

# LABOR SUPPLY, VOLUNTARY WORK, AND CHARITABLE CONTRIBUTIONS IN A MODEL OF UTILITY MAXIMIZATION

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## I. Introduction

Research interest in the economics of charity has grown significantly in recent years. Because of its apparent inconsistency with self-interest, many people have looked for some rational explanation for charitable behavior. Also because of its importance as a source of funds for a wide variety of public services, charitable giving and its implication for tax policy and revenue have received considerable attention from public finance economists.

In respect of the economic rationality of personal philanthropy, Boulding [2] and Vickrey [9] were among the first of the modern economists to suggest that individual's welfare depend on levels of consumption of unrelated individuals as well as their own consumption. Becker [1] integrated this kind of utility interdependence into a formal model of choice and derived some empirical implications of philanthropy. More recently Phillips [7] used Becker's household production approach and developed a complete model of charitable giving motivated by self-interest.

The focus of attention in most discussions of charitable giving and its implication for tax policy has been on the efficacy of income-tax deductibility of charitable contributions. Much less attention has been directed to the donation of time and talent as opposed to monetary contributions to charitable organizations. Nonetheless the amount of voluntary service in the economy is of great significance,<sup>1</sup> and it is conceivable that donations of time and money are considered simultaneously in individuals' decision-making process. Further, voluntary work and labor supply (i.e., work for pay) compete with each other in the individual's time-allocation decision. Therefore one must recognize the underlying systematic relationship

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<sup>1</sup>Survey estimates by Morgan et al. [6] indicate that over six billion hours of time per year are given to charitable organizations.

between charitable giving, voluntary work, and labor supply in order to fully understand the impact of alternative tax policies toward charitable contributions.

This study extends earlier research in this area by incorporating an individual's voluntary work and labor supply decisions into the model of charitable giving and further exploring their inter-relationship. We accepted the basic analytical framework of Phillips but replaced the household production technology by a more flexible functional form. In our model the individual's charitable behavior (i.e., giving money and/or time) as well as labor supply and consumption decisions are simultaneously derived from utility maximization. Further, comparative static analysis leads to some interesting implications about the impact of tax policy on giving, voluntary work, and labor supply.

We first consider a simple model of an individual's labor/leisure-consumption choice with income tax provision but without any consideration of charitable behavior. The individual's preferences are characterized by a Stone-Geary utility function. The main contribution of this paper lies in the subsequent section where charity is included in the individual's utility maximization problem. We also perform some comparative static analysis to examine the effect of tax-exempt status of charitable contributions on voluntary service, cash donations, and labor supply. Finally, the findings of the theoretical analysis are briefly summarized and some broad conclusions are drawn for policy.

## II. A Simple Model of Consumption-Leisure Choice

We consider the utility maximization problem of an individual who derives satisfaction from the consumption of a composite commodity,  $X_1$ , as well as from the enjoyment of leisure time,  $X_0$ . The individual's optimization problem is to maximize the utility function

$$U = \alpha_0 \ln(X_0 - \Gamma_0) + \alpha_1 \ln(X_1 - \Gamma_1) \quad (1)$$

subject to the budget and time constraints. In this Stone-Geary utility function  $\Gamma_0$  represents committed leisure and refers to the time necessary for eating, sleeping and other required non-market activities;  $\Gamma_1$  denotes committed consumption and may be interpreted as the subsistence level of expense necessary for food, clothing, shelter, etc.<sup>2</sup> The other two parameters  $\alpha_0$  and  $\alpha_1$  add up to unity.

The time constraint limits the sum of the time allocated to work ( $L$ ) and leisure ( $X_0$ ) to the total time endowment  $T$ . Thus

$$T = L + X_0 \quad (2)$$

The budget constraint limits the expenditure on the composite commodity at the price  $p$ , to the after-tax disposable income. The before-tax income is the sum of labor income (i.e., the wage rate,  $w$ , multiplied by the time worked,  $L$ ) and the non-labor income,  $NLY$ . Tax paid is the product of the taxable income and the tax rate,  $t$ . Here we assume the average tax rate to be parametrically fixed.<sup>3</sup> But one could specify a variable tax rate of the form  $t = f(wL + NLY)$ . We further assume that non-labor income is taxed at the same rate as labor income. Thus the budget constraint is:

$$(1 - t)(wL + NLY) = pX_1 \quad (3)$$

<sup>2</sup>The Stone-Geary specification of the utility function was preferred because it permits the parameterization of amounts of "committed leisure and consumption" of an individual. It is somewhat more flexible than some other utility functions (like Cobb-Douglas).

