J Popul Econ (2012) 25:1481–1502
DOI 10.1007/s00148-011-0374-8

ORIGINAL PAPER

Strategic transfers, redistributive fiscal policies, and family bonds: a micro-economic analysis

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Received: 30 September 2010 / Accepted: 18 February 2011 /
Published online: 17 May 2011

Abstract This paper presents a micro-economic model to analyze intergenerational exchange in which the utility maximizing decisions of "selfish" children on family services, labor market activities, and leisure are determined endogenously. We show that altruistic parents' financial transfers have a disincentive effect on the labor supply of their children and that the children's equilibrium income is positively correlated with parental income. Based on the theoretical model, we find that redistributing US$1 from children to their parents increases parental transfers by less than US$1, implying that intergenerational public transfers are Ricardian non-neutral. However, the non-neutral redistributive transfers may enhance intergenerational family bonds because the equilibrium levels of services rendered by children to their parents increase.

Keywords Altruistic transfers · Redistributive transfers · Family bonds

JEL Classification D1 · H31 · D31

1 Introduction

Family as a micro-economic unit is arguably the oldest institution for humans, and studies on the motives and determinants of private transfers within the

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family have interesting implications for the efficacy of government's intergenerational income redistributions. In their pioneering studies, Becker (1974) and Barro (1974) stress the importance of parental altruism in determining the intra-family allocation of resources. The pure altruism models of the family predict that redistributing US$1 from a recipient child to donor parents results in a one-dollar increase in the parents' transfer to the child. Private transfers thus undo redistributive public transfers from children to their parents and there are no real effects. This is the well-known Ricardian neutrality.

In their seminal work on the strategic bequest motive, Bernheim et al. (1985) further consider children-provided merit goods (companionship, attention, or care) and identify two problems typically ignored in modeling family transfers with purely altruistic motives. The first problem concerns *credibility*. Bernheim et al. contend that parents with a single recipient child cannot "credibly threaten universal disinheritance" and that "as long as there are two credible beneficiaries, it is possible for parents to devise a simple, intuitively appealing bequest rule that overcomes the problems of credibility" (p. 1046). The second problem concerns *enforceability*. The authors argue that models of transfers based on pure altruism generally assume that "unwritten agreements between family members are perfectly enforceable" (p. 1047). To deal with these two problems, Bernheim et al. (1985) adopt a cooperative principal–agent methodology and develop a model of strategic altruism in which parents use financial transfers as "payments" to influence children's provision of family-specific merit goods. The authors show that the Ricardian neutrality theory of Barro (1974) does not hold.

In this paper, we use a non-cooperative game to characterize altruistic parents' optimal decision on transfers and their adult children's optimal decisions on family services. Throughout the analysis, we consider financial transfers as rents and children as "rent seekers" within the family (Buchanan 1983).[1] Following the rent-seeking and contest literatures (e.g., Tullock 1980; Skaperdas 1996; Konrad 2007), we assume that altruistic parents employ a transfer-seeking game among their children for the purpose of distributing financial wealth. In the first stage of a three-stage game, the parents implement a sharing rule to distribute a transfer (i.e., "prize") according to the amounts of service times their children devote to them. In the second stage of the game, the children compete for financial transfers by determining their service times, labor market activities, and leisure. In the third and last stage of the game, the parents allocate their transfers among the children according to the rule. Parents thus have the "last word" in their wealth distribution (Hirshleifer 1977). Given that the non-cooperative equilibrium is derived under the condition that each player's choice is a "best response" to the choice of other players, the subgame perfect Nash equilibrium is *self-enforcing* in nature. This methodology

[1] Buchanan (1983) is the first in applying the notion of rent seeking within the family to characterize the behavior of sibling competition for parental transfers.

may provide an alternative way of resolving the credibility and enforceability problems in intergenerational transfers within the family.[2]

The endogeneity of the children's optimal time-allocation decisions on family services, labor market participations, and leisure permits us to examine the following two issues.[3] The first issue is how altruistic parents' transfers affect their children's allocations of time between providing services within the family and working outside the family. Would parental transfers have a disincentive effect on the labor supply of children? We show the presence of this disincentive effect under the condition that altruistic and exchange motives are strategically operative. This theoretical finding is consistent with several empirical studies (e.g., Holtz-Eakin et al. 1993; Joulfaian and Wilhelm 1994), that have documented a negative effect of parents' wealth transfers on labor supply.

The second issue, which is of policy importance from a micro-economic perspective, is how redistributive public transfers from children to their parents affect intergenerational relationships or family bonds. By family bonds, we mean the amounts of service times (or care) that parents receive from their children. We wish to go beyond the mere redistribution of income between generations to analyze the following question: What are implications of intergenerationally redistributive fiscal policies for non-pecuniary interactions between parents and their children within the family? Answers to this question may help explain whether public policies such as tax-financed welfare or pension programs enhance or erode family relationships across generations. In their contribution, Künemund and Rein (1999) present a review of empirical studies concerning the relationship between public welfare programs and family solidarity. The authors document that elderly parents received more children-provided services in certain countries with a relatively strong welfare state, as compared to parents in some other countries with a relatively weak welfare state. Künemund and Rein (1999) call for developing a theoretical framework capable of showing how redistributive public transfers affect family bonds. The present paper is an attempt in this direction.

The key findings of the analysis are presented as follows. First, parental transfers have a disincentive effect on the labor supply of children. Second, there is an endogenously determined transmission of family resources between adjacent generations in that children's post-transfer income is positively correlated with their parents' pre-transfer income. This suggests that, *ceteris paribus*, income inequality of parents across families directly affects income inequality of their respective children. Third, both lump-sum income taxes on children and bequest/transfer taxes negatively affect the labor supply and wage earnings of the children, as well as the aggregate consumption of the family.

