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Impure thoughts of charitable giving

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Impure thoughts of charitable giving

by

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For the Major Program

DEDICATION

This dissertation is dedicated to my wife Dana and our son Carter.

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CHAPTER 1. INTRODUCTION

People's motivations for giving are impure. Pure motivations result in gifts of time or money that are purely selfless. A selfless gift of time or money will keep an agent's utility level the same or less than it would have been without the donation. Imagine economic assumptions where firms are not profit maximizers and individual's utility can be increased by factors other than personal consumption. These kind of assumptions are distinct from the usual assumptions expected in economics; however, this is to some degree what is observed in the case of charitable giving. In 1776, Adam Smith may have wondered what prompted a self-interested individual to give. Adam Smith wrote, "it is not the benevolence of the butcher, the brewer, or the baker from which we expect to receive our dinner…" (p. 154). We observe benevolent behavior in the U. S. and all over the world. Gifts of time and money are important factors in determining social welfare. Monetary contributions have received the most attention over the past 30 years, which is one reason why time gifts are the focus of this research (Rose-Ackerman, 1996). The purpose of this dissertation is to determine whether people's decision to contribute time is dependent upon how much time other people are giving. Standard economic reasoning would lead one to think that no one would give to the needy since people believe that other people will help out those poor individuals. This is the free/easy-rider concept for public goods (Cornes and Sandler, 1984, 1996). If a privately supplied pure public good is intended to be funded voluntarily, it is common to observe people thinking that other people will pay for the good. Therefore, it is likely that public good production will be less than what is efficient and possibly not produced at all. Since a substantial amount of giving is observed in the United States (over $122 billion of monetary contributions in 1990 and 38 million volunteers in 1989), one safely can shelve the pure public good model as an underlying model of charity (Hodgkinson and Weitzman, 1994, Hayghe, 1991). Nevertheless, the pure public good model will serve as a benchmark case.

An interesting observation is that people of all income levels give time and/or money. The level of monetary gifts tends to be higher among a set of contributors as income rises, but what about the gift of time? All people are endowed with an equal amount of hours in a day, which makes time donations unique when compared to monetary donations. Valuing time is no exact science. Certainly, each individual has an opportunity cost. Hodgkinson and Weitzman (1994) valued 19.4813 billion hours of volunteer time in 1993 at $9.38 per hour (the average nonagricultural hourly wage plus 12% for fringe benefits). Whether that means anything to the agents receiving the time donation may differ case by case. The administrators of a soup line at a homeless shelter are indifferent to having a accountant or a janitor serving food at noon. Church members, however, may prefer an accountant over a janitor to serve as treasurer. The accountant may find it refreshing to scoop soup for the 41st hour of his work week rather than spend it working. It is not hard to imagine that the accountant is tired of accounting after 40 hours of work and would not consider spending his 41st hour working. This type of attitude by the accountant makes his wage inappropriate to serve as his opportunity cost. Time can be valued at the donor's or the recipient's opportunity cost, the two values need not be equal (Bilodeau and Slivinski, 1996).

Time donors may give where their value of marginal product is highest according to their skills (Andreoni, et. al., 1995). This theory would imply that the accountant gets more utility donating accounting time than soup serving time. Does a donor gain utility because of the money he is "saving" the recipient, or just from the raw amount of time he gives (Roy and Zimek, 2000)? A donor may be giving time to gain skills and/or experience to increase his income in the labor market (Day and Devlin, 1998). Brown and Lankford (1993) investigate another possibility, workers constrained by hours worked. If workers desire to work more and cannot, the opportunity cost of volunteering is no longer lost wages. Under this situation, an appropriate variable to estimate gifts of time is available hours (Clotfelter, 1985). Use of available hours as an independent variable implies a sequential decision-making process. A person's allocation of time to charity work most likely follows his or her labor decision- i.e., the number of hours worked. An appropriate theoretical structure to consider under these circumstances is a separable utility function (Pollak and Wachter, 1975). This dissertation develops a unique application of a separable utility function that supports household's focusing their decision of volunteer time on how much available time they have and other preference parameters. It will be argued theoretically and empirically that household's volunteer efforts are best modeled this way.

Within the topic of charitable giving are two items that are not in line with traditional economic thinking. First, the firms supplying the good are often not seeking profits, or are believed to not be profit seeking (Hansmann, 1980). Second, individuals appear, to some degree, not to be self-interested or to possess some unusual variables in their utility function (Sugden, 1984, Kaplow, 1995). Some common principles of economics are disrupted. Predictions about people's actions will change under different policies. In response to policy changes, good predictions about philanthropic behavior are crucial to social welfare. In 1997, President Clinton took a proactive role in encouraging citizen's participation in volunteerism.

He and many others are suggesting that the economy will experience real effects from a rise in volunteer work. Propaganda of this nature can spur people into giving, although it may be short-lived if the spirit of camaraderie slows as the efforts of the politicians move toward other topics.

Taxes undoubtedly play a role in determining the level of monetary gifts, but tax effects on gifts of time are less clear. A consumer's marginal tax rate is used for the calculation of the price of a monetary gift, because an itemizing taxpayer's income is reduced by the amount of the monetary gift, thereby reducing the person's tax liability (Long, 1977, Dye, 1980, Feenberg, 1987, Reece and Ziechang, 1987, Weisbrod, 1988, Auten, Cilke, and Randolph, 1992, Rose-Ackerman, 1996). Most authors, who have written on time gifts, have used the price of monetary gifts to estimate a relationship between monetary gifts and time gifts. Arguments against this practice are made in chapter three.

The amount of time a person volunteers may depend on how much time others have given, especially those close to the giver. One would suspect interdependent preferences among household members. Estimation of an individual's utility maximization problem without considering the entire household may create inefficient and/or biased coefficients. This paper shows the differences between modeling decisions of volunteer time for a household and an individual. Available time and other people's time are instrumental to the determination of an individual's choice of gifts. If people are determining their gifts in the same time period, simultaneous equation techniques should be used to estimate the coefficients of the demand for charitable giving.

The roles of the agents must be kept straight. The individual supplying the gift is considered to be the consumer of the charitable good, because he or she is forgoing private consumption so that someone else may consume. The individual(s) consuming the charitable good is (are) in reality supplying "need" to the donor. A transaction between these two agents can and does take place without any need for a government or a nonprofit firm. For the most part a nonprofit firm serves as an intermediary between the consumer and the supplier (Posnett and Sandler, 1988). Many nonprofit firms package need in a variety of ways and then "sell" it to consumers. For example, the United Way has fundraising activities that are targeted to specific projects like providing food to villages in Ethiopia. Money that is donated will be earmarked, as prescribed by the donor, to a certain project. Nonprofit firms are always presumed to be agents for someone or something else. Contrast that idea with the traditional for-profit firm which is presumed to be representing its shareholders or proprietor.

By keeping these characteristics of the good in mind, one starts to realize the possibilities of how charitable gifts fit into the household's decision process. We have two general gifts to contemplate, money and time. Each of these gifts has distinct, but interrelated constraints. Money gifts are bound by the amount of money generated in income from resources of a given household. Time gifts are bound by the amount of hours in the day, less some time for sleep. The interrelation of the two gifts is that one way for the household to generate income is through time in the labor market, but this uses up *available time* to give. An interesting question is what time horizon household's consider when choosing their level of gifts. Some household's may think of a daily devotion, others may set a certain level of gifts for the year, and others may be thinking that they will work hard while they are young, save, and give time and money when they retire. Different theoretical approaches to how a household solves a utility maximization problem of this kind are explored in Chapter 3. The resulting demand equations from different theoretical approaches can be tested.

Another issue with these models is that gifts of time are censored at zero. Many people choose not to give time and in fact may choose negative amounts of time if it were possible. The most common way to deal with this issue empirically is by using a Tobit model. Chapter 5 covers the empirical results of using a Tobit model to test whether the data from 2,347 households support a household or individual approach to modeling gifts of time. The empirical section also covers allocations of time among households and also among spouses. Interesting questions arise when someone begins to think about charitable gifts of time. How should the household be modeled given that there is likely two decision makers in one household (Pollak, 1976)? Problems of simultaneous decision making must be overcome in empirical estimation of giving behavior. Do spouses tend to give time together, or does the household tend to have the spouse with the lowest opportunity cost give while the other works? Do households who give time to church tend to be the households who give to other types of organizations? Do households use gifts of time as a substitute for gifts of money? Does a household's income level help determine the amount of time they give? The data suggests answers to these types of questions.

The remainder of the thesis consists of five chapters. A review of the nonprofit sector follows this chapter. In the third chapter, theoretical models are presented starting with general models of public goods and then building to basic models of charitable contributions.

Chapter four discusses a household approach to charitable giving. The fifth chapter covers a description of the data and econometrics. Concluding remarks are in the last chapter.

CHAPTER 2. NONPROFIT SECTOR REVIEW

A brief review of the nonprofit sector is essential to an understanding of the insights to the demand side of charitable giving. Competition and the incentive of profits drive most private good markets to an efficient level of production. There are goods, however, that fail to allow for competition or profits due to the characteristics of the goods. Private goods, like a cheeseburger, have characteristics of 1) being able to have only one person enjoy the benefits of consuming the good and 2) being able to exclude non-payers of the good. Private good's benefits are said to be rival and excludable. Public goods, like national defense, with non-rival and non-excludable benefits, are desired by consumers but may need to be provided by producers through non-market means. This follows because producers will have a difficult time making money producing goods which can be enjoyed without payment! There are also goods like golf courses that have a mixture of non-rivalry and excludability. These types of goods are referred to as impure public goods or club goods (Cornes and Sandler, 1996).

Profits may also not be the driving force due to some altruistic motive of the producer or apprehension by consumers of getting the good from a profit-seeking producer or both. Hansmann(1980) pointed out three conditions which facilitate an efficient market. The conditions are "that consumers can, without undue cost or effort, (a) make a reasonably accurate comparison of the products and prices of different firms before any purchase is made, (b) reach a clear agreement with the chosen firm concerning the goods or services the firm is to provide and the price to be paid, and (c) determine subsequently whether the firm complied with the resulting agreement and obtain redress if it did not" (p. 843). If the consumer cannot do any one of these things, there will be at least an underproduction of the good and more likely no production at all in a for-profit setting. Under the circumstances outlined above, a nonprofit enterprise may at least mitigate the market failure. To further complicate the problem, these goods are often characterized by some degree of publicness, through nonexcludability and/or nonrivalry. Some examples of goods and/or services that are of this nature are health care, museums, education, research, and the media.

An important characteristic of a nonprofit firm is that it can earn a profit, but is committed by law not to distribute it. This is precisely how for-profit and nonprofit firms differ. Can the nonprofit firm successfully distribute earnings through a veil of inflated wages, company cars, and other perks? In some cases, the answer is yes; however, through institutional arrangements like government monitoring, activities like these can be minimized. Even if there are no such arrangements, the output from a nonprofit firm is expected to be closer to the efficient level than that which would be produced in a for-profit setting. This implies a second-best answer to the market failure (Hansmann, 1980).

Within the nonprofit literature a person finds some interesting topics specific to the nonprofit field. One of these issues is the firm's objective. If profits are not the driving force, then is it the number of souls saved, the proportion of sick to healthy, the whale count, or any other ideological objective? While these functions are not easily defined or proxied, some of the literature has tried to estimate if the firms are acting as revenue maximizers or net revenue maximizers (Khanna and Sandler, 1999, Khanna, Posnett and Sandler, 1995, Weisbrod and Dominguez, 1986, Steinberg, 1987, Rose-Ackerman 1982). A revenue maximizer incurs fundraising expenses until the revenue generated by the last dollar spent is zero. A net revenue maximizer incurs fundraising expenses until the revenue generated by the last dollar spent is equal to the cost of what it took to get that last dollar.

Competition between for-profit and nonprofit firms is another relevant issue in this area (Hansmann, 1980). For example, suppose two firms produce goods that are similar and/or relatively substitutable for each other. One of the firms also produces other products, some with tax-exempt status, others without. The multi-product firm may be able to shift costs from the nonexempt good to the exempt good giving an "unfair" advantage (Weisbrod 1988). Weisbrod also discusses the potential for deception in the nonprofit sector. The producer, being a profit maximizer, sees the nonprofit sector as a great way to avoid the burden of corporate tax. If the industry has imperfect monitoring, a profit maximizer may do quite well in the nonprofit arena. Another issue is when for-profits and nonprofits engage in joint ventures. This can take a multi-product form or may be as simple as IBM and the United Way advertising products on television in the same ad. The issue is whether a for-profit firm gets an unfair advantage over its competitors by collaborating with a nonprofit firm that gained social status and respect through tax exempt activities.

It is important to understand the role of the government in the nonprofit sector. The government is the most natural enforcer of the implicit contract between the consumer and producer of a charitable good. The essential element needed for transactions to occur when one of Hansmann's conditions is not met is the non-distribution of profits. By having the donor know that the firm is nonprofit, he is less likely to be worried about his donation getting to the end user. The government provides the infrastructure necessary to document that the firm is nonprofit. Note, however, that the government is not necessary for carrying out of transactions of this nature. There is no reason why private agents in small numbers could not adopt a successful plan to carry out a contract (Coase, 1954). The government is the most commonly used because transactions of this sort typically involve large numbers of agents for which it would be too costly to use private contracts. The most common function provided by the government is monitoring. Private agents acting on their own could not feasibly monitor the firm's behavior.

The next consideration is government financing the monitoring need and other forms of output. The government not only helps identify the "worthiness" of the cause through the non-distribution criterion, but can also impose payments to the nonprofits. Since many charitable goods are public in nature, there will be free or easy riding associated with them so that the government may have to support them through taxation. Taxation will alleviate some free riding, but can affect current contributors to the pure public good. The neutrality theorem asserts that an individual who is taxed an amount equal to the value of the pure public good he will receive will reduce his private purchases of the public good by the amount of the tax (Bergstrom, et. al., 1986). From general tax revenues, the government can attempt to ameliorate the market failure derived from the public aspect of the goods by subsidizing the nonprofit firms directly or indirectly. The problem with this is that private contributors may decrease voluntary contributions in response to government donations. This idea is called "crowding out" (Duncan, 1999, Steinberg, 1991, Rose-Ackerman, 1986, Abrams and Schmitz, 1978, 1984). Note that it is possible to have "crowding in", for example, if consumers consider government involvement as positive information in evaluating the charity as a worthy cause (Khanna and Sandler, 2000, Rose-Ackerman, 1986, 1982). Direct subsidies are basically a check written from the government to the nonprofit firm. The nonprofit can direct these funds toward operating expenses or output as it desires. Indirect subsidies consist of money directed toward a specific purpose, such as low postage rates or free advertising on radio or television.

Another role that the government can fill is that of an information provider. For example, the government can authorize certain types of nonprofits and assign them a tax code. These services require tax dollars, so one should carefully analyze the benefits of relieving the informational asymmetry to the associated costs. Other informational asymmetries that may exist can be mitigated or eliminated through monitoring the operations; for instance, organizations that provide relief to third world nations are monitored. The government can publish the fraction of donations actually received in the third world and the amount goes toward fundraising expenditure and administrative costs.

Now that basic information regarding the nonprofit sector has been presented, theoretical models are explored in chapter three. The theoretical models have been designed to test the issues raised in this chapter.