<sup>3</sup>This is a simplifying assumption. In fact, income taxes are progressive and this would lead to a non-linear constraint defining the trade off between consumption and leisure. See Deaton and Muellbauer [3] on this point.

The time and budget constraints may be combined into

$$(1 - t)(wT + NLY) = (1 - t)wX_0 + pX_1 \quad (4)$$

In order to maximize (1) subject to (4) we set up the Lagrangian function

$$\mathcal{L}(X_0, X_1, \theta) = \alpha_0 \ln(X_0 - \Gamma_0) + \alpha_1 \ln(X_1 - \Gamma_1) + \theta[(1 - t)(wT + NLY) - (1 - t)wX_0 - pX_1] \quad (5)$$

where  $\theta$  is the Lagrangian multiplier. The first order conditions for a maximum are:

$$\alpha_0 / (X_0 - \Gamma_0) - \theta(1 - t)w = 0; \quad (6)$$

$$\alpha_1 / (X_1 - \Gamma_1) - \theta p = 0 \quad (7)$$

From the above,

$$\alpha_0 = \theta[(1 - t)w(X_0 - \Gamma_0)]; \quad (8)$$

$$\alpha_1 = \theta p(X_1 - \Gamma_1) \quad (9)$$

Further, because of the normalizing condition and also because of (4):

$$\alpha_0 + \alpha_1 = 1 = \theta[(1 - t)(wT + NLY) - (1 - t)w\Gamma_0 - p\Gamma_1] \quad (10)$$

Thus

$$\theta = 1 / [(1 - t)(wT + NLY) - (1 - t)w\Gamma_0 - p\Gamma_1] \quad (11)$$

The Lagrangian multiplier may, therefore, be interpreted as the reciprocal of the discretionary after-tax full income.

We may combine (11) with (6) and (7) to derive the demand functions for leisure and consumption respectively as

$$X_0 = \Gamma_0 + [\alpha_0 / (1 - t)w] [(1 - t)(wT + NLY) - (1 - t)w\Gamma_0 - p\Gamma_1]; \quad (12)$$

$$X_1 = \Gamma_1 + (\alpha_1 / p) [(1 - t)(wT + NLY) - (1 - t)w\Gamma_0 - p\Gamma_1] \quad (13)$$

Further, the optimal amount of labor supply can be expressed as

$$L = T - X_0 = T - \alpha_1 \Gamma_0 - [\alpha_0 / (1 - t)w] [(1 - t)(wT + NLY) - p\Gamma_1] \quad (14)$$

Comparative static analysis shows that labor supply increases with  $w$  so long as after-tax  $NLY$  exceeds the committed expenditure level. Also, ceteris paribus, an increase in  $NLY$  causes a decline in labor supply. Finally, labor supply increases with the tax rate.

## III. Utility Maximization Including Charity

Economists have regarded charitable behavior as motivated by self-interest, or altruism or by both. Individuals may be charitable in order to obtain political office, to maintain a prestigious position in the community, to avoid social pressure, or even merely to meet the implicit condition of employment.<sup>4</sup> Individuals may also contribute out of pure altruism; they really care about others and feel good from the act of contribution.<sup>5</sup> Empirically it has remained an unresolved problem to ascertain to what extent which motive for charity is consistent with observed behavior. Nonetheless, we can accommodate alternative motives for charity by postulating that individuals act charitably in order to attain "something(s) they cherish", like good feeling, the perceived reward in heaven, and so on. This "something

<sup>4</sup>Various selfish motives for giving are summarized in Ireland [5].

<sup>5</sup>In some ultimate sense, there is no pure altruism. The altruist receives "psychic benefits" ("good feeling") from giving and engages in philanthropy because such satisfaction increases his own welfare.

cherishable" constitutes an argument in their utility function, and is denoted by  $Z$ . Hence the individual's utility function is expanded as

$$U = \alpha_0 \ln(X_0 - \Gamma_0) + \alpha_1 \ln(X_1 - \Gamma_1) + \alpha_2 \ln(Z - \Gamma_2); \quad \alpha_0 + \alpha_1 + \alpha_2 = 1 \quad (15)$$

Here  $\Gamma_2$  is the committed demand for  $Z$  and could possibly be zero if the individual could do without it.

