Analyzing Quality Differentials in the Egg-market. *Review of Economic Studies*, *47*, 843–856.

Harbaugh, W. (1998). What Do Donations Buy? A Model of Philanthropy Based on Prestige and Warm Glow. *Journal of Public Economics*, *67*, 269–84.

Hendel, I. (1999). Estimating Multiple-Discrete Choice Models: An Application to Computerization Returns. *Review of Economic Studies*, *66*, 423–446.

Hobbs, T. (1651). *Leviathan*. Hackett Publishing Company. Indianapolis and Cambridge.

Hotz, J. and Miller, R. (1993). Conditional Choice Probabilities and Estimation of Dynamic Models. *Review of Economic Studies*, *60*, 497–529.

Keane, M. and Wolpin, K. (1994). The Solution and Estimation of Discrete Choice Dynamic Programming Models by Simulation and Interpolation: Monte Carlo Evidence. *Review of Economics and Statistics*, *76*, 648–672.

Keane, M. and Wolpin, K. (1997). The Carrer Decisions of Young Men. *Journal of Political Economy*, *105(3)*, 473–523.

Keane, M. and Wolpin, K. (2007). Exploring the Usefulness of a Non-Random Holdout Sample for Model Validation: Welfare Effects on Female Behavior. *International Economic Review*, *48*.

Kingma, B. (1989). An Accurate Measurement of the Crowd-Out Effect, Income Effects, and the Price Effect to Charitable Contributions. *Journal of Political Economy*, *97*, 1197–1207.

Lancaster, K. (1966). A New Approach to Consumer Theory. *Journal of Political Economy*, *74*, 132–157.

Manzoor, S. and Straub, J. (2004). The Robustness of Kingma's Crowd-Out Estiamte: Evidence from New Data on contributions to Public Radio. Working Paper.

Miller, R. (1984). Job Matching and Occupational Choice. *Journal of Political Economy*, *92 (6)*, 1086–1120.

Pakes, A. (1986). Patents as Options: Some Estimates of the Value of Holding European Patent Stocks. *Econometrica*, *54*, 755–785.

Randolph, W. (1995). Dynamic Income, Progressive Taxes, and the Timing of Charitable Contributions. *Journal of Political Economy*, *103(3)*, 709–38.

Ribar, D. and Wilhelm, M. (2002). Altruistic and joy-of-Giving Motivations in Charitable Behavior. *Journal of Political Economy*, *110*, 425–57.

Romano, R. and Yildrim, H. (2001). Why Charities Announce Donations: A Positive Perspective. *Journal of Public Economics*, *81*, 423–47.

Rust, J. (1987). Optimal Replacement of GMC Bus Engines: An Empirical Model of Harold Zurchner. *Econometrica*, *55 (5)*, 999–1033.

Rust, J. (1994). *Structural Estimation of Markov Decision Processes*, p. Chapter 51. Handbook of Econometrics. Elsevier.

Steinberg, R. (1990). Voluntary Donations and Expenditures in a Federal System. *American Economic Review*, *77*, 24–36.

Tood, P. and Wolpin, K. (2006). Assessing the Impact of a School Subsidy Program in Mexico: Using Experimental Data to Validate a Dynamic Behavioral Model of Child Schooling and Fertility. *American Economic Review*, *96*, 1384–1417.

Vesterlund, L. (2003). The information value of sequential fundraising. *Journal of Public Economics*, *87*, 627–57.

Wolpin, K. (1984). An Estimable Dynamic Stochastic Model of Fertility and Child Mortality. *Journal of Political Economy*, *92*, 852–874.