CHAPTER 3. THEORETICAL CONSIDERATIONS

General Models of Public Goods

The purpose of this chapter is to show some different ways that charitable gifts can be modeled. The public nature of charitable gifts has interesting implications for a utility function. This chapter starts with basic models of public goods. Then a canonical model of charitable gifts is examined, followed by a discussion of how charitable gifts differ from other goods. In the chapter's last section, time gifts are separated from monetary gifts. Controversial comments against the use of the tax price of monetary gifts in modeling gifts of time are presented. Such comments are controversial, because most volunteer models have used the tax price of monetary gifts to determine if the two goods are complements or substitutes.

Recall that the two important features of the benefits of a public good are non-excludability and non-rivalry (see p. 8). The benefits (harm) of the public good will spread to all agents through the group of agents who choose to buy or provide it. This means that the utility function for each individual will contain other people's levels of consumption. As stated earlier, the private provision of a pure public good model will be used as a benchmark case. The typical way of representing a pure public good is by using a summation technology of supply, in which the aggregate level of the good is the sum of the individual contributions (Cornes and Sandler, 1996). This method assumes that individuals care only about the aggregate level of the pure public good. In the simplest case, it does not matter who actually purchases or provides the public good. The summation technology implies that each contributor's provision is perfectly substitutable. Define an individual's problem as maximizing a strictly increasing and strictly quasi-concave utility function ($U_i(\cdot)$) dependent on a private good y_i and a pure public good, Q. The budget constraint for this maximization problem has p as the relative price of the public good and I_i as the i^{th} consumer's income. q_i is agent i's contribution and $q_{(i)}=\Sigma q_j$, for $i \neq j$, is all others' contributions to the public good.

$$\max_{y_i, q_i} \; U_i(y_i, Q) \tag{1}$$

subject to

$$pq_i + y_i = I_i, \tag{2}$$
$$q_i + q_{(i)} = Q, \tag{3}$$
$$y_i, q_i \geq 0. \tag{4}$$

Equation (2) is a standard budget constraint, (3) shows that the public good is the sum of the private contributions from each individual, and the non-negative constraints are in (4). Under this private provision framework, the first order condition for an interior solution generated by the market:

$$MRS^i_{Qy} = p, \qquad q_i > 0 \tag{5}$$

This expression shows that consumers will choose a level of q_i and y where their willingness to trade the public good (Q) for the private good (y), their MRS^i_{Qy}, is equal to what they are able to trade in the market, the relative price p. Using a Benthamite social welfare utility function:

$$U = \sum_{i=1}^{n} U_i(y_i, Q) \tag{6}$$

and a constraint:

$$\sum_{i=1}^{n} I_i = pQ + \sum_{i=1}^{n} y_i \tag{7}$$

The social welfare optimum must satisfy:

$$\sum_{i=1}^{n} MRS^{i}{}_{Qy} = p \qquad (8)$$

or

$$MRS^{i}{}_{Qy} + \sum_{j \neq i}^{n} MRS^{j}{}_{Qy} = p \qquad (9)$$

The market first order condition (5) does not match the Pareto condition (8), because individuals do not take into account that their contribution q_i potentially benefits all other individuals (the second left-side term of (9)) by raising the level of Q. Thus, each individual does not provide enough q_i and the market fails to provide the first best solution.

An extension of the pure public good model is the joint products model (Cornes and Sandler, 1984). The latter model maintains the summation idea to some extent, but it also asserts consumers gain another form of satisfaction jointly with the level of the public good. This can be viewed in two ways. One way is that two different goods are being produced from one primary resource. A second way is to think in terms of the household theory of consumption. This theory asserts that individuals derive satisfaction from different characteristics of an activity. The new variables introduced here capture the joint products produced by q_i, which is an activity that produces x_i and z_i. Contrast this specification with the pure public good model. The summation of the public component is preserved but is now applied to one of the characteristics derived from q_i. Let α and β be fixed proportion parameters creating a linear relation between the level of q_i and quantities of x_i and z_i. Note that if α=0 and β=1, the model reduces to the pure public good model. x_i is the private characteristic specific to consumer i. z_i and $z_{(i)}$ are the public component enjoyed or disliked by individual i and others, respectively. For example, suppose a person decides to put a new exhaust system on his or her car because he or she is tired of the noise. In so doing, he or she not only benefits from the noise reduction (αq), but also confers a benefit to the community (βq) by way of reducing noise and air pollution.

Let individual i maximize a utility function that is continuously differentiable, strictly increasing and strictly quasi-concave:

$$U_i=U_i(y_i,x_i,z_i+z_{(i)}) \tag{10}$$

subject to:

$$I_i=y_i+pq_i, \tag{11}$$
$$Z=z_i+z_{(i)}=\beta q_i+\beta q_{(i)}=\beta Q, \tag{12}$$
$$x_i=\alpha q_i, \tag{13}$$
$$z_i=\beta q_i \text{ for every i.} \tag{14}$$

Decisions on the level of y_i and q_i are based on the exogenous variables, income and other's choices of $q_{(i)}$, and the preference parameters, α and β. Equation (11) is a standard budget constraint and (12) shows the public good Z as the sum of the individual's production of z_i. Equations (13) and (14) show the private and public good produced from q_i, respectively.

The Lagrangian function for solving this problem is:

$$L= U_i(y_i,\alpha q_i,\beta q_i+\beta q_{(i)})+ \lambda(I_i-y_i-pq_i). \tag{15}$$

The first order independent, Nash conditions for the joint products model generated in the market are:

$$p = MRS^i_{qy}=\alpha MRS^i_{xy}+\beta MRS^i_{zy}, \text{ for every i.} \tag{16}$$

This equation implies that the consumer's decision of how much q to consume is based on a productivity weighted average of his marginal rate of substitutions. His willingness to substitute the jointly produced private characteristic with the private good is weighted by α. His willingness to substitute the jointly produced public characteristic with the private good is weighted by β. The Pareto optimal consumption of the two goods would be again determined by a Samuelson condition (Cornes and Sandler, 1984, 1996):

$$p = \alpha MRS^{i}_{xy} + \beta \sum_{j=1}^{n} MRS^{j}_{zy} \qquad i=1,\ldots,n. \qquad (17)$$

Once again, the independent and Pareto optimal first order conditions are different. The difference arises because the market solution in (16) ignores the spillover benefits from the public component. This means there may be room for an optimistic economist to design a mechanism to bring about the efficient solution, but this is not the focus of this dissertation.

Basic Models of Charitable Contributions

A basic model of charitable contributions would need to include all possible contributors to a good in which its benefits are presumed to be shared by many. As discussed previously, it is difficult to think of an organization that collects contributions that does not benefit more than a few people with the output it produces. When modeling this type of good, four main agents are identified: an individual donor, all other private donors, a charity and the government. As may be expected there are interdependencies among each agent. There is no consensus in the literature on the crowding that agents cause each other. Indeed some have hypothesized and demonstrated crowding-in rather than crowding-out (Khanna and Sandler, 2000, Rose-Ackerman, 1982).

A general model would include a utility function that exhibits the usual concavity and differentiability requirements like equation (10):

$$U_i = U_i(Y_i, Q) \qquad (18)$$

and constraints:

$$I_i = Y_i + pC_i \tag{19}$$
$$Q = C_i + C_{(i)} + G \tag{20}$$
$$Y_i, C_i \geq 0 \tag{21}$$

where Y_i, C_i and I_i is the i^{th} agent's private good consumption, charitable contribution, and income, respectively. $C_{(i)}$ is all other private contributions and G is government support of the charitable good. A standard budget constraint is shown in equation (19). Equation (20) shows that the public good Q is created from three different, perfectly substitutable, sources. The non-negative constraints are in (21).

The focus of many papers is on agent's perception of the other agents' contributions (Schiff, 1985, Andreoni, 1990, Rose-Ackerman, 1986, Kingma, 1989). The treatment of Q as a pure public good was one of the initial models in the literature. It has the well-known prediction that private contributions will be crowded out dollar for dollar by government contributions (Roberts, 1984). If, however, non-contributors are involved in the tax and spend policy, less than dollar for dollar crowding would be expected (Bergstrom, et. al., 1986). Schiff (1985) concluded that it is important to differentiate by the source of contribution and he suggested that agents receive different amounts of utility depending on the source— gift is from that agent, some other agent or the government. Schiff modeled this idea by having the aforementioned variables in the utility function as arguments along with a private good. Crowding of the agent's gift will differ depending on the source.

The "impure altruist" model of Andreoni (1990) differs by the assumption that people care about the amount of their donation and the total level of contributions. This implies that others' donations and government's donations are perfect substitutes. The implication on crowding for this model is less than dollar for dollar due to the private benefits from the act of giving. Furthermore, this model helps reconcile the fact that most households do give money and the amount of the household gift is often large. These empirical observations are impossible to reconcile with the pure public good model.

The price of giving, p, is different for itemizers and non-itemizers. People who itemize their tax returns face a price of giving of:

$$p=(1-t), \qquad (22)$$

where t is the marginal tax rate. This representation implies that a person facing a t=33% is giving up $.67 worth of private goods for each dollar of donations. If agents do not itemize, however, they are giving up $1 of private goods for each dollar given. To go one step further, one should take into account that part of the dollar given to charity goes toward administration and fundraising (Khanna and Sandler, 2000, Rose-Ackerman, 1982). Therefore, if consumers are truly interested in how much charitable output their dollar buys, the price of giving should be:

$$p=(1-t)/[1-(f+a)], \qquad (23)$$

where f is the fraction of donations that is put toward fundraising expenditure and a is the fraction spent on administrative expenses. Together, these two items raise the price of giving, offsetting the effect of the marginal tax rate. Suppose that t=33% and f+a=20%. This then implies an effective price of p=.8375. The effect of the tax price of monetary gifts on gifts of time will be further discussed in the next section.

Time as a Gift

Models of time donations are few. This may be due to a social need for concentration on monetary donations starting in the 1970's. It may also be due to the lack of available data on time gifts relative to monetary gifts for the last 30 years. Previous researchers interested in charitable giving have had monetary gifts from tax returns at their disposal. Time gift data is not as easy to find. Previous attempts to explain gifts of time have come from unspecified utility functions (Brown and Lankford, 1992). In the Brown and Lankford paper, money and time donations were estimated simultaneously. A determinant of time and money donations worth noting in their paper is available time. They did not presume the price of giving per hour as the after-tax wage rate. What they did assume is that people are constrained by their current work load. They either have optimally chosen their level of work or could not work more hours if they wanted to. This leaves 16 available hours minus average hours of market work. The Independent Sector data showed that only 53% of workers in the sample would be able to work additional hours at their current pay. This notion implies a sequential nature to the decision of the household. The story is that people first decide how much market work to do, then allocate the residual time to leisure and charitable time gifts. Since the amount of work is determined prior to the decision of leisure and time gifts, the opportunity cost of their time is no longer the after-tax wage.

Another way that time can be accounted for is through agents receiving utility from the value of their time to the recipient (Andreoni, 1995). It is argued that "warm glow" altruists prefer to donate time where their marginal product is most highly valued and receives a larger glow when the recipient values their service more. For example, "if a person can volunteer to do either a low-skilled job or a high-skilled job, we assume that the person would prefer to do the highly skilled job, because it is more valuable to the charity in the sense that the charity would have to pay a higher price to acquire the same service from the market" (Andreoni, 1995, p. 5).

All previous studies of time and money donations have used the tax price of monetary gifts and the quantity of time to determine whether gifts of money and time are complements or substitutes. There may be error in making a conclusion of how the goods are related based on the tax price of monetary gifts. The models proposed in this dissertation and other papers assume a two-stage decision process for the consumer (Brown and Lankford, 1992). In the current context, people first decide their labor hours, then their private good purchases and, finally, their time spent on leisure and charitable time gifts. For each individual, his or her time donation is made in concert with the other members of the household. Therefore, appropriate econometric techniques must be used to account for the simultaneous decisions. Chapter five discusses how this issue is managed.

In the case of charitable giving, there is good reason not to use the tax price for the estimation of the relationship among time and money. The simple tax price, p(1-t), of monetary contributions is negatively related to the level of monetary contributions for an itemizer. Larger monetary gifts lower an individual's tax rate, raising the tax price. In other words, the tax rate affects the tax price which affects the level of gifts which, in turn, affects the tax rate. This endogeneity bias has been addressed in the following ways. One way is to use the tax price applicable to the first dollar given rather than the last (Clotfelter, 1985, Slemrod, 1989). Another way suggested by Reece and Zieschang (1985), is to estimate contributions using the entire schedule of tax rates which captures the fact that people face a non-linear budget constraint. Those methods are fine for addressing the endogeneity problem for studies looking at only monetary contributions. Despite those types of corrections, there still exists a problem with using the tax price to determine the relationship between time and money gifts. As the tax rate falls, the tax price rises and monetary contributions fall, ceteris paribus. If money and time are complements, time will fall also. Due to the endogeneity problem, however, when the tax rate falls, disposable income rises. If money and time gifts are normal goods one would expect both to increase. This is not an income effect from a price change, this is a separate effect from the real change in disposable income due to the endogeneity bias (see Figure 1). Therefore, the idea that the relationship between time and monetary contributions can be gauged by the tax price is not satisfactory.

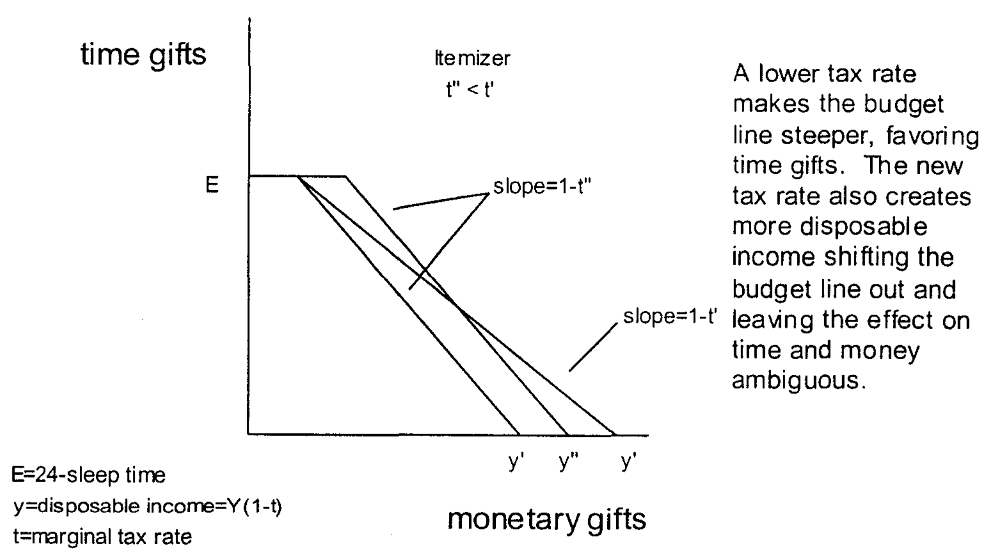

Figure 1. Effect of a lower tax rate

There is yet another reason not to use the tax price for judging whether monetary and time gifts are substitutes or complements. Non-itemizers always face a simple tax price of one. Therefore, when looking at aggregate contributions of time and money, a change in the tax rate will only be viewed as a change in income for the non-itemizer (see Figure 2). This further distorts any systematic, predictable relation between the tax price of monetary gifts and the quantity of time given.

The direct effects of changes in the tax price of monetary contributions on non-itemizers are presumably zero. There may, however, be indirect effects generated by changes in the tax price. As discussed earlier, changes in tax rates directly affect disposable income, so that is not the issue raised here. The issue is the possibility of spillover effects from changes in the tax price. Here are two comments that support the possibility of this issue.