By construction,  $Z$  is essentially a household production commodity a la Becker. For practical purposes  $Z$  will thereafter be treated as (without any need to be restricted to) community status. In order to maintain or improve community status, an individual could either contribute time by serving in charities, or donate cash and property, or do both. Thus voluntary work ( $V$ ) and charitable contributions or gifts ( $G$ ) serve as inputs in the production of community status ( $Z$ ).

The underlying production technology for  $Z$  is specified by the Generalized Leontief (dual) cost function:<sup>6</sup>

$$C \equiv pG + wV = Z[b_{11}p + 2b_{12}(pw)^{1/2} + b_{22}w] \quad (16)$$

Here  $p$  and  $w$  are the prices of gift donations and voluntary work time respectively.  $b_{11}$ ,  $b_{12}$ , and  $b_{22}$  are technological parameters. It is apparent from (16) that

$$C_Z = b_{11}p + 2b_{12}(pw)^{1/2} + b_{22}w = C/Z \quad (17)$$

so that the average cost of producing  $Z$  also equals marginal cost. We can also write the cost function as:

$$C = pG + wV = ZC_Z \quad (18)$$

Inclusion of voluntary work in the model requires that the individual's time constraint be reformulated as:

$$T = L + X_0 + V \quad (19)$$

By assumption the monetary value of amount of gifts ( $pG$ ) would be tax deductible. Hence, the individual's after-tax income is

$$(wL + NLY) - t(wL + NLY - pG),$$

and the budget constraint is revised as:

$$(1-t)(wL + NLY) = pX_1 + (1-t)pG \quad (20)$$

As before, the time and budget constraints may be combined to yield

$$(1-t)(wT + NLY) = (1-t)wX_0 + pX_1 + (1-t)ZC_Z \quad (21)$$

In order to maximize (15) subject to (21) we set up the Lagrangian function

$$\begin{aligned} \mathcal{L}(X_0, X_1, Z, \theta) = & \alpha_0 \ln(X_0 - \Gamma_0) + \alpha_1 \ln(X_1 - \Gamma_1) + \alpha_2 \ln(Z - \Gamma_2) \\ & + \theta[(1-t)(wT + NLY) - (1-t)wX_0 - pX_1 - (1-t)ZC_Z] \end{aligned}$$

and the resulting first order conditions are:

$$\alpha_0/(X_0 - \Gamma_0) - \theta(1-t)w = 0; \quad (22)$$

$$\alpha_1/(X_1 - \Gamma_1) - \theta p = 0; \quad (23)$$

$$\alpha_2/(Z - \Gamma_2) - \theta(1-t)C_Z = 0 \quad (24)$$

<sup>6</sup>In using the dual cost function to specify the household production technology we followed the lead of Phillips [7]. The Generalized Leontief cost function was chosen because of its flexibility.

Again, the normalizing condition may be utilized as

$$\begin{aligned} 1 = \alpha_0 + \alpha_1 + \alpha_2 = & \theta[(1-t)w(X_0 - \Gamma_0) + p(X_1 - \Gamma_1) + (Z - \Gamma_2)(1-t)C_Z] \\ = & \theta[(1-t)(wT + NLY) - (1-t)w\Gamma_0 - p\Gamma_1 - (1-t)\Gamma_2C_Z] \text{ due to (21)} \end{aligned} \quad (25)$$

Therefore,

$$\theta = 1/[(1-t)(wT + NLY) - (1-t)w\Gamma_0 - p\Gamma_1 - (1-t)\Gamma_2C_Z] \quad (26)$$

So, as in the previous section, the Lagrangian multiplier  $\theta$  equals the reciprocal of the individual's after-tax discretionary full income. The system of demand equations may be derived using (26) along with the first order conditions (22)-(24). Thus the demand for leisure is

$$X_0 = \Gamma_0 + \{\alpha_0/[(1-t)w]\}[(1-t)(wT + NLY) - (1-t)w\Gamma_0 - p\Gamma_1 - (1-t)\Gamma_2C_Z] \quad (27)$$