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[2] See also the study by Chang and Weisman (2005).

[3] Becker (1988, p.11) remarks that "Family behavior is active, not passive, and endogenous, not exogenous.… A heightened awareness of the interaction between economic change and family choices will hasten the incorporation of family life into the mainstream of economics."

Forth, redistributing US$1 from children to their altruistic parents increases parental transfers but by less than US$1. This suggests that private transfers do not undo redistributive public transfers, a contradiction to the Ricardian neutrality proposition. Interestingly, such intergenerationally redistributed fiscal transfers may actually enhance family bonds because the equilibrium amounts of service times that children provide to their parents increase.

It should be mentioned at the outset that the present paper differs from those of Chang and Weisman (2005) and Chang (2009) in two important aspects. First, these two studies adopt the assumption that children maximize income in the allocation of time between family services and labor market activities, without allowing for the consumption of leisure. The present paper considers the more general case in which children maximize utility in allocating their time not only to family services and labor market activities but also to leisure. Second, policy implications for public transfers across two generations differ. The income-maximization models in the above two studies imply that private family transfers will perfectly offset redistributive fiscal transfers between two generations. We show in the utility-maximization model that intergenerationally redistributive fiscal transfers do not result in correspondingly equal and offsetting private transfers.[4]

It should also be noted that in the two-generation model of transfers and exchange, the parents are assumed to be "norm setters" in choosing a division rule and orchestrating a rent-seeking game among their children for allocating financial resources within the family. Also, the "egoistic" children are assumed to have discretion in making their own utility-maximizing decisions between family services and labor market participations, depending upon financial incentives provided by their parents. From these perspectives, the game-theoretic analysis of intra-family transfers and exchange complements the recent contributions by Cigno (2006a, b). Cigno (2006a) is the first to show that intergenerational transfers are fundamentally linked to certain types of political equilibrium such as a self-enforcing family constitution or representative democracies. In analyzing the possibility of mutually beneficial cooperation across generations, Cigno (2006b) further characterizes the roles of norms and institutions that enhance intra-family transfers and intergenerational bonds.[5]

The remainder of the paper is organized as follows. In Section 2, we develop a three-stage Nash game framework to characterize the equilibrium outcome of strategic interactions between parents and children. In Section 3, we present policy implications based on the theoretical model of family interaction across the two generations. We first examine issues concerning the validity of the Ricardian neutrality theory within the analytical framework and then analyze

[4]The result of non-neutrality in public transfers can also be found in Bernheim et al. (1985), Feldstein (1988), Kotlikoff et al. (1990), Altonji et al. (1977).

[5]With respect to possible elements that determine intergenerational transfers within the family, Cigno et al. (2006) rejects the hypotheses of altruistic and exchange motives. The authors further show that such intra-family transfers may be generated by self-enforcing family rules or norms.

issues concerning how redistributive public transfers affect intergenerational family relationships. Section 4 contains concluding remarks.

2 A three-stage Nash Game of strategic altruism and transfers

Consider a family in which altruistic parents are prepared to transfer $B(>0)$ dollars of wealth to their $n(\geq 2)$ "selfish" children.[6] The parents, however, do not make their transfers to the children unconditionally. Rather, the parents divide the "prize" B according to a sharing rule.[7] Under the rule, the transferred amount to a child depends on the proportion of time the child expends in rendering services (or care). Denoting S_i as the amount of service time that child $i(i = 1, ..., n)$ devotes to his parents, the child's share of the prize is specified as

$$P_i(S_1, ..., S_n) = \frac{S_i}{S_i + S_{-i}}, \tag{1}$$

where $S_{-i} = \sum_{k}^{n} S_k$ for $k = 1,...,n$ and $k \neq i$.[8] This sharing rule implies that child i's share of the prize depends positively on his time of services, S_i, and negatively on the service times of other siblings, S_{-i}. Note that the marginal effect of S_i on P_i, $P_i^{'} \equiv \partial P_i/\partial S_i = S_{-i}\big/(S_i + S_{-i})^2$, is positive but is subject to diminishing returns. The amount of money that child i expects to receive is

$$B_i = \left(\frac{S_i}{S_i + S_{-i}}\right) B. \tag{2}$$

The use of a transfer rule by parents serves dual objectives. One is to induce family-specific merit goods such as care from children to parents.[9] The other

[6]Becker (1993, p. 398) remarks that "most parents believe that the best example of selfish beneficiaries and altruistic benefactors is selfish children with altruistic parents."

[7]Menchik and David (1983) and Bernheim (1991) use the Longitudinal Retirement Household Survey data and show empirically that financial wealth transfers or bequests are intrinsically intentional. Kohli and Künemund (2003) further indicate that "accidental" transfers or bequests are "not really motives per se in terms of purposeful action."

[8]The additive form of the sharing rule in Eq. 1 has been widely employed to examine various issues such as those on rent-seeking and lobbying, tournaments and labor contracts, political conflict, war and peace, and sibling rivalry. See, e.g., Tullock (1980), Lazear and Rosen (1981), Hirshleifer (1989), Chang and Weisman (2005), and Garfinkel and Skaperdas (2007). Konrad (2007) presents a systematic review of applications in economics and other fields that use sharing rules similar to Eq. 1.