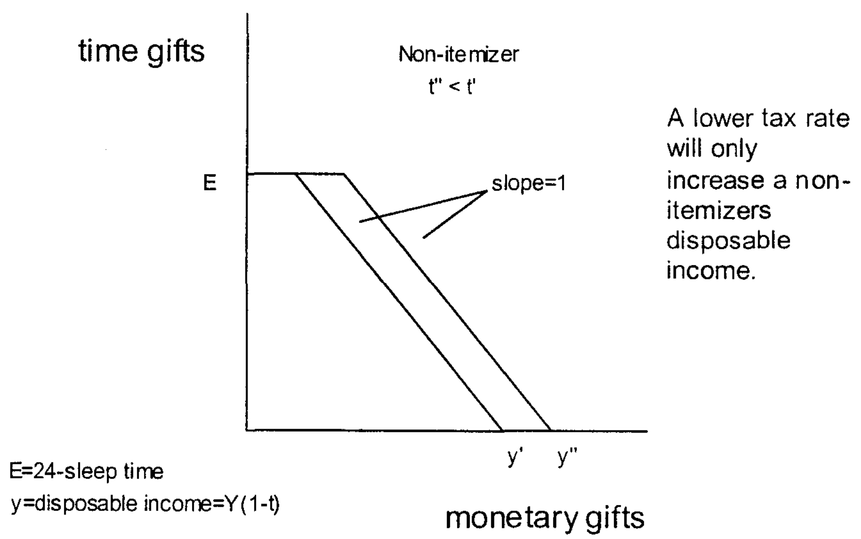

Figure 2. Effect of a lower tax rate on a Non-itemizer

First, suppose a policy change favors itemizers of monetary gifts. A non-itemizer may view this as an increase in future or current tax liability and be induced to save, but instead of reducing current consumption, the non-itemizer reduces monetary contributions. This implies a spillover effect to non-itemizers from a policy designed for itemizers. Another spillover effect could come from the supply side. Suppose that charities know about a policy change that will favor itemizers of monetary contributions. In response to the upcoming change, the charities increase advertising and fundraising expenditure. These expenditures will elicit contributions from non-itemizers as well. In order to justify this thought empirically, data would be needed from itemizers and non-itemizers. Then, total demand for charitable goods would be equal to the sum of the demands from itemizers and non-itemizers. The previous claim will be absolved by including the tax price in the non-itemizers demand. A negative relation between the tax price and non-itemizers contributions is expected if one believes a complementary relation exists between itemizer's and non-itemizer's gifts. The coefficient for the tax price variable measures the value of the spillover effect. It also will determine if the spillover effect is significant. One would expect, however, the non-itemizer's demand to be less elastic than itemizer's demand. A study like this is important so that policy makers have appropriate insight to the impact of contribution tax reform.

CHAPTER 4. A HOUSEHOLD APPROACH TO CHARITABLE GIVING

Introduction

The purpose of this chapter is to present a household utility maximization problem. It will be shown that a household approach results in variables entering demand equations that would otherwise not be included under an individual approach. Later in the empirical section a nested test is used to determine which approach is more appropriate. Chapter 3 presented reasons to believe that a household solves its utility maximization problem in two stages. In the first stage, each household member chooses the number of hours to work, given the wage he/she is able to command for his/her skills. In the second stage, the household spends all of its monetary income on desired levels of private goods and monetary gifts. Each household member also chooses desired levels of leisure and time gifts according to the number of hours left after work and sleep. This two-stage process has not been modeled theoretically in the volunteer literature, although it has been modeled empirically (Brown and Lankford, 1992). It is easy to justify a two-stage decision process for a short-run analysis. In the short run, households are constrained by their choice of hours at work via an implicit or explicit contract. This is especially useful when a researcher is using cross-sectional data. One may argue that in the long run households choose work hours dependent upon the number of hours he/she wishes to volunteer rather than vice versa. I would argue that the two-stage process describes short and long run behavior for the average person. For the purposes of this work, however, the short run justification is sufficient. The two-stage process is addressed by using a separable utility function in four differentiated cases. In each case, demand equations are derived. The separable utility function shows theoretically how a household's choice of volunteer time can be determined without prices, specifically the wage and the price of monetary gifts. It will also be shown how the household utility maximization problem can be modeled using a "full income" approach.

Cooperating Spouses

The model here differs from previous models by assuming that people receive double pleasure from giving time. A joint product is derived from the gift of time, a private warm glow from giving and the satisfaction from the total time given. Let g_i be the private benefit agent i receives by giving time, a_i is the benefit agent i receives from total time given, and t_i is volunteer time by agent i. T_H is volunteer time by household H and l_i is leisure. w_i is an individual's wage per hour net of tax, h_i is labor hours, $w_ih_i+w_jh_j$ is household earnings, p is the tax price of giving and E_i is agent i's available time for activities other than sleep. Let y_i be a private good with its price normalized to 1, and m be the level of household monetary contributions. α and β are fixed proportion parameters that make it possible to test if a joint products model is appropriate. If $\alpha=0$ and $\beta=1$, then the pure public good model is observed. If $\alpha=1$ and $\beta=0$, time is just a private good. If $\alpha=\beta=1$, then the "warm glow" model results. If $\alpha>0$ and $\beta<1$, then a joint products model is observed (Cornes and Sandler, 1984).

Let U_H be a well-behaved separable utility function for household H. Subscripts on variables and parameters in the utility function represent an individual family member, husband (i=1) and wife (i=2),

$$U_H=U_H(y_1,y_2,m,G[g_1,a_1,g_2,a_2,l_1,l_2]). \qquad (24)$$

Let household h be constrained by:

$$w_1h_1+w_2h_2=y_1+y_2+pm, \tag{25}$$
$$T_H=t_1+t_2, \tag{26}$$
$$g_i=\alpha_i t_i, \qquad i=1,2, \tag{27}$$
$$a_i=\beta_i T_H, \qquad i=1,2, \tag{28}$$
$$E_i=h_i+t_i+l_i, \qquad i=1,2, \tag{29}$$
$$y_i,m,t_i,l_i\geq 0, \qquad i=1,2. \tag{30}$$

Equation (25) is a standard budget constraint showing that the household will spend all of its earnings on private goods and monetary gifts. Equation (26) shows that the sum of each spouse's volunteer time creates total time given by the household. The private benefit that each agent receives from his or her volunteer time is expressed in equation (27). Equation (28) shows that total volunteer time by the household is a variable that may contribute to household utility by argument a_i. Equation (29) restricts people to allocating their time over work, leisure and volunteer time. Equation (30) shows that none of the choice variables can be negative.

There is no distinction made for monetary contributions among cooperating spouses. These contributions are purely public in the benefit that they confer to a household that pools member's income together. This is why there is no separation among spouses for monetary gifts. Time contributions, however, are separated by spouse due to the uniqueness of the gift. Total time given does still enter the utility function, but in a way that allows a joint product aspect to reveal itself. The wage rate is modeled as net of tax to reflect disposable income. The crowding effect of tax revenues used to purchase charitable goods is not modeled here directly. Since monetary gifts are separated in the utility function from time gifts, there is no issue of interrelated crowding effects.

The crowding of time gifts is quite different from monetary gifts, if it exists at all. The government does not have an endowment of time per se. Its time is drawn from employees or volunteers. A crowding story for time gifts would go like this. The government substitutes employees for volunteers by hiring people to do a job that has volunteers at it. The volunteers receive utility from the new workers through the overall level of the public good rising (T), but the volunteers lose their warm glow (g) because they are not contributing to the public good. If the worker's hours perfectly substitute for the volunteer's hours, the volunteer's utility will fall. This is due to the level of the public good remaining the same, but losing the private glow. Volunteers, however, can still consume their glow by volunteering at a less crowded venue. Therefore, as Kingma (1989) points out, the degree of crowding is sensitive to the availability of substitute goods. In general, it seems volunteers are always welcome. If they are turned away, they can easily give somewhere else. Also, it is unlikely that the government put employees into situations where there is already properly functioning volunteer effort. Therefore, concerns about crowding time gifts should be small.

The assumption that households make decisions in a two-stage fashion, as previously described, implies a weakly separable utility function is being used. For purposes of explanation, allow there to be two branches to the utility function (Strotz, 1957). Let the portion of the utility function containing y_1, y_2, and m be called the income branch and the portion with G(•) be the time branch. The two branches are named to reflect the constraints that the consumer faces when making decisions for each branch. There are four variables in the time branch of the utility function: volunteer time by each spouse (t_1 and t_2) and leisure consumed by each spouse (l_1 and l_2). Volunteer time by each spouse creates two products for each spouse, a_i and g_i. Let $G(g_1,a_1,g_2,a_2,l_1,l_2)$ be the sub-utility function to be maximized. In other words, utility is dependent upon y_1, y_2, m, and G(•).

$$U_H=U_H(y_1,y_2,m,G[g_1,a_1,g_2,a_2,l_1,l_2]) \tag{31}$$

The assumption of separability allows one to show the maximization of each branch separately. After making some substitutions of the constraints, the income branch of the household utility maximization problem can be represented as:

$$\underset{y_1,m}{\text{Maximize}}\ \ U_H(y_1,w_1h_1+w_2h_2-y_1-pm,m). \tag{32}$$

From this branch, the household determines the amount of private goods consumed and the level of monetary gifts. Recall that income is solved in the first stage in which hours worked are determined. All money income is spent in the income branch, so that the only constraint that the consumer faces in the time branch is a time constraint;

$$E_i=h_i+l_i+t_i \qquad\qquad i=1,2, \tag{33}$$

where h_i is fixed. This constraint is substituted into (31) replacing leisure. The time branch of the maximization problem is:

$$\underset{t_1,t_2}{\text{Maximize}}\qquad G[\alpha_1t_1,\beta_1(t_1+t_2),\alpha_2t_2,\beta_2(t_1+t_2),E_1-h_1-t_1,E_2-h_2-t_2], \tag{34}$$

where hours worked by each spouse (h_1 and h_2) have been determined in the first stage and E_i is exogenous. The assumption of a separable utility function implies that the marginal rates of substitution between the elements of G(•) are independent of the non-G(•) elements. The usual comment made about weak separability is that consumers partition their income between the two branches and there is no substitution effect among goods in each branch for relative price changes among branches. There still exists, however, an income effect that may have implications on the other branch. The effect is through changes in hours worked. Any price change that causes hours worked to change causes there to be more or less time for leisure and/or time gifts.

The marginal utilities derived from G(•) for $t_1>0$ and $t_2>0$ are:

$$dG/dt_1=G^1\alpha_1+G^2\beta_1+G^4\beta_2-G^5=0, \tag{35}$$

$$dG/dt_2=G^2\beta_1+G^3\alpha_2+G^4\beta_2-G^6=0, \tag{36}$$

where

$$\begin{aligned} G^1 &= \partial G/\partial(\alpha_1 t_1), \\ G^2 &= \partial G/\partial(\beta_1(t_1+t_2)), \\ G^3 &= \partial G/\partial(\alpha_2 t_2), \\ G^4 &= \partial G/\partial(\beta_2(t_1+t_2)), \\ G^5 &= \partial G/\partial(E_1-h_1-t_1), \\ G^6 &= \partial G/\partial(E_2-h_2-t_2). \end{aligned}$$

The first order conditions for corner solutions are straight forward. For $t_1>0$ and $t_2=0$, equation (35) will stand alone. For $t_1=0$ and $t_2>0$, equation (36) will stand alone. For $t_1=0$ and $t_2=0$, both vanish. A convenient way to represent the first order conditions is to keep them separate. Equation (38) shows the result of rearranging (35) by dividing the left and right side of the equation by G^5.

$$1=\alpha_1\frac{G^1}{G^5}+\beta_1\frac{G^2}{G^5}+\beta_2\frac{G^4}{G^5} \tag{37}$$

$$\Rightarrow 1=\alpha_1 MRS_{g_1l_1}+\sum_{i=1}^{2}\beta_i MRS_{a_il_1} \tag{38}$$

Equation (39) shows the result of rearranging (36) the same way (35) is done.

$$\Rightarrow 1=\alpha_2 MRS_{g_2l_2}+\sum_{i=1}^{2}\beta_i MRS_{a_il_2} \tag{39}$$

Equations (38) and (39) show that consumers choice of time gifts and leisure is a weighted average of the marginal rates of substitution of their glow for leisure, their public good benefits for leisure and their spouse's public good benefits for leisure. These equations will be useful for comparison with a model in which the household aspect is not present.

Since one or both spouses may not contribute time, it is important to allow for the possibility of t_i=0. Ransom (1987) discussed a similar situation, but he looked at the joint labor supply of a couple allowing one spouse to choose non-market work. The idea is that some households may receive higher utility by doing something other than contributing time. When this is the case, dG/dt_1 and/or dG/dt_2 will be less than or equal to zero. This means that household utility may fall if the spouse for whom the inequality holds gives time. Demand equations from the second stage take the form of:

$$t_1 = \begin{cases} t_1(h_1, h_2, E_1, E_2; \alpha_1, \beta_1, \beta_2) & t_1 > 0 \\ 0 & \text{otherwise} \end{cases} \tag{40}$$

$$t_2 = \begin{cases} t_2(h_1, h_2, E_1, E_2; \alpha_2, \beta_1, \beta_2) & t_2 > 0 \\ 0 & \text{otherwise} \end{cases} \tag{41}$$

The demand equations capture the idea of each spouse taking the other spouse's residual time into account. This interaction of the spouse's decisions is complemented by hours worked serving as a proxy to each spouse's opportunity cost. The interdependence of the spouse's decisions will be captured by a correlation coefficient. These demand equations will be estimated using a bivariate tobit model since the two demand equations are solved simultaneously. The econometrics applied to these demand equations are explained in greater detail in chapter 5.