The demand for the composite consumption good is

$$X_1 = \Gamma_1 + [\alpha_1/p][(1-t)(wT + NLY) - (1-t)w\Gamma_0 - p\Gamma_1 - (1-t)\Gamma_2C_Z] \quad (28)$$

Finally, the demand for the commodity which motivates charity is

$$Z = \Gamma_2 + \{\alpha_2/[(1-t)C_Z]\}[(1-t)(wT + NLY) - (1-t)w\Gamma_0 - p\Gamma_1 - (1-t)\Gamma_2C_Z] \quad (29)$$

The expenditure on  $Z$  (e.g., community status) is

$$C = ZC_Z = C_Z\Gamma_2 + [\alpha_2/(1-t)][(1-t)(wT + NLY) - (1-t)w\Gamma_0 - p\Gamma_1 - (1-t)\Gamma_2C_Z],$$

which because of (17) leads to

$$C = \alpha_2(wT + NLY) - \alpha_2w\Gamma_0 - \alpha_2p\Gamma_1/(1-t) + (1-\alpha_2)\Gamma_2[b_{11}p + 2b_{12}(pw)^{1/2} + b_{22}w] \quad (30)$$

Applying Shephard's lemma from neoclassical duality theory, the derived demands for inputs into the household production process of  $Z$  can be obtained by taking partial derivatives of the cost function with respect to the two input prices  $p$  and  $w$  respectively. Hence the demand for charitable giving is

$$G = C_p = -\alpha_2\Gamma_1/(1-t) + (1-\alpha_2)\Gamma_2[b_{11} + b_{12}(w/p)^{1/2}] \quad (31)$$

The optimal amount of voluntary work is

$$V = C_w = \alpha_2(t - \Gamma_0) + (1-\alpha_2)\Gamma_2[b_{12}(p/w)^{1/2} + b_{22}] \quad (32)$$

Finally, the individual's labor supply can be obtained by

$$\begin{aligned} L = T - X_0 - V = & \alpha_1(T - \Gamma_0 - b_{22}\Gamma_2) - \{\alpha_0/[(1-t)w]\}[(1-t)NLY \\ & - p\Gamma_1 - (1-t)pb_{11}\Gamma_2] + b_{12}\Gamma_2(\alpha_0 - \alpha_1)(p/w)^{1/2} \end{aligned} \quad (33)$$

We now perform the comparative static analysis for this extended model incorporating charities. First, labor supply response to changes in the wage rate becomes ambiguous:

$$L_w = \{\alpha_0/[(1-t)w^2]\}[(1-t)NLY - p\Gamma_1 - (1-t)pb_{11}\Gamma_2] + \frac{1}{2}(\alpha_1 - \alpha_0)b_{12}\Gamma_2(p/w)^{3/2} \quad (34)$$

Now  $L_w > 0$  only if  $(1-t)NLY > p\Gamma_1 + (1-t)pb_{11}\Gamma_2$  and  $\alpha_1 > \alpha_0$ . We can broadly say that this would be the situation when after-tax non-labor income exceeds the individual's committed expenditure on goods and  $\alpha_1 > \alpha_0$ . Typically the first of these conditions will hold, but there is no prior reason to expect  $\alpha_1 > \alpha_0$  and labor supply response to the wage rate remains inconclusive.

In respect of the impact of tax rate changes on labor supply, the same conclusions would be carried over from the previous section, namely that labor supply would increase with an increase in the tax rate, because

$$L_t = \alpha_0 p \Gamma_1 / [(1-t)^2 w] > 0 \quad (35)$$

This demonstrates that under the prevailing tax system in which charitable contributions are tax exempt, the impact of changes in the tax rate on labor supply is much more complex than what is contended by the supply-side economists. A tax increase will alter an individual's take-home wage, after-tax non-labor income, and also the real costs of consuming leisure and of charitable contributions. The final outcome of the complicated income and substitution effects which are generated is an increase in labor supply.