[9]Although the variable S_i is defined as service time, it can be considered as a family-specific merit good that parents desire. That is, S_i may be variously interpreted as frequency of parental visits, the level of care or attentions that children supply to their parents, etc. Pollak (1988) introduces the notion of "tied transfers" in that parental transfers are tied to a child's consumption of particular goods or services that the parents value. As in Becker (1974), Bernheim et al. (1985), Cox (1987), Pollak (1988), Chami (1998), and Stark (1998), we consider family transfers and ignore human capital investment of children. The aim of our analysis is to characterize the behavior of adult children and their interactions with siblings and parents.

is to work as a mechanism for parents in distributing family resources among their children. We will show that the simple transfer rule specified in Eq. 1 is financially attractive to the children. That is, the incentive participation constraint is satisfied.

In what follows we employ a three-stage Nash game to characterize the endogeneity of parental-children interactions. These interactions are captured by children's decisions on time allocation (family services, labor market activities, and leisure) and their parents' decisions on transfers. The timing of the game is as follows. In the first stage, the parents commit to distribute B dollars of wealth among their children according to the rule in Eq. 1. In the second stage, the children compete for financial transfers by simultaneously and independently choosing the amounts of service times that maximize their objective functions. The parents do not allocate financial wealth until after they have received services from their children.

As with a standard rent-seeking game, we assume that information is common knowledge to all parties. Also from game theory, we use backward induction to solve for the sub-game perfect equilibrium in the three-stage game. Consistent with backward induction, we first solve for the Nash equilibrium allocations of time by the children. We then solve for the optimal bequeathed amount (the prize) committed by the parents.

2.1 Children's optimal decisions on time allocation

We analyze the optimizing behavior of the children in allocating their time. Let K be the total time endowment of each child in a given period. Denoting Z_i as leisure time that child i consumes, the child's expected income is

$$Y_i = (K - Z_i - S_i)w_i + B_i - T_i = L_i w_i + B_i - T_i, \tag{3}$$

where $L_i (= K - Z_i - S_i)$ is the amount of time allocated to work outside the family, w_i is the competitive wage rate he commands in the labor market, and $T_i (\geq 0)$ is a lump-sum income tax. This specification allows for the interaction between two sources of income: personal wage income earned from labor market activities, $L_i w_i$, and the expected transfer from the parents, B_i. The inclusion of the exogenous variable T_i permits us to investigate how a lump-sum income tax affects the children's decisions on work, leisure, and family services.

To determine each child's optimal allocation of time, we employ the traditional income-leisure choice framework in which child i's utility (U^i) is defined over income (Y_i) and leisure (Z_i): $U^i = U^i(Y_i, Z_i)$. The utility function is strictly quasi-concave such that its corresponding indifference curves are strictly convex in income and leisure.[10] Specifically, we assume that the

[10] In the income-maximization model of Chang and Weisman (2005) and Chang (2007, 2009), children are assumed to be risk neutral in allocating their time between providing services to their parents and working outside the family. The utility-maximization model developed in this paper further allows for children's optimal demands for leisure.

preferences of each child take a Cobb–Douglas form, $U^i = Y_i Z_i$, which implies that the marginal rate of substitution of leisure for income is $MRS_{Z_i Y_i}(\equiv -dY_i/dZ_i = \frac{\partial U^i/\partial Z_i}{\partial U^i/\partial Y_i}) = Y_i/Z_i$. Substituting Eqs. 1–3 into the utility function yields

$$U^i = \left[(K - Z_i - S_i)w_i + \frac{S_i}{S_i + S_{-i}}B - T_i\right] Z_i. \tag{4}$$

Given the total amount of financial wealth committed by the parents, the children in the second stage of the game independently and simultaneously choose their leisure and service allocations, $\{Z_i, S_i\}$, to maximize their individual utilities in Eq. 4.[11] The first-order conditions (FOCs) for child i are:

$$\frac{\partial U^i}{\partial S_i} = \left[\frac{S_{-i}}{(S_i + S_{-i})^2}B - w_i\right] Z_i = 0; \tag{5}$$

$$\frac{\partial U^i}{\partial Z_i} = \left[(K - Z_i - S_i)\, w_i + \left(\frac{S_i}{S_i + S_{-i}}\right) B - T_i\right] - Z_i w_i = 0. \tag{6}$$

Equation 5 indicates that the child's service time is optimally chosen when the expected marginal benefit of expending one more unit of service time equals its marginal cost (in terms of wage forgone), i.e., $P_i'(S_1, ..., S_n)B = w_i$. Equation 6 indicates that child i's leisure time is optimally chosen when his marginal rate of substitution of leisure for income, $MRS_{Z_i Y_i} = Y_i/Z_i$, equals his opportunity cost of leisure (which is wage forgone). For expositional simplicity, we assume that the children as rent seekers are homogeneous. This implies a symmetric Nash equilibrium so that $q_i = q_j = q$, where $q = \{w, S, Z, L, T\}$ for $i, j = 1,...,n$, and $i \neq j$. Under the assumption of symmetry, we have from the FOCs in Eqs. 5 and 6 the following:

$$\frac{(n-1)\, S}{(nS)^2}B = w; \tag{7}$$

$$(K - Z - S)\, w + \frac{B}{n} - T = Zw. \tag{8}$$

Solving for the equilibrium service time and leisure yields

$$S = \frac{(n-1)\, B}{n^2 w}; \tag{9}$$

$$Z = \frac{(Kw - T)n^2 + B}{2n^2 w}. \tag{10}$$

[11] Once the equilibrium leisure and service allocations, $\{Z_i, S_i\}$ are determined, the equilibrium amount of time allocated to work outside the family is given by $L_i = (K - Z_i - S_i)$.