Non-Cooperating Spouses

The model to be presented next is called the model of non-cooperating spouses. It differs from the previous model by assuming that each spouse spends only his/her earnings rather than pooling the earnings together. Each spouse however can still receive some extra utility when the other spouse gives time. Let y_i be a private good with a price normalized to 1. m_i is the level of monetary contributions. Let g_i be the private benefit that agent i receives by giving time; a_i is the benefit agent i receives from total time given by the household; t_i is volunteer time by agent i; $t_{(i)}$ is his/her spouse's time donations. T_H is total volunteer time by household H, l_i is leisure, w_i is the net of tax wage, h_i is hours worked, w_ih_i is net earnings, p is the tax price of giving, and E_i is each agent's available time for activities other than sleep. α_i and β_i are fixed proportion parameters that make it possible to test if a joint products model is appropriate. Let U_i be a well-behaved separable utility function for individual i. As in the cooperating spouse model, the portion of the utility function with y_i and m_i is called the income branch and the portion with G(•) is called the time branch. Agent i's utility function,

$$U_i=U_i(y_i,m_i,G[g_i,a_i,l_i]), \qquad (42)$$

is constrained by:

$$w_ih_i=y_i+pm_i, \qquad (43)$$
$$T_h=t_i+t_{(i)}, \qquad (44)$$
$$g_i=\alpha_it_i\ , \qquad (45)$$
$$a_i=\beta_iT_H, \qquad (46)$$
$$E_i=h_i+t_i+l_i, \qquad (47)$$
$$y_i,m_i,t_i,l_i\geq 0. \qquad (48)$$

Equation (43) is a standard budget constraint showing that an individual will spend all of his or her earnings on private goods and monetary gifts. Total household hours are determined by the sum of each spouse's hours, equation (44). Equation (45) shows each spouse's private benefit from his or her volunteer time. Equation (46) is present to recognize that total time given is a variable that may contribute to an individual's utility. Equation (47) restricts individuals to allocating their time among total time they are endowed. The non-negative constraints are in (48). With substitutions of the constraints, the individual's utility maximization problem reduces to:

$$\underset{m_i,t_i}{\text{Maximize}}\ U_i(w_ih_i\text{-}pm_i,m_i,G[\alpha_it_i,\beta_i(t_i+t_{(i)}),E_i\text{-}h_i\text{-}t_i]). \qquad (49)$$

Based on the assumption that the individual makes decisions in a two-stage fashion as previously described, h_i is determined in the first stage. The separability assumption allows one to solve for the utility maximizing levels of t_i and l_i by maximizing the function G(•) in the time branch with choice variable t_i. Therefore, the time branch of the utility maximization problem presents itself as:

$$\underset{t_i}{\text{Maximize}}\ G(\alpha_it_i,\beta_i(t_i+t_{(i)}),E\text{-}h_i\text{-}t_i). \qquad (50)$$

The marginal utility function derived from (50) is:

$$dG/dt_l=G^1\alpha_l+G^2\beta_l-G^3=0. \qquad (51)$$

The first order condition for the second stage of this optimization problem is a weighted average of agents' willingness to substitute their own time with leisure and other's time with their leisure. Equation (53) shows the results of rearranging (51).

$$1=\alpha_l\frac{G^1}{G^3}+\beta_l\frac{G^2}{G^3} \qquad (52)$$

$$\Rightarrow 1=\alpha_l MRS_{g_l l_l}+\beta_l MRS_{a_l l_l} \qquad (53)$$

The idea is that a people's choices of time gifts and leisure will depend on how they weight their personal gain (α) from their own contribution of time and their gain (β) from knowing that they along with others contributed to the task at hand. Contrast equation (53) with equation (38). In so doing, one observes the inefficiency of the non-cooperating spouses. Each spouse does not take into account that his or her choice of time influences the other's utility through β. The demand equation generated from this model is:

$$t_i = \begin{cases} t_i(t_{(i)}, h_i, E_i; \alpha_i, \beta_i) & t_i > 0 \\ 0 & \text{otherwise} \end{cases} \tag{54}$$

Most models have a utility function similar to the non-cooperating spouse model. The implication of this scenario is that the estimated demand will be understated and less efficient. If the household model is a better representation of the real world, then one will find the estimated demand for household time gifts greater than the sum of the demands from non-cooperating spouses. This is due to the household model recognizing that each spouse will consider the other spouse's welfare in his/her choice of time.

A "Full-Income" Approach

Another hypothesis to test is whether the joint products model is appropriate. The utility function is structured to allow volunteer time to create two goods, a private and public component to consumption. Two tests will be performed. One will test the pure public model versus the joint products model. The other test will be for a private good model versus the joint products model. Each independent test is performed to show that regardless of the specification, volunteer time creates a joint product in consumption. In order to test whether the joint products model is preferred to the pure public model, a "full-income" approach is used. The basic idea of a full-income approach is to directly incorporate an externality into the income constraint. For example, suppose that there exists a spillover effect for individual i with income I_i. The spillover effect can be added to each side of the budget constraint creating full-income, $I_i^*=I_i+spill_{(i)}$, where $spill_{(i)}$ is the value of the external effect (Cornes and Sandler, 1996).

In this case, recall that there is no money spent in the time branch, therefore, full-income takes on a new meaning. A full-income approach is accomplished by adding one spouse's time to each side of the other's time constraint, equation (47). Now using (44) we have a "full-time" constraint:

$$E_i+t_{(i)}=h_i+T_H+l_i. \tag{55}$$

Let $E_i^*=E_i+t_{(i)}$,

$$E_i^*=h_i+T_H+l_i. \tag{56}$$

The effects of E* on the non-cooperating spouse model will first be examined, then E* will be applied to the cooperating spouse model. The G(•) function has not changed except for a substitution of t_i. Using (56), (50) becomes:

$$G(\alpha_i(T_H-t_{(i)}),\beta_i T_H,E_i^*-h_i-T_H). \tag{57}$$

Now the consumer is choosing T_H rather than t_i. By maximizing G(•) with respect to T_H, one finds the following demand function:

$$T_H=T_H(t_{(i)},h_i,E^*). \tag{58}$$

If we treat T_H as a pure public good, then G(•) becomes:

$$G(T_H,E_i^*-h_i-T_H) \tag{59}$$

and the resulting demand function is:

$$T_H = T_H(h_i, E_i^*). \tag{60}$$

Equation (60) is nested in equation (58) and therefore a likelihood ratio test can be used to determine if the household creates a joint product from volunteer time. Simultaneous equation techniques must be employed because $t_{(i)}$ is determined in concert with t_i. In addition to simultaneity, decisions of t_i are censored at zero, therefore a bivariate tobit model will be used for estimation of the parameters. A two-stage tobit process is presented in chapter 5 to show the significance of the joint products specification.

The joint products model can also be tested against a private good specification. A model without joint products and t_i a private good would bear a demand equation,

$$t_i = t_i(h_i, E_i). \tag{61}$$

The demand equation for the joint products model was derived earlier and rewritten here:

$$t_i = t_i(t_{(i)}, h_i, E_i). \tag{62}$$

Since equation (61) is nested in (62), a likelihood ratio test can determine the appropriateness of the joint products model. Once again $t_{(i)}$ is chosen in concert with t_i, so simultaneous equation estimation will produce a correlation coefficient that will capture correlated, unpredictable noise in the error term of each equation.

Now let us consider the effects of E* on the cooperating spouses model. The household's second stage maximization problem (34) now looks like this:

$$\underset{t_1, T_H}{\text{Maximize}} \; G[\alpha_1 t_1, \beta_1 T_H, \alpha_2(T_H - t_1), \beta_2 T_H, E_1 - h_1 - t_1, E_2^* - h_2 - T_H]. \tag{63}$$

Note that the household's choice variables are now t_1 and T_H instead of t_1 and t_2. The full-time convention is used so that marginal effects and interdependencies among the variables can be shown at the household level. The marginal utilities derived from G(•) are:

$$dG/dt_1=G^1\alpha_1-G^3\alpha_2-G^5+G^6=0 \quad (64)$$

$$dG/dT_H=G^2\beta_1+G^3\alpha_2+G^4\beta_2-G^6=0. \quad (65)$$

The first order conditions for the full-time model, (64) and (65), are equivalent to the first order conditions without full-time, equations (35) and (36).[1] By presenting the consumer's problem in the full-time model, one is able to test the impact of the independent variables on individual and household consumption simultaneously. In the empirical section, these two demand equations will be estimated simultaneously using a bivariate tobit model. Demand equations from the second stage take the form of:

$$t_1 = \begin{cases} t_1(h_1,h_2,E_1,E_2{*};\alpha_1,\beta_1,\beta_2) & t_1>0 \\ 0 & \text{otherwise} \end{cases} \quad (66)$$

$$T_H = \begin{cases} T_H(h_1,h_2,E_1,E_2{*};\alpha_1,\beta_1,\beta_2) & T_H>0 \\ 0 & \text{otherwise} \end{cases} \quad (67)$$

[1] The following short proof is included to verify the equivalence of the two sets of first order conditions. Since (65) is the same as (36), one can see what conditions must be true for (64) to be equal to (35). Therefore, set (35) equal to (64),

$$G^1\alpha_1+G^2\beta_1+G^4\beta_2-G^5= G^1\alpha_1-G^3\alpha_2-G^5+G^6. \quad (a)$$

Rearranging (a) and canceling terms reveals,

$$G^2\beta_1+G^3\alpha_2+G^4\beta_2-G^6=0. \quad (b)$$

(b) is (65)//.

Non-Cooperating Spouses Considering Others' Time

Another model to test is essentially the same as the previous model. It differs by adding a third group to the collective. This model is not tested empirically in the dissertation, but is provided to show how the theoretical model can be adapted to consider more detail. The idea is that a person can also get benefits of camaraderie from people other than one's spouse participating in the volunteer work. For example, suppose a person named Roger does volunteer work for a blood drive at his church. He can enjoy utility in a few different ways. One way is that he has contributed to the overall supply of blood in the county. Another way is that he enjoyed the act of giving, a "warm glow" (Andreoni, 1990). Another way is that he enjoyed the camaraderie of the other church members he was with while giving time. Thus, the consumer receives utility from his volunteer time, his spouse's volunteer time and all other's gift of time. Let y_i be a private good and its price be normalized to 1. m_i is the level of monetary contributions, $t_i \in T_H \subset T_a$ is volunteer time by agent i, $T_H \subset T_a$ is some subgroup of contributors time including agent i (possibly husband and wife), $t_f \subset T_H$ represents a friend's time (possibly the spouse of agent i), $t_0 \subset T_a$ is all others' time donations, T_a is the total level of time donations, $c_i = \gamma_i T_a$ is agent i's benefit from the total of all time donations, l_i is leisure, w_i is the net of tax wage, h_i is hours worked, $w_i h_i$ is net earnings, p is the tax price of giving and E_i is the agent's available time for activities other than sleep. α, β and γ are fixed proportion parameters. If $\gamma=0$, then other agent's gifts do not have a separate influence on individual i's utility and the model collapses down to the model of non-cooperating spouses. There may still exist an effect through β, however. The model is an extension of the model of non-cooperating spouses. Let U_i be a well-behaved utility function for individual i,

$$U_i=U_i(y_i,m_i,G[g_i,a_i,c_i,l_i]) \qquad i=1,\ldots,n. \tag{68}$$

Individual i is constrained by:

$$w_ih_i=y_i+pm_i, \tag{69}$$
$$T_a=T_H+t_o, \tag{70}$$
$$g_i=\alpha_it_i\ , \tag{71}$$
$$a_i=\beta_iT_H, \tag{72}$$
$$c_i=\gamma_iT_a\ , \tag{73}$$
$$T_H=t_i+t_f, \tag{74}$$
$$E=h_i+t_i+l_i, \tag{75}$$
$$y_i,m_i,t_i,l_i\geq 0. \tag{76}$$

Equations (69) – (76) have the same meanings as the constraints in the previous non-cooperating spouse model. The only difference is the addition of (73) which allows the individual to receive utility through all time contributed to the public good. Similar to before, the combination of the marginal rate of substitutions are shown in equation (78).

$$1=\alpha_i\frac{G^1}{G^4}+\beta_i\frac{G^2}{G^4}+\gamma_i\frac{G^3}{G^4} \tag{77}$$

$$\Rightarrow 1=\alpha_i\,MRS_{g_il_i}+\beta_i\,MRS_{a_il_i}+\gamma_i\,MRS_{c_il_i} \qquad i=1\ldots n \tag{78}$$

The idea is that peoples' choice of time and leisure will depend on three elements. The first is how they weight their own personal gain (α) from their contribution of time. The second is their gain (β) from the household's contribution to the public good. Finally, their gain (γ) from knowing they, along with others, contributed to the task at hand. The demand equation generated from this model is:

$$t_i=\begin{cases} t_i(t_f,t_o,h_i,E_i;\alpha_i,\beta_i) & t_i>0 \\ 0 & \text{otherwise} \end{cases} \tag{79}$$

A nested test is made possible by the form of the demand equation if t_o is predetermined or exogenous. Equation (62) is nested in the non-cooperating spouse's demand equation (79) making it possible to test the significance of other's time through a likelihood ratio test ($t_{(i)}$ from (62) is t_f in equation (79)). If t_o is endogenous and censored, a simultaneous tobit model is required to estimate the parameters.

Cooperating Spouses Considering of Others' time

The cooperating spouse model can also be modified to include all others' time. The "full-time" convention can be applied to any of the models in this paper. For simplicity I have not included the "full-time" transformation in the following. Revising the utility function found in equation (24):

$$U_H=U_H(y_1,y_2,m,G[g_1,a_1,c_1,g_2,a_2,c_2,l_1,l_2]). \qquad (80)$$

Household H is constrained by:

$$w_1h_1+w_2h_2=y_1+y_2+pm, \qquad (81)$$
$$T_a=T_H+t_o, \qquad (82)$$
$$T_H=t_1+t_2, \qquad (83)$$
$$g_i=\alpha_i t_i, \quad i=1,2, \qquad (84)$$
$$a_i=\beta_i T_H, \quad i=1,2 \qquad (85)$$
$$c_i=\gamma_i T_a, \quad i=1,2 \qquad (86)$$
$$E_i=h_i+t_i+l_i, \quad i=1,2 \qquad (87)$$
$$y_i,m,t_i,l_i\geq 0, \quad i=1,2. \qquad (88)$$

Equation (81) is a standard budget constraint for the household. Equations (82)-(88) have the same interpretation as the constraints previously presented in the model of non-cooperating spouses. The only change to the time branch of the utility function, G(•), is that it now has the gamma terms, $\gamma_i(t_1+t_2+t_o)$:

$$G=G(\alpha_1 t_1,\beta_1(t_1+t_2),\gamma_1(t_1+t_2+t_o),\alpha_2 t_2,\beta_2(t_1+t_2),\gamma_2(t_1+t_2+t_o),E_1-h_1-t_1,E_2-h_2-t_2). \quad (89)$$

Shown in equations (90) and (91) are the first order conditions that now contain an additional sum term capturing the effect of others' time.

$$1=\alpha_1 MRS_{g_1 l_1}+\sum_{i=1}^{2}\beta_i MRS_{a_i l_1}+\sum_{i=1}^{2}\gamma_i MRS_{c_i l_1} \quad (90)$$

$$1=\alpha_2 MRS_{g_2 l_2}+\sum_{i=1}^{2}\beta_i MRS_{a_i l_2}+\sum_{i=1}^{2}\gamma_i MRS_{c_i l_2} \quad (91)$$

In the demand equations a new variable, t_o, reveals itself:

$$t_1=\begin{cases} t_1(t_o,h_1,h_2,E_1,E_2;\alpha_1,\beta_1,\beta_2) & t_1>0 \\ 0 & \text{otherwise} \end{cases} \quad (92)$$

$$t_2=\begin{cases} t_2(t_o,h_1,h_2,E_1,E_2;\alpha_2,\beta_1,\beta_2) & t_2>0 \\ 0 & \text{otherwise} \end{cases} \quad (93)$$

Since equation (40) and (41) are nested in equation (92) and (93) respectively, a likelihood ratio test can be used to determine whether the addition of other people's time is appropriate when t_o is predetermined or exogenous. If t_o is censored and endogenous with t_1 and t_2, a simultaneous tobit specification must be used for estimation. The presentation of this model is here to show how the theoretical framework can be expanded and is not tested empirically. The next chapter will address how these models will be tested taking into account the simultaneous nature of the decision process for the household.

CHAPTER 5. DATA DESCRIPTION AND ECONOMETRICS

Description of the Data

This study uses data from the American Participation Study of 1990. The data is distributed by the Inter-university Consortium for Political and Social Research (ICPSR) and produced by the National Opinion Research Center (NORC). The interviews were done in person and usually lasted two hours. The sample is representative of non-institutionalized adults 18 years of age or older living in the United States. There were 2,517 people in the sample. They were asked questions regarding their donations of time and money to various types of organizations, including political, religious, and community involvement. Other demographic variables of interest include household income, job type, age, number of family members, and education. After shedding observations with missing or conflicting data, I am left with a sample of 2,232 households with 1265 of them being married.