Pure income effect is consistent with prior expectation that labor supply will decline as non-labor income increases:

$$L_{NLY} = -\alpha_0 / w < 0 \quad (36)$$

We focus our attention on the responses of charitable giving to changes in various independent variables.

$$G_w = \frac{1}{2}(1 - \alpha_2)b_{12}(pw)^{-1/2} \quad (37)$$

Thus  $G_w > 0$  if  $b_{12} > 0$ . In that event an increase in the wage rate would induce further charitable giving. It may be noted that  $b_{12}$  would be positive when the elasticity of substitution between  $G$  and  $V$  is positive, i.e., the time input and good input are substitutes in the production of  $Z$ .<sup>7</sup> A wage increase causes the opportunity cost of voluntary work to rise. Given the substitutability of  $G$  and  $V$ , the individual would be induced to adopt a less time-intensive and more good-intensive mode of household production for  $Z$ . This is the substitution effect of relative input price change. Further, an increase in  $w$  relaxes the individual's budget constraint somewhat and this income effect would cause an increase in the demand for  $Z$ . As a result the demand for  $G$  (and also for  $V$ ) would be further stimulated.

Further,

$$V_w = -\frac{1}{2}(1 - \alpha_2)\Gamma_2 b_{12}(p/w)^{3/2} \quad (38)$$

Thus  $V_w < 0$  when  $b_{12} > 0$ . When time and gift are substitutable inputs in the production of  $Z$  (which will be the case for  $b_{12} > 0$ ), the individual will reduce the time devoted to voluntary work when the wage rate increases. The results obtained in (38) and (37) are symmetric.

An interesting finding is that

$$G_t = -\alpha_2 \Gamma_1 / (1-t)^2 < 0 \quad (39)$$

This implies that an increase in the tax rate would discourage charitable contributions. On the surface, this result is rather strange. Since the effective cost of one dollar's giving to charities is one minus the tax rate, a rise in the tax rate is equivalent to a decline in the "price" of charitable gifts and one would naturally expect gifts to increase rather than decline when the tax rate increases. But note that apart from this price effect, there would also be an income effect of this change in the tax rate. The after-tax full income would fall when the tax rate increases. Assuming that  $Z$  is a normal good, the individual's demand for  $Z$  will decline. Such adverse "output effect" in the household production process of  $Z$  will result in a decline in the demand for gifts. The net effect is a decline implying that the output effect overwhelms the price effect.

<sup>7</sup>Uzawa [8] has shown that the Allen partial elasticity of substitution between inputs  $i$  and  $j$  is  $\sigma_{ij} = [C / (C_{P_i} C_{P_j})] C_{P_i P_j}$ , where  $P_i$  and  $P_j$  are the respective input prices. In the context of the Generalized Leontief cost function,  $\sigma_{ij} = [C / (X_i X_j)] q [b_{ij} / (P_i P_j)^{1/2}]$ . When  $b_{ij} > 0$ ,  $\sigma_{ij} > 0$  and inputs  $X_i$  and  $X_j$  are substitutes.

Finally,

$$V_t = 0 \quad (40)$$

The optimal amount of voluntary work is independent of the tax rate. This result is really surprising and after considerable speculation [4], we decided to leave it as an unresolved puzzle.

#### IV. Summary and Conclusions

This paper presents a theoretical model where an individual's decisions relating to charitable giving, voluntary work, labor supply, and consumption are derived from maximizing a Stone-Geary utility function subject to time and budget constraints along with the household production technology for "community status".

The comparative static analysis does not yield unambiguous results regarding the individual's labor supply response to changes in the wage rate. Nonetheless, the results clearly indicated that following a wage increase, the individual will reduce voluntary work time and increase donations of cash and property, provided that the individual perceives contribution of time and money as substitutes in the production process of generating "community status" ( $Z$ ). This may have some profound implications for charitable organizations in recruiting helping personnel and soliciting contributions. Furthermore, in contrast to the view held by supply-side economists, it is shown here that a tax cut would not encourage increased labor supply.

Many public organizations funded by charitable contributions anticipate substantial loss of revenue if such contributions are no longer tax exempt. However, the new tax laws also provide for a generally lower average tax rate. The resulting income effect should considerably soften such adverse impact on their revenues.

Overall, this paper demonstrate that individual's decisions on labor supply, consumption, voluntary work and charitable giving are interdependent. Assessment of the impact of changes in tax policies should take recognition of such joint decision-making by individuals.

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