The equilibrium amount of time that a child allocates to work outside the family, which defines his supply of labor to the job market, is calculated as follows:

$$L = K - Z - S = \frac{(Kw + T)n^2 - (2n-1)B}{2n^2 w}. \tag{11}$$

Note that the strict quasi-concavity of each child's utility function implies that the second-order sufficient condition is satisfied and that the interior solution is unique.

It is easy to verify the following comparative-static derivatives:

$$\frac{\partial S}{\partial B} = \frac{(n-1)}{n^2 w} > 0; \quad \frac{\partial Z}{\partial B} = \frac{1}{2n^2 w} > 0; \text{ and } \frac{\partial L}{\partial B} = -\frac{(2n-1)}{2n^2 w} < 0. \tag{12}$$

An increase in the total amount of transfers increases service time and leisure but decreases labor supply, *ceteris paribus*. Financial transfers thus have an incentive effect on children-provided merit goods, on the one hand, and a disincentive effect on the labor supply of children, on the other.

To see the participation incentives of the children in rendering services to their parents, we substitute S, Z, and L (Eqs. 9–11) into the income and utility equations in Eqs. 3 and 4 to obtain

$$Y = \frac{(Kw - T)n^2 + B}{2n^2}; \tag{13a}$$

$$U = YZ = \frac{[(Kw - T)n^2 + B]^2}{4n^4 w}. \tag{13b}$$

It is straightforward to show that the post-transfer income and utility (when $B > 0$) are, respectively, greater than the pre-transfer income and utility (when $B = 0$). Further, an increase the bequeathed amount increases both the post-transfer income and utility. That is, $\partial Y/\partial B > 0$ and $\partial U/\partial B > 0$.

2.2 Parents' optimal decision on the total amount of financial transfers

Next, we determine the optimal size of an overall transfer committed by the parents in the first stage of the game. Parental altruism implies that the children's utility functions enter into those of their parents' (Becker 1974, 1981). Specifically, we assume that the parents collectively have the following altruistic function:

$$V = \left(y_p - B - \tau B\right)\left(\sum_{i=1}^{n} S_i\right) + \alpha_p\left(\sum_{i=i}^{n} U_i\right), \tag{14}$$

where y_p is their pre-transfer income, $\tau(0 < \tau < 1)$ is a flat tax on the transfer, and $\alpha_p(0 < \alpha_p < 1)$ is the altruism coefficient attached to the children's utility functions (see Eq. 13b).[12] The first term in Eq. 14 is the parents' own utility v of a Cobb–Douglas form ($v = c_p\tilde{S}$), which is defined over their own consumption, $c_p(\equiv y_p - B - \tau B)$, and the total amount of service times they receive from the children, $\tilde{S} \equiv (\sum_{i=1}^{n} S_i)$.[13] The second term in Eq. 14 indicates the Beckerian assumption that the parents are equally altruistic toward their children.

The objective of the parents is to choose an overall transfer, B, that maximizes the altruistic function in Eq. 14, subject to the constraint that their consumption is positive, i.e., $(y_p - B - \tau B) > 0$. The Lagrangian function for the constrained optimization problem is

$$\Lambda = \left(y_p - B - \tau B\right)\left(\sum_{i=1}^{n} S_i\right) + \alpha_p\left(\sum_{i=i}^{n} U_i\right) + \lambda\left(y_p - B - \tau B\right).$$

Under the assumption of symmetry, the Kuhn-Tucker conditions for the parents are:

$$\frac{\partial\Lambda}{\partial B} = -\frac{(1+\tau)B(n-1)}{nw} + \frac{[y_p - (1+\tau)B](n-1)}{nw} + \frac{\alpha_p[(Kw-T)n^2 + B]}{2n^3w}$$
$$-\lambda(1+\tau) \leq 0;\ \frac{\partial\Lambda}{\partial B} < 0 \text{ if } B = 0;$$
$$\frac{\partial\Lambda}{\partial\lambda} = (y_p - B - \tau B) \geq 0;\ \frac{\partial\Lambda}{\partial\lambda} > 0 \text{ if } \lambda = 0;$$

For the level of consumption to be positive, we have $C_p = (y_p - B - \tau B) > 0$, which implies that $\lambda = 0$. Using this condition that $\lambda = 0$ and the equation that $\frac{\partial\Lambda}{\partial B} = 0$, we solve for the optimal size of an overall transfer:

$$B^* = \frac{n^2\left[2\left(n-1\right)y_p + \alpha_p\left(Kw - T\right)\right]}{4\left(1+\tau\right)\left(n-1\right)n^2 - \alpha_p}, \tag{15}$$

which is unambiguously positive.[14]

[12] An additively separable utility function has been widely adopted to analyze various issues such as the "rise and fall of families" (Becker and Tomes 1979, 1986), the economic analysis of fertility (Becker and Barro 1988), the biological origin of altruism (Mulligan 1997), residential choice of family members (Konrad et al. 2002), and sibling rivalry and parental transfers (Chang and Weisman 2005; Chang 2007, 2009).

[13] The specification in Eq. 14 assumes that there is a Hicksian composite good whose price is normalized to one.

[14] The SOC for an interior solution is satisfied since $\partial^2\Lambda/\partial B^2 = -[4(1+\tau)(n-1)n^2 - \alpha_p]/(2n^3w) < 0$.