The data show that 64% of households contributed money to religious organizations, while 32% contributed time. By taking the total amount of monetary gifts given to religious organizations and dividing it by the number of donors, I compute the average annual gift of $785 per household. The sample is close to evenly split between households with and without children, 49% of the households have children (of which 37% had children under age five). The distribution of race is 66% white, 19% black, 1% Asian, 1% Alaskan native, 12% Hispanic/Latino, 1% other. Approximately 70% of the respondents graduated from high school, 54% attended college, 33% earned at least an Associates Degree and 1.5% earned a Ph.D.

Approximately 58% of the respondents worked full-time while 10% worked part-time. About 13% of the people considered themselves to be housekeepers, 9% retired, and 10% other. Of the people who chose to work, 14% was self-employed.

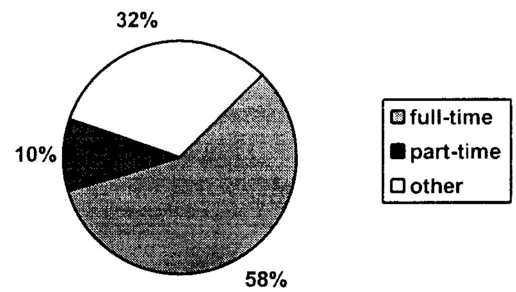

Figure 3. Respondent's labor decisions

The data reveals that 60% of the respondents was married. From the group of married persons, people who are married, 63% had spouses working full-time and 10% had them working part-time. By looking at the education level of a person's spouse, one finds that 86% married someone with at least a high school diploma.

Approximately 60% of the respondents attended a religious service at least once a month, and 34% claimed that they attended at least once a week. The data show that 42% of people who attended church also did volunteer work for the church. This means that a greater percent chose not to volunteer, and this is why a tobit model is needed for estimation. The numbers also reveal that 94% of people who attended church also gave money to church. The average gift among attendees was approximately $577.43 (see Appendix, Table 1-A). The average gift among givers was $815.83. Nearly 48% of people who attended church gave time in ways other than attending services. The average amount of volunteer time per week was 2.09 hours (see Appendix, Table 2-A). Since this research is concerned about the household, Tables 3-A, 4-A, and 5-A of the Appendix are included to get a general feel for the variables involved. Table 3-A shows statistics for all households. Statistics for married couples are found in Table 4-A and single respondent's statistics are found in Table 5-A. The variables' descriptions are found in Table 1 of this chapter.

Econometric Specification

A tobit model is the most common way to approach censored data like charitable gifts. Many people choose not to give time, approximately 33% from the data used here. This creates a lower bound of zero for the quantity of gifts. In each of the econometric models, the number of non-zero observations for the dependent variables are listed as non-limit observations. There are two ways in which a tobit model is used in this paper. When evaluating total gifts of time by the household, I used a standard tobit model. When evaluating time gifts that are determined simultaneously, I used a bivariate tobit model. The following econometric specification corresponds to the theoretical variables described earlier. The standard tobit model is used to estimate total time given for the household. Let t_i* be an index function:

$$t_i^* = \boldsymbol{\beta}'\mathbf{x}_i + \varepsilon_i, \qquad (94)$$

$$t_i = 0, \qquad \text{if } t_i^* \leq 0 \qquad (95)$$

$$t_i = t_i^*, \qquad \text{if } t_i^* > 0 \qquad (96)$$

where $\beta=(\beta_0,\beta_1,\ldots\beta_n)$, $\mathbf{x}_i=(x_0,x_1,\ldots x_n)$ and ε_i is a normally distributed random error term. With Φ as a cumulative density function and φ as a probability density function, the tobit specification has the following structure:

$$E[t_i|\mathbf{x}_i]=\Phi(\beta'\mathbf{x}_i/\sigma)(\beta'\mathbf{x}_i+\sigma\lambda_i), \tag{97}$$

where

$$\lambda_i = \varphi(\beta'\mathbf{x}_i/\sigma) / \Phi(\beta'\mathbf{x}_i/\sigma). \tag{98}$$

The marginal effects for the model are:

$$\partial E[t_i^*|\mathbf{x}_i]/\partial \mathbf{x}_i = \beta. \tag{99}$$

The log likelihood function takes the form:

$$\ln L = \sum_{t_i>0} -\tfrac{1}{2}\left[\ln(2\pi)+\ln\sigma^2+\frac{(t_i-\beta'\mathbf{x}_i)^2}{\sigma^2}\right]+\sum_{t_i=0}\ln\left[1-\Phi\left(\frac{\beta'\mathbf{x}_i}{\sigma}\right)\right]. \tag{100}$$

Throughout the theory section there is foreshadowing of hypothesis tests to be performed. Many of these take the form of nested tests in which a variable enters one demand equation and not another. Likelihood ratio tests will be used to identify the significance of these variables.

The bivariate tobit model is used to estimate the simultaneous choice made by households of time gifts to church and non-church activities. It is also used to show the simultaneous decision of total hours given by each spouse. The equations estimated simultaneously are:

$$t_1 = \beta_1'x+\varepsilon_1, \tag{101}$$

$$t_2 = \beta_2'x+\varepsilon_2, \tag{102}$$

where

$$E[\varepsilon]=0, \qquad \text{for } \varepsilon=[\varepsilon_1,\varepsilon_2], \tag{103}$$

$$E[\varepsilon\varepsilon']=V\begin{bmatrix} \sigma_{11}\Omega_{11} & \sigma_{12}\Omega_{12} \\ \sigma_{21}\Omega_{21} & \sigma_{22}\Omega_{22} \end{bmatrix}. \tag{104}$$

Each equation is a standard tobit model. The difference is that the disturbances are jointly normally distributed with variances σ_{11} and σ_{22} and covariance σ_{12}=rho. Joint estimation will result in efficiency gains provided the correlation coefficient, rho, is nonzero. The statistical software used for the calculations is LIMDEP, version 7.0.

Interpretation of Data

Joint Products and Full-Time

This section shows how the full-time joint products model can be applied to households' choices of volunteer time. There are seven econometric models presented in this section. The first one is the primary contribution made to the volunteer literature from this dissertation. The other six models, following the first, show a progression of results that leads one to the full-time joint products model. There are hypothesis tests presented for each of the six models that show the full-time joint products model is best representation for modeling household volunteer time.

Before addressing the specification of the full-time joint products model, it will be useful to examine the various ways the dependent variables can be presented. Figure 4 shows how the dependent variables can be combined for different types of analysis. The big circle represents total hours donated by the household to all kinds of activities (HTOTANHR). The smaller ovals show two things. The horizontal ovals show how total household hours can be broken down into each spouse's gifts (DADTOT and MOMTOT). The vertical ovals show how total household hours can be broken down into hours given to church (HCSHOURS) and hours given to all other activities (HSTIME). Finally, the small circles show each spouse's gifts of time to each kind of activity. Other statistics, such as the mean of the variables, are shown in Tables 3-A, 4-A, and 5-A of the Appendix.

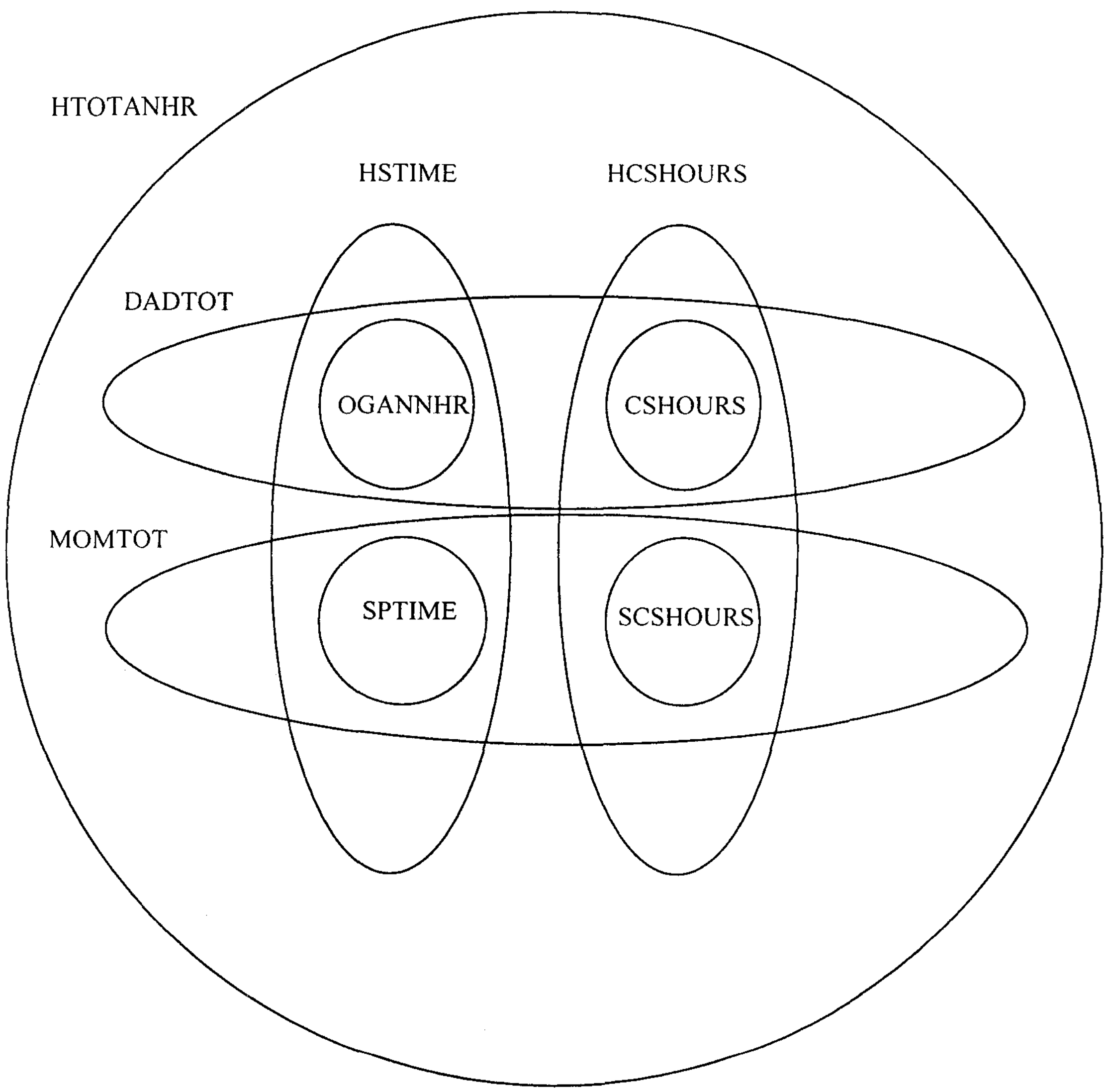

Figure 4. Various relationships among dependent variables

Table 1. Variable Descriptions

Variable	Description
CSHOURS	Dad's volunteer time per year at his or her church aside from attending services
DADEDUC	Dad's education equals 1 if greater than a high school diploma, 0 otherwise.
DADTOT	Dad's total volunteer time per year
FITDAD	Predicted value of DADTOT
FITMOM	Predicted value of MOMTOT
FULLHATD	HRTOTH plus FITMOM
FULLHATM	HRTOTH plus FITDAD
FULLTIME	'Full-time' for the household, HRTOTH plus FITDAD
HCSHOURS	Household's volunteer time per year given to their church aside from attending services
HEDUC	Household's level of education found by the sum of DADEDUC and MOMEDUC
HRTOTH	HRTOTD plus HRTOTM
HRTOTD	Total hours in a year less Dad's sleep time and hours of work
HRTOTM	Total hours in a year less Mom's sleep time and hours of work
HSTIME	Household's volunteer time per year given to various organizations other than a church
HTOTANHR	Household's total volunteer time given per year, DADTOT plus MOMTOT
HTOTHATD	DADTOT plus FITMOM
HTOTHATM	MOMTOT plus FITDAD
KIDS	Equals 1 if household has at least one child living at home, otherwise equals 0
MOMTOT	Mom's total volunteer time per year
MOMEDUC	Mom's education equals 1 if greater than a high school diploma, 0 otherwise.
OGANNHR	Dad's volunteer time per year to various organizations other than a church
OVER62	Age of respondent if age is greater than 62, 0 otherwise
RLMEMB	Member of, or belong to a church, synagogue or other religious institution, member equals 1, otherwise equals 0
SCSHOURS	Mom's volunteer time per year given to his or her church aside from attending services
SPTIME	Mom's volunteer time to various organizations other than church
YRBORN	Age of respondent if age is less than or equal to 62, 0 otherwise

The descriptions of the variables used in this study are found in table 1. The demand equations for the full-time joint products model for cooperating spouses are inseparable for household members making decisions simultaneously. Restated below are the demand equations from chapter 4:

$$t_1 = \begin{cases} t_1(h_1, h_2, E_1, E_2^*; \alpha_1, \beta_1, \beta_2) & t_1 > 0 \\ 0 & \text{otherwise} \end{cases} \quad (105)$$

$$T_H = \begin{cases} T_H(h_1, h_2, E_1, E_2^*; \alpha_1, \beta_1, \beta_2) & T_H > 0 \\ 0 & \text{otherwise} \end{cases} \quad (106)$$

In using the full-time convention it is necessary to use simultaneous equation techniques, because interdependencies among spouses are revealed through each spouse's time in the demand equations. The following equations show total household hours and one spouse's time linearly dependent on various demographic variables and full-time. The public good aspect of the model reveals itself through the significance of the full-time variable, FULLTIME (E*, as discussed in the theory section). Taste parameters are added to the empirical model to capture various effects of household characteristics. Age, presence of kids, church membership and education variables were added as taste parameters. Health status is a variable in which this data set has no information on. It is a variable that I expect has a positive relationship with volunteering. The age variable may be picking up some of this effect. Age is modeled with a break at age 62. In early models without a spline, the age coefficient was significantly negative. Adding a spline uncovered a positive relation for younger people and a negative relation for older people in respect to their volunteering with aging. Except for the taste parameters, this system of equations follows directly from the theory work in chapter four, equations (66) and (67).

$$\text{DADTOT}= \alpha_0+\alpha_1\text{YRBORN}+\alpha_2\text{OVER62}+\alpha_3\text{KIDS}+\alpha_4\text{RLMEMB}+\alpha_5\text{DADEDUC} +\alpha_6\text{FULLTIME} +\varepsilon. \tag{107}$$

$$\text{HTOTANHR}= \beta_0+\beta_1\text{YRBORN}+\beta_2\text{OVER62}+\beta_3\text{KIDS}+\beta_4\text{RLMEMB}+\beta_5\text{MOMEDUC} +\beta_6\text{FULLTIME} +\varepsilon. \tag{108}$$

The variables in table 2 follow from the theory developed in chapter 4. The alpha and beta coefficients provide empirical measures of the variables, they are not the productivity parameters presented in the theory section. The key aspects of this work that separate it from others is the use of full-time (FULLTIME) and the use of a bivariate tobit model yielding the correlation coefficient RHO. Table 2 shows the results of using a bivariate tobit model to simultaneously estimate total individual volunteer time (DADTOT) and total household annual hours of volunteer time (HTOTANHR). The following comments will describe the results in table 2 and provide the logic that went into the development of the structure.