According to B^* in Eq. 15, we have the following comparative-static derivatives:

$$\frac{\partial B^*}{\partial \alpha_p} = \frac{2(n-1)n^2[y_p + 2n^2(1+\tau)(Kw-T)]}{[4(1+\tau)(n-1)n^2 - \alpha_p]^2} > 0; \tag{16a}$$

$$\frac{\partial B^*}{\partial y_p} = \frac{2(n-1)n^2}{4(1+\tau)(n-1)n^2 - \alpha_p} > 0; \tag{16b}$$

$$\frac{\partial B^*}{\partial w} = \frac{\alpha_p n^2 K}{4(1+\tau)(n-1)n^2 - \alpha_p} > 0; \tag{16c}$$

$$\frac{\partial B^*}{\partial T} = -\frac{\alpha_p n^2}{4(1+\tau)(n-1)n^2 - \alpha_p} < 0; \tag{16d}$$

$$\frac{\partial B^*}{\partial \tau} = -\frac{4[2(n-1)y_p + \alpha_p(Kw-T)](n-1)n^4}{[4(1+\tau)(n-1)n^2 - \alpha_p]^2} < 0. \tag{16e}$$

The findings of the analysis permit us to establish the following proposition:

Proposition 1 *In a three-stage noncooperative Nash game where altruistic parents set a transfer-sharing rule according to the proportion of service time that a child devotes to them and where children independently make their time allocation decisions between family services, labor supply, and leisure, we have the following:*

1. *More altruistic parents transfer more resources to their children than do less altruistic parents.*
2. *Higher-income parents transfer more financial resources to their children than do lower-income parents.*
3. *An increase in a child's market wage rate increases his opportunity cost of rendering services to his parents, causing the parents to increase their optimal transfer.*
4. *An increase in a lump-sum income tax on each child lowers the parents' optimal transfer. This decrease in bequeathed amount is due to the fact that the tax has a negative effect on the equilibrium service time rendered by each child to the parents.*

Note that in the analysis of the transfer-seeking game, parents do not choose the actions of their "selfish" children. The children are able to determine their time-allocation decisions independently. Moreover, the three-stage noncooperative game has the property of *self-enforcement* because each individual pursues behavior that maximizes self-interest. The division rule set by the parents and the transfer-seeking contest that they orchestrate may be interpreted as "a family constitution," which explicitly governs the distribution of parental wealth among children. Under these circumstances, our analysis complements the contributions by Cigno (2006a, b) who examines intra-family transfers from the standpoint of self-enforcing family constitutions. In another contribution that analyzes the behavior of a family with three generations, Cigno (1993) looks at issues on intergenerational transfers by assuming total selfishness of individuals. Although the model in the present paper involves two consecutive generations, it can be used to discuss the case of selfishness by assuming that the altruism coefficient is zero, i.e., $\alpha_p = 0$. It follows immediately from Eq. 15 that the overall size of parental transfer reduces to

$$\tilde{B} = \frac{y_p}{2(1+\tau)},$$

which is strictly positive. Given that $\tilde{B} > 0$, we have from the income and utility equations (see Eqs. 13a and 13b) of the children that their incentive participation constraints for the transfer-seeking contest are satisfied. Thus, intergenerational financial transfers and service exchange can also be generated without the assumption of altruism (Cigno 1993). In our analysis, family transfers and exchange are due to the rent-seeking game and the rule of division set by the parents. It is easy to verify that

$$B^* > \tilde{B} > 0,$$

which implies that the overall transfer is higher with altruism than without altruism.[15]

2.3 The endogeneity of intergenerational income transmission

Utilizing the two-generation model of strategic altruism, we wish to analyze the correlation between the children's equilibrium post-transfer income and their parents' pre-transfer income. This issue is concerned with the transfer of family resources from one generation to the next. Is there an endogenously determined downward transmission of wealth from parents to their children? To answer the question, we substitute the optimal transfer from Eq. 15 into Eq. 13a and solve for the equilibrium post-transfer income (denoted as Y_k^*) of each child as follows:

$$Y_k^* = \frac{(n-1)[y_p + 2(1+\tau)(Kw - T)n^2]}{4(1+\tau)(n-1)n^2 - \alpha_p}. \tag{17}$$

Taking the derivative of Y_k^* in Eq. 17 with respect to y_p yields

$$\frac{\partial Y_k^*}{\partial y_p} = \frac{(n-1)}{4(1+\tau)(n-1)n^2 - \alpha_p} > 0,$$

[15] In the subsequent analysis, it will be shown that the qualitative findings continue to hold whether we make the assumption of altruism or selfishness. I thank the editor for drawing my attention to the notion of family constitution that may implicitly govern intergenerational transfers with or without altruism.

which indicates that the children's endogenous income is positively correlated with their parents' pre-transfer income. Alternatively, we use the income equation in Eq. 13a and the optimal transfer in Eq. 15 to obtain the same result:

$$\frac{\partial Y_k^*}{\partial y_p} = \left(\frac{\partial Y_k^*}{\partial B}\right)\bigg|_{B=B^*} \cdot \left(\frac{\partial B^*}{\partial y_p}\right) = \left(\frac{1}{2n^2}\right)\left(\frac{2(n-1)n^2}{4(1+\tau)(n-1)n^2 - \alpha_p}\right)$$
$$= \frac{(n-1)}{4(1+\tau)(n-1)n^2 - \alpha_p} > 0.$$

We thus have

Proposition 2 *Consider two altruistically linked generations in which parents use financial transfers as incentives to induce their children to render services and the children are independent decision makers in allocating their time between family services, leisure, and work in the labor market. Other things being equal, there is a mechanism of intergenerational income transmission under which the children's equilibrium post-transfer income and their parents' pre-transfer income are positively correlated.*

Proposition 2 indicates that, *ceteris paribus*, income inequality across parents of different families is likely to be preserved as income inequality among the next generation. The endogeneity of labor supply permits us to show a positive relationship in income of family members between generations. This finding may help explain the evidence of several empirical studies on the intergenerational transmission of income or income equality (e.g., Tomes 1981; Behrman and Taubman 1990; Solon 1992).