Table 2. Cooperating Spouses with "Full-Time"

	Variable	Coefficient	Standard Error	Coeff./SE	Prob. Value
DADTOT					
	Constant	-307.7815	83.8425	-3.6710	0.0002
	YRBORN	4.2482	1.3438	3.1610	0.0016
	OVER62	-20.7273	6.2966	-3.2920	0.0010
	KIDS	11.5351	32.2033	0.3580	0.7202
	RLMEMB	214.5673	28.2130	7.6050	0.0001
	DADEDUC	2.1766	7.7265	0.2820	0.7782
	FULLTIME	0.0199	0.0086	2.3050	0.0212
HTOTANHR					
	Constant	-577.0069	160.3334	-3.5990	0.0003
	YRBORN	8.1473	2.5406	3.2070	0.0013
	OVER62	-39.2549	12.0837	-3.2490	0.0012
	KIDS	-1.5417	59.9456	-0.0260	0.9795
	RLMEMB	408.0211	54.0001	7.5560	0.0001
	HEDUC	11.9685	8.9928	1.3310	0.1832
	FULLTIME	0.0390	0.0172	2.2640	0.0236
Variances and Correlation					
	Sigma(1)	434.4898	5.9474	73.0550	0.0001
	Sigma(2)	826.8874	12.2842	67.3130	0.0001
	RHO(1,2)	0.9870	0.0005	1950.5270	0.0001
Observations					1265.00
Non-limit observations forDADTOT					903.00
Non-limit observations for HTOTANHR					959.00
Value of Log likelihood function					-13234.18

Beginning with the five demographic variables, an interpretation is provided for each coefficient in the DADTOT equation. The age of the respondent is modeled with a structural break at age 62. This is done to see if volunteer behavior changes around retirement age.

This may also reflect how health affects volunteer effort since there was not a variable in the survey to proxy health. The age coefficient, YRBORN shows that for each additional year a person ages before 62, total time gifts increase approximately 4.25 hours per year. Volunteering decreases dramatically when people are over age 62. For each additional year of age over 62, volunteering falls 20.72 hours per year. The coefficient for KIDS is insignificant showing that the presence of children does not influence volunteering. The church membership coefficient, RLMEMB, demonstrates that on average church members give 215 more total hours per year than non-members. People with an education level greater than a high school diploma have an insignificant difference in total hours given compared with people who have at most a high school diploma. The coefficient for FULLTIME shows that for each additional hour available to an individual, he or she tends to increase volunteer time by 1.19 minutes (.019*60 minutes).

An interpretation of the coefficients for the HTOTANHR equation is presented next. The HTOTANHR equation's coefficients provide the marginal effects for the household as well as the other spouse. The coefficient for AGE shows that a household tends to increase total annual hours given by 8.15 hours per year for each additional year of age before 62. After age 62, volunteer hours by the household fall by 39.25 hours per year. The youngest respondent was 19, the oldest was 89, and the average age was 43. Households with children did not show significantly different hours due to children in the household as indicated by the insignificant coefficient for KIDS. Membership in a church by a household, RLMEMB, leads to 408 hours more volunteering per year than those households that do not belong to a church. Recall that HTOTANHR includes both volunteering for church and non-church activities. The coefficient for HEDUC shows that education level of the household is not significant to a household's decision of total time to give. An important variable for the decision of volunteer time by the household is full-time. For every additional hour of full-time available to the household, the household increases volunteer time by 2.34 (.039*60 minutes) minutes per year.

By comparing coefficients for the same variable across equations, one can see importance of using simultaneous equation techniques. For example, the difference between the YRBORN coefficients in the two equations shows that one cannot assume a coefficient for the spouse's equation can be doubled to analyze the household. The effect of age on the household is less than double the effect on an individual respondent.

The final parameter to evaluate is important for this work, RHO. Rho is significant and positive indicating that the bivariate tobit model is an appropriate way to model the interdependencies of household volunteer time. A value of rho=.987 suggests that the error terms of the spouses are highly correlated. This means that unobserved things that effect one spouse's decision of volunteer time also affect the other spouse in the same way. It is especially important to estimate rho when the correlation among the dependent variables is high.

Now that the primary model of volunteering has been presented, the supporting models are explored. There is a specific purpose for each of the six supporting models, a hypothesis is tested in each one. The results of the hypothesis test will be explained, but there will be no discussion of the individual coefficients of the model.

The demand equation generated from the non-cooperating spouse model without full-time is tested empirically in this section. The specification of this model is shown in equations (109) and (110) and follows directly from the theoretical specification for non-cooperating spouses, equation (54).

$$DADTOT=\alpha_0+\alpha_1 YRBORN+\alpha_2 OVER62+\alpha_3 KIDS+\alpha_4 RLMEMB+\alpha_5 DADEDUC +\alpha_6 HRTOTD +\varepsilon. \quad (109)$$

$$MOMTOT=\beta_0+\beta_1 YRBORN+\beta_2 OVER62+\beta_3 KIDS+\beta_4 RLMEMB+\beta_5 MOMEDUC +\beta_6 HRTOTM +\varepsilon. \quad (110)$$

The focus of this model is on the coefficients of the non-cooperating spouse's available time, α_6 and β_6. Rho is also important in that if rho is positive and significant, then the spouses' decisions of volunteer time are affected the same way from unobserved, random disturbances. The utility function generates a demand equation with one spouse's time as an argument of the other spouse's volunteer time. Because one spouse's time is determined simultaneously with the other spouse's time, one must test this interdependence with a bivariate tobit model. The demographic variables are the same as those found in the model of table 2. The only difference is that available time for each spouse is used instead of full-time for estimation of his or her total hours given individually. Table 3 shows the results of testing the non-cooperating spouse model. The coefficients for available time are insignificant, but rho is .94 and significant.

It is a surprise to find available time insignificant. It may be that spouses behave in a cooperating way, or that there are omitted variables. Another possibility is that the RHS variables that the spouses share cause too much noise. In an attempt to simplify the problem, equations (111) and (112) present demand equations for non-cooperating spouses without the shared variables.

$$\text{DADTOT}=\alpha_0+\alpha_1\text{DADEDUC}+\alpha_2\text{HRTOTD}+\varepsilon. \qquad (111)$$

$$\text{MOMTOT}=\beta_0+\beta_1\text{MOMEDUC}+\beta_2\text{HRTOTM}+\varepsilon. \qquad (112)$$

Table 4 shows the results of a bivariate tobit model testing the demand equations in (111) and (112). Note that rho remains significant and virtually the same in magnitude. Recall from the theory section that since DADTOT and MOMTOT are chosen in concert, one must test for simultaneity through rho. The following null and alternative hypothesis define the test:

$$H_o\text{: rho}=0$$

$$H_a\text{: rho}\neq 0.$$

Since the prob-value for rho is .0001, we must reject the null hypothesis at the highest level. The value of rho=.944 implies that the error terms of the two spouses are highly correlated. The coefficient for Dad's available time is still insignificant and Mom's available time is significant at a 6% level. The cooperating spouse model will be tested next.

The difference between the cooperating and non-cooperating spouse models is that each spouse's available time appears in the demand equation for each spouse in the cooperating spouse model. The non-cooperating spouse model has only available time of agent i as an argument for agent i's demand for time gifts (see equations (109) and (110)).

Table 3. Non-Cooperating Spouses

	Variable	Coefficient	Standard Error	Coeff./SE	Prob. Value
DADTOT					
	Constant	-229.2212	73.2757	-3.1280	0.0018
	YRBORN	4.9324	1.3571	3.6340	0.0003
	OVER62	-19.4829	6.3208	-3.0820	0.0021
	KIDS	2.9053	32.5675	0.0890	0.9289
	RLMEMB	221.5183	28.9139	7.6610	0.0001
	DADEDUC	-4.7870	11.0459	-0.4330	0.6647
	HRTOTD	0.0051	0.0068	0.7480	0.4545
MOMTOT					
	Constant	-229.7058	65.7192	-3.4950	0.0005
	YRBORN	4.8496	1.2697	3.8200	0.0001
	OVER62	-17.9519	6.0324	-2.9760	0.0029
	KIDS	-20.9004	29.3930	-0.7110	0.4770
	RLMEMB	212.3376	27.3893	7.7530	0.0001
	MOMEDUC	15.1630	9.8044	1.5470	0.1220
	HRTOTM	0.0061	0.0051	1.2040	0.2285
Variances and Correlation					
	Sigma(1)	442.5066	6.0163	73.5510	0.0001
	Sigma(2)	419.2186	6.8343	61.3410	0.0001
	RHO(1,2)	0.9406	0.0024	390.2050	0.0001

Observations	1265.00
Non-limit observations for DADTOT	903.00
Non-limit observations for MOMTOT	872.00
Value of Log likelihood function	-12827.05

Therefore, the non-cooperating spouse's demand is nested in the cooperating spouse's demand. Except for the taste parameter, education, equations (113) and (114) are directly related to the cooperating spouse demand equations (40) and (41) from the theory chapter. The cooperating spouse model is presented below:

$$DADTOT=\alpha_0+\alpha_1 DADEDUC+\alpha_2 HRTOTD+\alpha_3 HRTOTM+\varepsilon, \qquad (113)$$

$$MOMTOT=\beta_0+\beta_1 MOMEDUC+\beta_2 HRTOTM+\beta_3 HRTOTD+\varepsilon. \qquad (114)$$

Table 4. Non-Cooperating Spouses

	Variable	Coefficient	Standard Error	Coeff./SE	Prob. Value
DADTOT					
	Constant	131.1246	26.4899	4.9500	0.0001
	DADEDUC	-3.6666	10.8293	-0.3390	0.7349
	HRTOTD	0.0004	0.0055	0.0710	0.9437
MOMTOT					
	Constant	83.6510	21.5767	3.8770	0.0001
	MOMEDUC	16.2171	9.7345	1.6660	0.0957
	HRTOTM	0.0090	0.0047	1.9270	0.0540
Variances and Correlation					
	Sigma(1)	454.4335	6.2775	73.3910	0.0001
	Sigma(2)	430.8273	6.9919	61.6180	0.0001
	RHO(1,2)	0.9436	0.0023	413.2190	0.0001
Observations					1265.00
Non-limit observations for DADTOT					903.00
Non-limit observations for MOMTOT					872.00
Value of Log likelihood function					-12874.42

The purpose of equations (113) and (114) is to allow a test to determine if the cooperating or non-cooperating spouse model is a better representation of the household's demand equations. The coefficients for available time (α_2, α_3, β_2, β_3), found in table 5, are disappointing because they reflect collinearity between each spouse's available time. In each equation, one coefficient for available time has a very small, insignificant value. The multicollinearity will be corrected in the next model, presented in table 6. The purpose of this model is to test whether each spouse's available time should be included in the demand equations. So in spite of the multicollinearity, a likelihood ratio test can be used to test the following null and alternative hypothesis:

$$H_o: \alpha_3=\beta_3=0$$

$$H_a: \alpha_3\neq\beta_3\neq0.$$

The purpose of this test is to determine whether the cooperating spouse model is preferred to the non-cooperating spouse model. The null hypothesis supports the non-cooperating model. The calculated value of the test is found by $-2*[(L(\beta_R)-L(\beta_{UR})]$, where $L(\beta_R)$ is the maximum value of the restricted log-likelihood function and $L(\beta_{UR})$ is the maximum value of the unrestricted log-likelihood function (Pindyck and Rubinfeld, 1991). Since the calculated value of the likelihood ratio test is 4.90 and the critical value at a 90% level is 4.61, we must reject the null hypothesis. This means that a cooperating household approach is statistically superior to a non-cooperating approach when estimating gifts of time. Table 6-A of the appendix shows how the results of table 5 are robust to adding the taste parameters back to the model.

Table 5. Cooperating Spouses

	Variable	Coefficient	Standard Error	Coeff./SE	Prob. Value
DADTOT					
	Constant	32.9307	55.9909	0.5880	0.5564
	DADEDUC	-3.7824	10.8695	-0.3480	0.7279
	HRTOTD	0.0083	0.0140	0.5950	0.5518
	HRTOTM	0.0247	0.0123	2.0040	0.0450
MOMTOT					
	Constant	-9.0211	53.9201	-0.1670	0.8671
	MOMEDUC	16.7423	9.7453	1.7180	0.0858
	HRTOTM	0.0300	0.0125	2.3950	0.0166
	HRTOTD	0.0095	0.0127	0.7470	0.4553
Variances and Correlation					
	Sigma(1)	452.9535	6.3838	70.9540	0.0001
	Sigma(2)	429.5973	6.9651	61.6790	0.0001
	RHO(1,2)	0.9432	0.0023	411.0570	0.0001
Observations					1265.00
Non-limit observations for DADTOT					903.00
Non-limit observations for MOMTOT					872.00
Value of Log likelihood function					-12871.97

To correct for the multicollineartiy, the two spouses available time are added together to create household available time, HRTOTH. A likelihood ratio test is used to test the following null and alternative hypothesis from equations (113) and (114):

$$H_o: \alpha_2=\alpha_3 \text{ and } \beta_2=\beta_3$$

$$H_a: \alpha_2\neq\alpha_3 \text{ and } \beta_2\neq\beta_3$$

Since the calculated value of the likelihood ratio test is 1.10 and the critical value at a 99% level is 4.61, we must fail to reject the null hypothesis. This means that the cooperating household model is preferred, and it is appropriate to combine the available time of household members to use as an argument for each spouse's demand for time. Table 7-A of the appendix shows the model in table 6 with all of the taste parameters added. The robustness of the model is shown by comparing the similar results for the HRTOTH coefficients.

Table 6. Cooperating Spouses

	Variable	Coefficient	Standard Error	Coeff./SE	Prob. Value
DADTOT					
	Constant	31.1211	54.4880	0.5710	0.5679
	DADEDUC	-3.8383	10.7389	-0.3570	0.7208
	HRTOTH	0.0165	0.0080	2.0650	0.0389
MOMTOT					
	Constant	-11.9137	53.4805	-0.2230	0.8237
	MOMEDUC	17.5062	9.7019	1.8040	0.0712
	HRTOTH	0.0198	0.0080	2.4770	0.0132
Variances and Correlation					
	Sigma(1)	453.0804	6.2321	72.7010	0.0001
	Sigma(2)	429.8658	6.9077	62.2300	0.0001
	RHO(1,2)	0.9432	0.0023	416.1110	0.0001
Observations					1265.00
Non-limit observations for DADTOT					803.00
Non-limit observations for MOMTOT					872.00
Value of Log likelihood function					-12872.52

The previous analysis of the joint products model tested joint products demand equations in their reduced form. In chapter four, it was explained through the theoretical models how the joint products model can be tested versus a private and public good specification. With full-time applied to the model, one can test the joint products model versus the pure public model as discussed in the full-time section of chapter 4. By using a full-income approach and 2SLS, Sandler and Murdoch (1990) formulated a way to test for joint products' structural demand equations for military expenditure. The method used here to test for joint products is similar. The main difference is that tobit estimation is used instead of least squares. It is important to validate the joint products specification for times when the utility function is used for welfare analysis. The non-cooperating spouse model shows that each spouse's time appears as an argument in the other spouse's demand equation (equation (54) is reproduced below).

$$t_i = \begin{cases} t_i(t_{(i)}, h_i, E_i; \alpha_i, \beta_i) & t_i > 0 \\ 0 & \text{otherwise} \end{cases}$$

A two-stage process, similar to 2SLS, will be applied to the demand equations so that the estimates of the coefficients are unbiased and efficient. Since choices of volunteer time by members of a household are simultaneous and censored at zero, the estimation technique is a two-stage bivarate tobit (2SBT) process. In the first stage, estimates of $t_{(i)}$ will be determined by a single equation tobit model using all of the exogenous variables as instruments. Equations (115) and (116) show how the first stage fitted values for $t_{(i)}$ are determined.

$$\text{DADTOT} = \alpha_0 + \alpha_1\text{YRBORN} + \alpha_2\text{OVER62} + \alpha_3\text{KIDS} + \alpha_4\text{RLMEMB} + \alpha_5\text{DADEDUC} + \alpha_6\text{HRTOTH} + \varepsilon. \qquad (115)$$

$$MOMTOT=\beta_0+\beta_1 YRBORN+\beta_2 OVER62+\beta_3 KIDS+\beta_4 RLMEMB+\beta_5 MOMEDUC +\beta_6 HRTOTH +\varepsilon. \qquad (116)$$

The fitted values for DADTOT and MOMTOT are saved and renamed FITDAD and FITMOM respectively. In order to properly use the fitted values in the second stage of the process, negative fitted values are assigned a zero value. In the second stage, the fitted values will be incorporated into the demand equations for one to see if the coefficients for the fitted values are significant. Significant coefficients for the fitted values mean that the joint products model is the correct choice for modeling household volunteer time.

Equations (117) and (118) allow one to test the private good model versus the joint products model. The key to this econometric specification is that it shows each spouse's observed volunteer time linearly dependent on his or her spouse's predicted volunteer time:

$$DADTOT=\alpha_0+\alpha_1 DADEDUC+\alpha_2 HRTOTH+\alpha_3 FITMOM +\varepsilon, \qquad (117)$$

$$MOMTOT=\beta_0+\beta_1 MOMEDUC+\beta_2 HRTOTH+\beta_3 FITDAD +\varepsilon. \qquad (118)$$

The following null hypothesis supports volunteer time as private good, and the alternative hypothesis supports a joint products model:

$$H_o: \alpha_3=\beta_3=0$$

$$H_a: \alpha_3\neq 0 \text{ and } \beta_3\neq 0.$$

The coefficients are estimated simultaneously with a bivariate tobit model. The results in table 6.1 show that the null hypothesis must be rejected in favor of the joint products model. Table 8-A of the appendix shows that the results become mixed when the model of table 6.1 has the taste parameters added.

The next econometric specification is used to test the pure public model versus the joint products model. The second stage for the test is set up by applying the full-time convention to the model using the fitted values from the first stage. Full-time for each spouse is created by adding the fitted value for spouse's time to the observed HRTOTH for each spouse creating FULLHATD and FULLHATM for each spouse respectively. Finally, the dependent variable for each spouse is created by adding the fitted value of the other spouse's time to the observed DADTOT and MOMTOT respectively. Equations (119) and (120) represent the second stage demand equations for cooperating spouses with full-time:

$$HTOTHATD=\alpha_0+\alpha_1 DADEDUC+\alpha_2 FULLHATD+\alpha_3 FITMOM+\varepsilon. \tag{119}$$

$$HTOTHATM=\beta_0+\beta_1 MOMEDUC+\beta_2 FULLHATM+\beta_3 FITDAD+\varepsilon. \tag{120}$$

Table 6.1 Private good model vs. joint products model, 2SBT

	Variable	Coefficient	Standard Error	Coeff./SE	Prob. Value
DADTOT					
	Constant	-181.1422	55.8027	-3.2460	0.0012
	DADEDUC	54.5755	13.3241	4.0960	0.0001
	HRTOTH	0.0032	0.0083	0.3920	0.6954
	FITMOM	1.0939	0.1308	8.3660	0.0001
MOMTOT					
	Constant	-276.2230	57.5494	-4.8000	0.0001
	MOMEDUC	70.0317	11.8556	5.9070	0.0001
	HRTOTH	0.0149	0.0080	1.8680	0.0617
	FITDAD	1.0440	0.1216	8.5860	0.0001
Variances and Correlation					
	Sigma(1)	439.0202	5.7807	75.9460	0.0001
	Sigma(2)	417.0088	6.5217	63.9420	0.0001
	RHO(1,2)	0.9377	0.0024	386.5040	0.0001
Observations					1265
Non-limit observations for DADTOT					903
Non-limit observations for MOMTOT					872
Value of Log likelihood function					-12836.44

This representation of the model allows a nested test of the joint products model. The following null hypothesis supports a pure public model, and the alternative hypothesis supports a joint products model:

$$H_o: \alpha_3=\beta_3=0$$

$$H_a: \alpha_3\neq0 \text{ and } \beta_3\neq0.$$

The coefficients of the model are estimated simultaneously with a bivariate tobit model. The results in table 6.2 show that the null hypothesis must be rejected in favor of the joint products model. It has now been shown that the joint products model for volunteer time is superior to a pure public model. Table 9-A of the appendix shows the robustness of the results in table 6.2 by adding the taste parameters back into the model.

This concludes the six model analysis of the logic that supports the full-time joint products model. By applying the full-time convention to the model in table 6 and adding back the shared demographic variables, the model in table 2 is restored. The full-time convention is applied to the empirical work in the same way that it is applied to the theory work of chapter four. The full-time convention allows one to look at the marginal effects of the independent variables at the individual and household level in the same model.

Decomposing Household Level Giving

The previous analysis of the data focused on married households. It showed how one spouse's time influenced the other's volunteer time and, therefore, the household's gifts. The

Table 6.2 Pure Public Model vs. Joint Products Model, 2SBT

Variable	Coefficient	Standard Error	Coeff./SE	Prob. Value
HTOTHATD				
Constant	9.1980	47.4019	0.1940	0.8461
DADEDUC	20.2729	9.8591	2.0560	0.0398
FULLHATD	0.0128	0.0066	1.9310	0.0534
FITMOM	1.4914	0.1015	14.6930	0.0001
HTOTHATM				
Constant	-37.0192	48.2010	-0.7680	0.4425
MOMEDUC	29.8270	8.6418	3.4510	0.0006
FULLHATM	0.0177	0.0063	2.8020	0.0051
FITDAD	1.4526	0.0935	15.5400	0.0001
Variances and Correlation				
Sigma(1)	353.6776	4.6633	75.8420	0.0001
Sigma(2)	333.5008	5.0894	65.5280	0.0001
RHO(1,2)	0.9407	0.0020	478.6200	0.0001
Observations				1265.00
Non-limit observations for HTOTHATD				1265.00
Non-limit observations for HTOTHATM				1265.00
Value of Log likelihood function				-16994.61

following models include single and married households and show household total annual hours broken down to its components. Recall that total annual hours given is the sum of volunteer time to church (HCSHOURS) and volunteer time to other organizations (HSTIME), see figure 4 for details. The independent variables of (121) and (122) are the same ones used in the married household models. A bivariate tobit model is used to estimate the parameters because the dependent variables are determined simultaneously.

$$HSTIME=\alpha_0+\alpha_1 YRBORN+\alpha_2 OVER62+\alpha_3 KIDS+\alpha_4 RLMEMB+\alpha_5 DADEDUC +\alpha_6 HRTOTH +\varepsilon. \quad (121)$$

$$HCSHOURS=\beta_0+\beta_1 YRBORN+\beta_2 OVER62+\beta_3 KIDS+\beta_4 RLMEMB+\beta_5 DADEDUC +\beta_6 HRTOTH +\varepsilon. \quad (122)$$

Table 7. Decomposing Household Giving

	Variable	Coefficient	Standard Error	Coeff./SE	Prob. Value
HSTIME					
	Constant	-930.8803	74.1424	-12.5550	0.0001
	YRBORN	5.4385	1.4641	3.7140	0.0002
	OVER62	-25.0759	6.3157	-3.9700	0.0001
	KIDS	57.6026	34.4128	1.6740	0.0942
	RLMEMB	143.6501	33.3499	4.3070	0.0001
	HSEDUC	358.7059	38.4159	9.3370	0.0001
	HRTOTH	0.0708	0.0087	8.1750	0.0001
HCSHOURS					
	Constant	-878.0800	64.6954	-13.5730	0.0001
	YRBORN	1.0635	1.1669	0.9110	0.3621
	OVER62	-11.8694	5.0119	-2.3680	0.0179
	KIDS	84.1072	29.3457	2.8660	0.0042
	RLMEMB	539.3997	32.1214	16.7930	0.0001
	HSEDUC	53.5249	29.3387	1.8240	0.0681
	HRTOTH	0.0417	0.0070	5.9630	0.0001
Variances and Correlation					
	Sigma(1)	664.5229	7.1165	93.3780	0.0001
	Sigma(2)	489.1967	5.2108	93.8820	0.0001
	RHO(1,2)	0.1969	0.0262	7.5250	0.0001
Observations					2232.00
Non-limit observations for HSTIME					1251.00
Non-limit observations for HCSHOURS					890.00
Value of Log likelihood function					-17831.72

Starting with the five demographic variables, an interpretation is given for each coefficient in the HSTIME equation presented in table 7. As people age, they tend to give more time before age 62 and less time after 62. The coefficient for age in the HSTIME equation implies that for every additional year of age before 62, a household increases annual time volunteered to non-church activities by 5.44 hours. After age 62, the household reduces annual non-church volunteering by 25.08 hours. The coefficient for KIDS indicates that children do not significantly effect hours given to non-church activities at the 5% level of significance, but do at a 10% level. The church membership coefficient, α_3=143.65, has a prob-value of .0001. This is interesting in that it implies church members give 144 hours more time to non-church events than non-members. The coefficient for HSEDUC, α_5=358.71, suggests that on average households with education greater than high school give about 359 more annual hours to other organizations. The coefficient for available time, HRTOTH, is α_6=.0708. This means that for each additional hour of available time, the household gives an additional 4.25 minutes to other organizations.

Next is an interpretation of the coefficients for the church time equation, HCSHOURS. Each additional year of age before 62 has an insignificant impact on volunteering to church. For every additional year of age after 62, households tend to reduce hours given to church by 11.87 hours per year. The coefficient for KIDS, β_2=84.11, means that children in households causes those households to volunteer 84 hours more to church annually. As expected, the coefficient for RLMEMB is significant and large. It implies that members of a church give 539 hours more time to church than non-members. Higher education, HSEDUC, has an insignificant effect on church volunteering. Available time, HRTOTH=.0417, has a significant impact on decisions of time volunteered to church. This means that for each hour of available time the household gives 2.50 minutes to church.

In analyzing the coefficients across equations one draws some interesting conclusions about the behavior of households in their allocation of time to different types of organizations. The coefficients of age, OVER62, show a slightly greater reduction in non-church time with age for households over 62. For households under age 62, volunteering to non-church activities increases with age, while volunteering for church activities are not sensitive to age. The coefficients of KIDS both show a positive effect for the two types of volunteering. KIDS are significant at only a 10% level of significance for non-church giving but significant at a 1% level for church giving. Church volunteering is more sensitive to the presence of children than non-church volunteering.

There is evidence to suggest that households give higher priority to church time. By assuming that only members gave to church, one sees that there are 890 givers. Since there are 1,498 observations of total household time, HTOTANHR, there must have been 608 non-member givers (1498-890). Due to there being 1,251 givers of non-church time (HSTIME), 643 of them must have been church members (1251-608). This implies that there are 247 members who gave to church but did not give to other organizations. Therefore, the data suggests that members of a church first look to church to give time and then to other organizations.

The education coefficient is another interesting one to decompose into parts because it is positive and large for volunteer time at other organizations but insignificant for church volunteer time at a 5% level of significance (prob. value=.0681). Available time is significant to the decision of volunteer time to other organizations and in volunteer time to church. Household's volunteer time to non-church activities is more sensitive to available time than household's volunteer time to church. Andreoni, Gale, Scholz, 1995 commented, "There is a presumption in the literature that religious giving is somehow different than other forms of giving" (p. 25). This paper uncovers evidence that supports this statement in terms of voluntary time given.

One of the more important variables in determination of volunteer time is what other types of time are being given. The bivariate tobit model provides us with that information through the correlation coefficient, rho. A rho that is positive and significant means that gifts of time to church and time to other organizations tend to be effected the same way from unobserved disturbances. Rho=.1969 implies that there is a weak positive correlation among the error terms. This finding is one of the more important findings of this dissertation. The significance of rho identifies the inefficiencies of modeling volunteer hours without acknowledging the interdependencies of various time gifts.

The next model analyzes volunteer hours at the most aggregate level for this data set. The givers are viewed as a household rather than an individual, and the gifts to various activities are summed together as one dependent variable, HTOTANHR (see figure 4). This model is included in the dissertation to show how the coefficients change when the interdependencies of time gifts are ignored. Equation (123) shows household total annual hours linearly dependent on five taste parameters and available time.

$$\text{HTOTANHR}=\gamma_0+\gamma_1\text{YRBORN}+\gamma_2\text{OVER62}+\gamma_3\text{KIDS}+\gamma_4\text{RLMEMB}+\gamma_5\text{HSEDUC}$$
$$+\gamma_6\text{HRTOTH}+\varepsilon. \qquad (123)$$

Table 8 presents the results of using a single equation tobit model to estimate the coefficients in equation (123). One can see that the signs of the estimates are mostly consistent with those of the bivariate model, however, the magnitudes of the estimates indicate how the household treats the two types of gifts differently.

Provided next is an explanation for each of the coefficients presented in table 8. The coefficient for age indicates that total hours given increases by 4.13 hours per year for each additional year of age before 62. After age 62, however, volunteering falls by 26.38

Table 8. Total Household gifts

Variable	Coefficient	Standard Error	Coeff./SE	Prob. Value
HTOTANHR				
Constant	-864.4617	75.6093	-11.4330	0.0001
YRBORN	4.1306	1.5151	2.7260	0.0064
OVER62	-26.3832	5.7765	-4.5670	0.0001
KIDS	61.7080	34.5259	1.7870	0.0739
RLMEMB	365.9042	35.4195	10.3310	0.0001
HSEDUC	296.7901	36.9417	8.0340	0.0001
HRTOTH	0.0824	0.0089	9.3010	0.0001
Variances and Correlation				
Sigma	722.4418	13.6950	52.7520	0.0001
Observations				2232.00
Non-limit observations for HTOTANHR				1498.00
Value of Log likelihood function				-12478.36

hours per year for each additional year of age. The coefficient for KIDS is significant at a 10% level. This implies that the presence of children leads a household to give about 62 hours more time per year. The church membership coefficient, γ_3=365.90, has a prob-value of .0001. This means that a household that is a member of a church tends to give 366 more volunteer hours per year to all types of activities when compared to a non-member. The variable for education, HSEDUC, has a coefficient that is significant and positive. This suggests that on average people with education greater than high school give about 297 more annual hours to all types of volunteering. Available time, HRTOTH, is important to the decision of how much time a household allocates to volunteering. A value of .0824 means that for each additional hour of available time, the household volunteers an additional 4.94 minutes to all types of organizations.

By comparing results of table 7 and 8, one can see the effect of differentiating different types of volunteer time. For example, total household volunteer hours is not sensitive to whether a household has children or not at a 5% level. The results of the bivariate tobit model, however, show that the KIDS coefficient is significant for church volunteering, but insignificant for non-church volunteering at a 5% level of significance. This means that the insignificant effect of KIDS on non-church time, α_2, must have overwhelmed the significant effect of KIDS on church time, β_2, in the total effect, γ_2.

Decomposing household giving has given insight to the interdependencies of various types of gifts. When one is looking at the demand for a specific type of volunteering, it is important to analyze other types of volunteering the household is currently doing. This was shown by the significance of rho in the bivariate tobit model of table 7.

CHAPTER 6. CONCLUSION

Charitable gifts of time impact the welfare of individuals and society. To this date, theoretical and empirical research has been insufficient to make confident predictions on the demand for hours given to nonprofit organizations. This dissertation is distinct from previous research in two ways. One is that it presents a theoretical model that derives demand equations for time without prices. This is accomplished by use of a separable utility function in which all income is spent in the branch where market goods are chosen. The goods "volunteer time" and leisure are chosen in a branch of the utility function where the only binding constraint is the number of hours left in a day after work and sleep. The second way this work is distinct is that demand for volunteer time by households is estimated by using data on each spouse's gifts. The simultaneous estimation of the parameters of the model gives insights to the giving behavior among spouses.