3 Policy implications of the theoretical model

Based on the analytical framework, we now discuss policy implications for an economy where (1) altruistically motivated transfers are operative and (2) children's labor market decisions are endogenous functions of the transfers. The first issue is how parents' transfers and their children's income would change in response to public policies that redistribute income between the two generations. This concerns the validity of the Ricardian neutrality proposition in an economy where parental transfers may be affected by public transfers. The second issue concerns how redistributive public transfers from children to parents affect their relationships in terms of the children-provided service times. This concerns whether intergenerationally redistributive fiscal policies (e.g., taxed-financed transfer policies or pension programs) would enhance or erode the children's responsibilities of caring for their parents.

3.1 Will Ricardian neutrality hold?

Barro (1974) popularizes the notion of Ricardian neutrality. The seminal work of Becker (1974) is further connected to Barro's model of intergenerational altruism and fiscal policies (Barro 1996, p. 2). Both authors emphasize altruism as the motive in determining parental transfer. Accordingly, redistributive fiscal transfers from children to their parents are shown to be totally inefficient because the altruistic parents will adjust their transfers back to the children *dollar-for-dollar* in reaction to public transfers. Intergenerational public transfers are thus completely neutralized by private transfers and there are no real effects.[16]

The question we wish to examine is: by imposing a lump-sum income tax of US$1 on children and transferring the taxed dollar to their parents, will the parents make an equivalent amount of a transfer to the children? Note that redistributive public transfers from children to parents can be treated as an exogenous increase the parents' income, y_p. This component of the public transfer effect on parental transfers is measured by the so-called transfer-income derivative.[17] This derivative, based on the optimal transfer B^* in Eq. 15, is given as

$$\frac{\partial B^*}{\partial y_p} = \frac{2(n-1)n^2}{4(1+\tau)(n-1)n^2 - \alpha_p} > 0. \tag{18}$$

Other things being equal, a one-dollar public transfer to the parents increases their financial ability of increasing the optimal bequeathed amount according to Eq. 18.

Next, we calculate the other component of the public transfer effect on parental transfers. A lump-sum tax that lowers income of children by US$1 leads the parents to change their bequeathed amount which is measured by the derivative ∂B*/∂T. This "transfer-tax derivative," based on B^* in Eq. 15, is

$$\frac{\partial B^*}{\partial T} = -\frac{\alpha_p n^2}{4(1+\tau)(n-1)n^2 - \alpha_p} < 0. \tag{19}$$

Other things being equal, a lump-sum income tax on children negatively affects their parents' bequeathed amount according to Eq. 19. This negative effect results from the fact that the tax lowers the equilibrium service times $\partial S^*/\partial T$ which, in turn, lower the optimal amount of the overall transfer (see Proposition 1).

[16] Several contributions (e.g., Bernheim et al. 1985; Feldstein 1988; Kotlikoff et al. 1990; Altonji et al. 1977) cast doubt on the general applicability of Ricardian neutrality. See also discussions in Laferrère and Wolff (2006).

[17] This term is borrowed from Altonji et al. (1977).

Taking into account both the transfer-tax and transfer-income derivatives as shown in Eqs. 18 and 19, we have

$$0 < \frac{\partial B^*}{\partial T} + \frac{\partial B^*}{\partial y_p} = \frac{2(n-1)n^2 - n^2\alpha_p}{4(1+\tau)(n-1)n^2 - \alpha_p} < 1. \tag{20}$$

Thus, in response to redistributive fiscal transfers from children to parents, the parents increase their transfers but not dollar-for-dollar. This shows that public transfers do not completely crowd out private transfers. We therefore have

Proposition 3 *For an economy in which altruistically motivated transfers are operative and children's labor market decisions are endogenous functions of financial transfers, redistributing US\$1 from the children to their parents lead the parents increase their transfers but by less than US\$1.*

The findings in Proposition 3 indicate that redistributive public transfers between two adjacent generations are not completely neutralized by private transfers. In the utility-maximizing model with endogenous labor supply and leisure, Ricardian neutrality breakdowns when children's labor supply and earnings are responsive to parental transfers, as well as public transfers. This result complements the studies by Bernheim et al. (1985), Feldstein (1988), Kotlikoff et al. (1990), and Altonji et al. (1977). However, the non-neutrality outcome contrasts with the purely altruistic models of family transfers developed by Barro (1974) and Becker (1974, 1981). The policy implications of our analysis also run contrary to the income-maximization models of Chang and Weisman (2005) and Chang (2009).

Given that government's intergenerational income redistributions are Ricardian non-neutral as shown in Eq. 20, how would the policies affect (i) the children's labor supply and (ii) the family's aggregate income or consumption? To examine the effect on labor supply, we make use of Eqs. 11 and 15 and derive the following:

$$\frac{\partial L^*}{\partial T} = \left(\frac{\partial L^*}{\partial B}\right)\bigg|_{B=B^*} \cdot \left(\frac{\partial B^*}{\partial T}\right) = \frac{2(n-1)y_p}{2w[4(1+\tau)(n-1)n^2 - \alpha_p]} > 0; \tag{21}$$

$$\frac{\partial L^*}{\partial y_p} = \left(\frac{\partial L^*}{\partial B}\right)\bigg|_{B=B^*} \cdot \left(\frac{\partial B^*}{\partial y_p}\right) = -\frac{(n-1)(2n-1)}{2w[4(1+\tau)(n-1)n^2 - \alpha_p]} < 0; \tag{22}$$

$$\frac{\partial L^*}{\partial T} + \frac{\partial L^*}{\partial y_p} = -\frac{(2n-1)[(n-1) - \alpha_p]}{2w[4(1+\tau)(n-1)n^2 - \alpha_p]} < 0. \tag{23}$$

Equation 21 indicates that imposing a lump-sum income tax on the children by US\$1 has a positive effect on their labor supply. Equation 22 indicates that transferring the dollar to the parents has a negative effect on the children's labor supply. Equation 23 shows that the total effect of redistributive public transfers on labor supply is unambiguously negative.

Next, we examine what effects redistributive public transfers have on the family's aggregate income or consumption. Substituting B^* from Eq. 15 into c_p, we calculate the parents' equilibrium level of consumption,

$$c_p^* = y_p - (1+\tau)B^* = y_p - \frac{(1+\tau)n^2[2(n-1)y_p + \alpha_p(Kw - T)]}{4(1+\tau)(n-1)n^2 - \alpha_p}.$$

An increase in a public transfer to the parents by US\$1 increases their consumption by less than US\$1 since

$$0 < \frac{\partial c_p^*}{\partial y_p} = \frac{2(1+\tau)(n-1)n^2 - \alpha_p}{4(1+\tau)(n-1)n^2 - \alpha_p} < 1. \tag{24}$$

That is, the parents' marginal propensity to consume is less than one. In the meanwhile, imposing a lump-sump tax on the children by US\$1 lowers their consumption since

$$\frac{\partial Y_k^*}{\partial T} = -\frac{-2(1+\tau)(n-1)n^2}{4(1+\tau)(n-1)n^2 - \alpha_p} < 0. \tag{25}$$

Combining these two effects as shown in Eqs. 24 and 25 yields

$$\frac{\partial Y_k^*}{\partial T} + \frac{\partial c_p^*}{\partial y_p} = -\frac{\alpha_p}{4(1+\tau)(n-1)n^2 - \alpha_p} < 0,$$

which indicates that redistributive public transfers negatively affect aggregate family income or consumption. We thus have

Proposition 4 *Increasing lump-sum income taxes on children by US\$1 and giving the dollar to their parents has a negative effect on the children's labor supply and wage earnings. The redistributive public transfers increase the consumption of the parents, but decrease the consumption of their children. The total effect on aggregate family income or consumption is unambiguously negative.*

The implications of Proposition 4 are interesting. Government's intergenerational income redistributions have a counter-productive effect on families. On one hand, lump-sum income taxes on children increase their labor supply due to an income effect. On the other hand, tax-financed public transfers from children to their parents increase family transfers which, in turn, negatively affect the children's labor supply due to a disincentive effect. The total effect is negative, causing the children's labor market participations to decline and their wage earnings to fall. Note that the "equilibrium price" of child service—measured by compensation for each unit of service time—exceeds the market wage rate. That is,

$$\frac{B^*}{S^*} = \left(\frac{n^2}{n-1}\right) w > w.$$

Parents who value children-provided services have to offer an incentive sufficiently high enough to outweigh their children's opportunity cost of time (as measured by the market wage). This explains why in equilibrium children's labor supply (L^*) and wage earnings (wL^*) decrease.

The counter-productive effect of redistributive fiscal transfers on family income is not the overwhelming reason to militate against government actions, however. Going beyond the mere reallocation of income between generations, the issue of interest is how such public transfers affect intergenerational family relationships.

3.2 Will redistributive public transfers erode family bonds?

Bernheim et al. (1985) and Cox (1987) are among the first to introduce children-provided merit goods into the family economics literature on bequests or inter vivos transfers. This makes it possible to examine parental–children relationships and issues related to family solidarity. It is of policy importance to analyze possible effects that government's intergenerational income redistributions have on family relationships across generations. Would public welfare provisions reduce the willingness of children to render services to their parents? Would tax-financed pension programs affect family bonds, especially in terms of parental-children contact and companionship? These issues concern whether redistributive public transfers "crowd out" family obligations to the elderly parents, thereby eroding intergenerational family bonds. Interestingly, there are competing views on these important social–economic issues.

It has been a conventional wisdom that tax-financed public transfers to the elderly generates a deterioration of family bonds, because adult children paying the taxes have less incentives to provide services or care to their elderly parents. The argument is dated back to the early 1960s in the sociological literature that modernization in Western societies results in a decay of parent–child relationships and a shift in responsibility from the family to the state (e.g., Burgess 1960). Sociologists emphasize the aspects of norms, obligations, and reciprocity in analyzing the effect of public welfare programs on the relationship between children and their aging parents.

In their contribution, Künemund and Rein (1999) investigate data from five developed countries (the USA, Canada, Germany, Japan, and the UK) and examine whether more generous welfare systems displace family bonds across generations and "crowd out" services given by children to their elderly parents. The authors find that the giving of resources by the elderly to their adult children increases the likelihood that they receive services from them. Künemund and Rein (1999) find no evidence to support the crowding-out hypothesis. Their study further demonstrates that the rate of elderly parents receiving services from their children was greater in countries with a relatively strong welfare state, such as Germany. By contrast, countries with a relatively weak welfare state, such as the USA, showed a weak pattern of family bonds.