This paper offers a different theoretical approach to modeling gifts of time by modeling the household instead of just an individual. Empirical results found herein support a household approach to estimation of time giving behavior. The simultaneous decisions of the household on the spouse's level of time gifts are ground out from the theoretical model and tested with a bivariate tobit model. The theory work put forth also recognizes the potential for an agent to receive utility not only from the level of the public good but also from his/her private contribution to the public good. This concept is known as joint products theory. Empirical results found herein support the idea that households receive utility in multiple ways from their gifts of time. The theoretical models are tested empirically by analyzing a national sample of giving behavior. Statistical tests are performed to show the joint products approach is preferred to a pure public and pure private consumption model. Previous research has found that spouses tend to give time together (Andreoni, Brown and Rischall, 1999), but quantifies those results using a probit approach. The tobit approach of this paper allows one to see more clearly the quantitative effects of the independent variables.

Models of household gifts of time have not been thoroughly explored to this point. Theoretical models of this kind can take a closer look at allocations of gifts among spouses. Application of the joint products model proves to be essential to the determination of time gifts. The following bullets outline the results of this dissertation:

- A joint products approach that explains household's utility and associcated demand equations for time gifts is shown to be superior to other methods.
- Previous models of time and money have come from unspecified utility functions which limits the ability to do policy simulations (Brown and Lankford, 1992). This study presents a separable utility function and empirical evidence suggesting the validity of the separable utility function.
- Previous research has suggested hours given to be partially dependent on the tax price of charitable gifts of money. The theory chapter shows the inconsistency of using the tax price of monetary contributions in the determination of time gifts.
- This dissertation brings to the literature a new data set to test and compare to previous findings of monetary and time gift studies. This information is valuable because of the lack of data to date on gifts of time.
- Unlike previous research, this study evaluates the giving behavior among spouses, finding that spouses tend to give time together. This is contrary to the way some economists

conceive giving behavior. An opportunity cost approach predicts that the spouse with lower opportunity cost, measured in wages foregone, will be the one volunteering more time. The opportunity cost approach suggests a substitution of one spouse's time for the other's time; the results of this research suggest a complementary relationship of each spouse's volunteer time. This finding is similar to the finding that people who give money, also tend to give time (Freeman, 1997).

- The data indicate that households first tend to give time to their church and then give time to other organizations.
- Interdependencies among various types of volunteering exist. Researchers may not be getting the most efficient results if the interdependencies among various gifts of time are ignored. The use of simultaneous equation techniques in this paper uncovered a relationship among different types of giving as well as the interdependencies among spouses. The amount of error a researcher is making by not considering the correlation between dependent variables diminishes the smaller the correlation coefficient is.
- The household views gifts of time to other organizations and gifts of time to church to be complements in their budgeting of available time.
- The data confirms the importance of available time in the household's decision of time gifts. In the main empirical model of the household, available time is cast as full-time. Full-time in this paper is similar to full-income in other research. It is a way to deal with externalities. The use of full-time is helpful in setting up the theoretical models for empirical testing. The first order conditions with the full-time convention applied are proven to be equivalent to the first order conditions derived for the household.

The data set used in this study did not allow the demand equations derived from the utility functions of "Cooperating Spouses Considering Other's Time" to be tested. Future research could test that theoretical approach if there is a data set containing information on household's gifts to a specific charity. One could then proceed on with the thought that one person's gift of time is dependent on how many other people are contributing to the good. Future empirical studies with data of this nature should continue to identify the importance of group effects on charitable gifts of time.

APPENDIX. ADDITIONAL TABLES

Table 1-A. Monetary gifts to church

level of gift	# of givers	% at each level
$0	111	7%
$25	267	16%
$75	226	13%
$175	280	16%
$375	270	16%
$750	228	13%
$1,750	211	12%
$2,500	107	6%
total attendees	1700	100%
total givers	1589	
average gift among attendees	$577.43	
average gift among givers	$815.83	

107 people gave more than $2,500, so the calculated average gift is lower than what it really is.

Table 2-A. Time gifts to church

hours/wk	# of people
0	913
1	258
2	190
3	92
4	65
5	45
6	28
7	9
8	25
10	29
12	12
13	1
14	3
15	9
16	2
17	1
20	10
24	1
25	2
26	1
30	3
35	1
40	2
42	1
50	2
60	3
72	1
	1709
average among attendees per week	1.9906
average among givers per week	4.2739

Table 3-A. General Statistics for all respondents

Variable	Mean	Std.Dev.	Minimum	Maximum	Cases
CSHOURS	62.600	170.369	0	2600	2232
FEDGRADE	0.543	0.498	0	1	2232
FSPEDUC	0.312	0.463	0	1	2232
FULLTIME	5242.554	2023.827	0	14127	2232
GENDER	0.463	0.499	0	1	2232
HCSHOURS	108.680	280.702	0	4368	2232
HRTOTH	5063.418	1967.571	0	12775	2232
HRTOTR	3290.487	1287.951	0	7300	2232
HRTOTSP	1772.931	1654.140	0	6205	2232
HSTIME	201.593	468.000	0	4853	2232
HTOTANHR	310.273	580.831	0	6067	2232
KIDS	0.483	0.500	0	1	2232
OGANNHR	116.536	262.173	0	3120	2232
RLMEMB	0.629	0.483	0	1	2232
RTOTANHR	179.136	332.531	0	3328	2232
SCSHOURS	46.079	136.626	0	2288	2232
SPTIME	85.058	243.035	0	2773	2232
STOTANHR	131.137	302.070	0	3467	2232
YRBORN	42.561	16.086	18	92	2232

Table 4-A. General statistics for married respondents

Variable	Mean	Std.Dev.	Minimum	Maximum	Cases
CSHOURS	66.017	165.159	0	2080	1265
FEDGRADE	0.556	0.497	0	1	1265
FSPEDUC	0.550	0.498	0	1	1265
FULLTIME	6359.581	1710.329	1996	14127	1265
GENDER	0.498	0.500	0	1	1265
HCSHOURS	147.321	334.212	0	4368	1265
HRSWORK	6.563	4.705	0	16	1265
HRTOTH	6165.705	1648.386	1996	12775	1265
HRTOTR	3037.499	1212.806	0	6935	1265
HRTOTSP	3128.206	765.836	1631	6205	1265
HSTIME	277.936	568.711	0	4853	1265
HTOTANHR	425.257	691.253	0	6067	1265
KIDS	0.649	0.477	0	1	1265
OGANNHR	127.858	267.085	0	2080	1265
RLMEMB	0.660	0.474	0	1	1265
RTOTANHR	193.876	327.998	0	2600	1265
SCSHOURS	81.303	173.439	0	2288	1265
SPTIME	150.078	307.389	0	2773	1265
SPWORKHR	6.561	4.284	0	10	1265
STOTANHR	231.381	371.267	0	3467	1265
YRBORN	43.439	13.822	19	89	1265

Table 5-A. General statistics for single respondents

Variable	Mean	Std.Dev.	Minimum	Maximum	Cases
CSHOURS	58.130	176.939	0	2600	967
FEDGRADE	0.527	0.500	0	1	967
GENDER	0.418	0.493	0	1	967
HCSHOURS	58.130	176.939	0	2600	967
HRSWORK	5.897	4.778	0	16	967
HRTOTH	3621.440	1308.805	0	7300	967
HRTOTR	3621.440	1308.805	0	7300	967
HSTIME	101.724	254.983	0	3120	967
HTOTANHR	159.854	337.568	0	3328	967
KIDS	0.265	0.441	0	1	967
OGANNHR	101.724	254.983	0	3120	967
RLMEMB	0.587	0.493	0	1	967
RTOTANHR	159.854	337.568	0	3328	967
YRBORN	41.414	18.581	18	92	967

Table 6-A. Cooperating Spouse model of Table 5 with shared RHS

	Variable	Coefficient	Standard Error	Coeff./SE	Prob. Value
DADTOT					
	Constant	-306.4434	80.9852	-3.7840	0.0002
	YRBORN	4.6688	1.3571	3.4400	0.0006
	OVER62	-20.7876	6.3325	-3.2830	0.0010
	KIDS	13.0230	32.6635	0.3990	0.6901
	RLMEMB	222.5881	28.8205	7.7230	0.0001
	DADEDUC	-5.1396	11.0742	-0.4640	0.6426
	HRTOTD	0.0042	0.0068	0.6210	0.5347
	HRTOTM	0.0289	0.0120	2.4130	0.0158
MOMTOT					
	Constant	-299.5146	75.0993	-3.9880	0.0001
	YRBORN	4.6044	1.2697	3.6260	0.0003
	OVER62	-19.1551	6.0544	-3.1640	0.0016
	KIDS	-11.7978	29.5386	-0.3990	0.6896
	RLMEMB	213.3344	27.2911	7.8170	0.0001
	MOMEDUC	15.1867	9.8229	1.5460	0.1221
	HRTOTM	0.0315	0.0125	2.5080	0.0122
Variances and Correlation					
	Sigma(1)	441.2153	6.1775	71.4230	0.0001
	Sigma(2)	418.1865	6.8357	61.1770	0.0001
	RHO(1,2)	0.9403	0.0024	387.8730	0.0001

Observations	1265.00
Non-limit observations forDADTOT	903.00
Non-limit observations for MOMTOT	872.00
Value of Log likelihood function	-12824.86

Table 6-A shows how one cannot reject the addition of Mom's available time to Dad's volunteer time equation. The coefficient for HRTOTM has a probability value of .0158. This is another argument supporting the cooperating spouse model over the non-cooperating spouse model.

Table 7-A.__Cooperating Spouse model of Table 6 with shared RHS________

	Variable	Coefficient	Standard Error	Coeff./SE	Prob. Value
DADTOT					
	Constant	-314.1923	84.9771	-3.6970	0.0002
	YRBORN	4.4361	1.3595	3.2630	0.0011
	OVER62	-21.3744	6.3472	-3.3680	0.0008
	KIDS	13.4802	32.7235	0.4120	0.6804
	RLMEMB	223.0139	28.6077	7.7960	0.0001
	DADEDUC	-5.1992	11.0233	-0.4720	0.6372
	HRTOTH	0.0190	0.0088	2.1650	0.0304
MOMTOT					
	Constant	-308.8728	81.2023	-3.8040	0.0001
	YRBORN	4.3205	1.2748	3.3890	0.0007
	OVER62	-19.8623	6.1058	-3.2530	0.0011
	KIDS	-11.1038	29.7262	-0.3740	0.7087
	RLMEMB	213.8220	27.3158	7.8280	0.0001
	MOMEDUC	16.1622	9.7835	1.6520	0.0985
	HRTOTH	0.0186	0.0093	2.0090	0.0446
Variances and Correlation					
	Sigma(1)	441.3375	6.0883	72.4890	0.0001
	Sigma(2)	418.4958	6.7860	61.6710	0.0001
	RHO(1,2)	0.9403	0.0024	391.9520	0.0001
Observations					1265.00
Non-limit observations forDADTOT					903.00
Non-limit observations for MOMTOT					872.00
Value of Log likelihood function					-12825.88

Table 7-A shows the cooperating spouse model of Table 6 with all of the taste parameters added. This is included in the appendix because the focus in this section of the main body of the dissertation was on available time and not the taste parameters. As one can see, the significance and magnitude of the HRTOTH coefficients are only slightly different.

Table 8-A. Joint Products vs. Private Good with shared RHS

	Variable	Coefficient	Standard Error	Coeff./SE	Prob. Value
DADTOT					
	Constant	-353.7741	88.3745	-4.0030	0.0001
	YRBORN	4.0417	1.6402	2.4640	0.0137
	OVER62	-18.3492	7.8055	-2.3510	0.0187
	KIDS	17.9538	32.7265	0.5490	0.5833
	RLMEMB	197.0481	47.9016	4.1140	0.0001
	DADEDUC	60.5567	23.1688	2.6140	0.0090
	HRTOTH	0.0167	0.0101	1.6460	0.0998
	FITMOM	0.1845	0.2953	0.6250	0.5322
MOMTOT					
	Constant	-328.5715	80.9681	-4.0580	0.0001
	YRBORN	1.1672	1.5644	0.7460	0.4556
	OVER62	-6.4654	7.2029	-0.8980	0.3694
	KIDS	-16.1732	29.6960	-0.5450	0.5860
	RLMEMB	74.7135	49.4500	1.5110	0.1308
	MOMEDUC	21.2950	18.0924	1.1770	0.2392
	HRTOTH	0.0134	0.0095	1.4210	0.1554
	FITDAD	1.0581	0.3156	3.3520	0.0008
Variances and Correlation					
	Sigma(1)	439.0056	6.0024	73.1380	0.0001
	Sigma(2)	416.6475	6.7405	61.8120	0.0001
	RHO(1,2)	0.9394	0.0025	382.9780	0.0001

Observations	1265.00
Non-limit observations forDADTOT	903.00
Non-limit observations for MOMTOT	872.00
Value of Log likelihood function	-12819.22

Table 8-A shows the cooperating spouse model of Table 6.1 with all of the taste parameters added. Adding the taste parameters to the equations leads to a mixed result for the test of the joint products model versus the private good model. In Table 6.1, FITDAD and FITMOM were both positive and significant. However, in the model with all the taste parameters added, the DADTOT equation has FITMOM as insignificant, and in the MOMTOT equation FITDAD is significant.

Table 9-A. Joint Products vs. Public Good with shared RHS

Variable	Coefficient	Standard Error	Coeff./SE	Prob. Value
HTOTHATD				
Constant	-86.5336	77.0203	-1.1240	0.2612
YRBORN	2.3732	1.3292	1.7850	0.0742
OVER62	-15.0674	6.7222	-2.2410	0.0250
KIDS	-7.4428	25.9942	-0.2860	0.7746
RLMEMB	132.2029	38.1482	3.4660	0.0005
DADEDUC	26.8194	17.7560	1.5100	0.1309
FULLHATD	0.0234	0.0081	2.8930	0.0038
FITMOM	0.8702	0.2257	3.8560	0.0001
HTOTHATM				
Constant	-64.8355	68.1949	-0.9510	0.3417
YRBORN	0.3743	1.1909	0.3140	0.7533
OVER62	-6.4995	5.8606	-1.1090	0.2674
KIDS	-26.2729	23.1847	-1.1330	0.2571
RLMEMB	44.1447	38.8714	1.1360	0.2561
MOMEDUC	-2.8325	13.4516	-0.2110	0.8332
FULLHATM	0.0186	0.0074	2.4970	0.0125
FITDAD	1.5219	0.2374	6.4100	0.0001
Variances and Correlation				
Sigma(1)	352.3896	4.8704	72.3530	0.0001
Sigma(2)	332.2565	5.3349	62.2800	0.0001
RHO(1,2)	0.9412	0.0021	454.1930	0.0001
Observations				1265.00
Non-limit observations for HTOTHATD				1265.00
Non-limit observations for HTOTHATM				1265.00
Value of Log likelihood function				-16980.14

Table 9-A shows the cooperating spouse model of Table 6.2 with all of the taste parameters added. Adding the taste parameters to the equations leads to the same conclusion for the test of the joint products model versus the private good model. Since FITMOM and FITDAD are significant in each equation respectively, the joint products model is superior to the public good specification. The robustness of the joint products model is shown through this alternative specification.

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