It seems that models of intergenerational transfers and public policy need to address the following two questions. Do pension programs for the elderly keep family members apart, as claimed by the conventional wisdom, or do such programs foster intergenerational contact, which is an implication of the Künemund and Rein study? By ignoring children's merit goods, it appears that the literature on family economics provides scant guidance.[18] The model developed in this paper provides a potentially interesting attempt to resolve the competing questions.

As redistributive public transfers are shown to be Ricardian non-neutral, we wish to examine how the transfers affect the equilibrium services that children render to their parents. Based on the present model of parental–children interactions, we substitute B^* from Eq. 15 into Eq. 9 to obtain the reduced-form solution for each child's service time:

$$S^* = \frac{(n-1)[2(n-1)y_p + \alpha_p(Kw - T)]}{w[4(1+\tau)(n-1)n^2 - \alpha_p]}. \tag{26}$$

An increase in a public transfer to the parents by US\$1 causes each child to increase service times since

$$\frac{\partial S^*}{\partial y_p} = \frac{2(n-1)^2}{w[4(1+\tau)(n-1)n^2 - \alpha_p]} > 0. \tag{27}$$

An increase in a lump-sump income tax on each child by US\$1 causes him to lower service time since

$$\frac{\partial S^*}{\partial T} = -\frac{(n-1)\alpha_p}{w[4(1+\tau)(n-1)n^2 - \alpha_p]} < 0. \tag{28}$$

Taking into account these two effects in Eqs. 27 and 28, we have

$$\frac{\partial S^*}{\partial T} + \frac{\partial S^*}{\partial y_p} = \frac{(n-1)[2(n-1) - \alpha_p]}{w[4(1+\tau)(n-1)n^2 - \alpha_p]} > 0.$$

Thus, tax-financed redistributive transfers from children to their parents have a positive effect on the children's equilibrium service times.

An alternative approach is presented as follows. We denote the equilibrium service time in Eq. 26 as $S^* = S^*(B^*(y_p, T))$, where $(\frac{\partial S^*}{\partial B})|_{B=B^*} = \frac{(n-1)}{n^2 w} > 0$. The marginal effect of a lump-sum income tax on S^* is negative since

$$\frac{\partial S^*}{\partial T} = \left(\frac{\partial S^*}{\partial B}\right)\bigg|_{B=B^*} \cdot \frac{\partial B^*}{\partial T} < 0, \tag{29}$$

[18] Becker (1993, p. 398) contends that a public policy involving an income redistribution between two generations may not affect the well-being of a family member. Bernheim et al. (1985) indicate that the neutrality effect does not hold for families with children-provided merit goods such as companionship or care. Note that in the purely altruistic transfer models of Becker (1974, 1981), children "have no decision-making authority and hence their preferences are assumed to have no bearing on economic outcomes" (Bergstrom and Bergstrom 1999, p. 47).

whereas that of a redistributive public transfer on S^* is positive since

$$\frac{\partial S^*}{\partial y_p} = \left(\frac{\partial S^*}{\partial B}\right)\bigg|_{B=B^*} \cdot \frac{\partial B^*}{\partial y_p} > 0. \tag{30}$$

It follows directly from Eqs. 29 and 30 that

$$\frac{\partial S^*}{\partial T} + \frac{\partial S^*}{\partial y_p} = \left(\frac{\partial S^*}{\partial B}\right)\bigg|_{B=B^*} \cdot \left(\frac{\partial B^*}{\partial T} + \frac{\partial B^*}{\partial y_p}\right) > 0,$$

where the term $(\frac{\partial B^*}{\partial T} + \frac{\partial B^*}{\partial y_p})$ is negative due to the Ricardian non-neutrality of redistributive fiscal transfers as shown in Eq. 20. The results of the analyses lead to

Proposition 5 *For an economy in which altruistic parents strategically use financial resources to influence the time allocation decisions of their children, redistributive public transfers from children to their parents positively affect the provision of children-supplied merit goods.*

The implications of Proposition 5 are straightforward. Family bonds may improve in an economy where altruism is strategically operative and children's provisions of family-specific merit goods are responsive to parental transfers. The underlying reason is that redistributive public transfers from children to their parents increase the parents' financial ability to induce services from their children, other things being equal. Our simple model may provide a theoretical underpinning for the supporting empirical evidence of Künemund and Rein (1999). They document that the rate of elderly parents receiving services from their children was greater in countries with a relatively strong welfare state than in countries with a relatively weak welfare state. The authors remark that this finding holds true despite the fact that pension programs are primarily designed to help the elderly, with little or no intention to establish efficient relationships within families.

Not surprisingly, the increased parental-children contact comes with a cost which, according to the model, is measured by a reduction in family income and consumption. Thus, redistributive public transfers involve a tradeoff. An economy could achieve higher levels of income and consumption (i.e., "market values") and ignore intergenerational family relationships without implementing policies that redistributive income across generations. Alternatively, implementing such policies could enhance the financial ability of parents to motivate their children for more services (i.e., "family values"), despite that the policies negatively affect the children's labor supply and the entire family's income and consumption. Interestingly, public policies, aimed to redistribute money income between generations, turn out to have a non-monetary impact on family bonds. We find conditions under which family bonds may actually be strengthened by intergenerational income redistribution policies.

4 Concluding remarks

This paper presents a simple micro-economic model of strategic altruism and transfers in which the utility-maximizing decisions of egoistic children on time allocations to family services, labor market activities, and leisure are endogenous. We incorporate a tournament-type transfer rule, which is widely used in the rent-seeking literature, into the analysis of wealth distribution in a family. Instead of adopting a principal–agent methodology where the principle chooses actions to be followed by the agent, we employ a non-cooperative Nash game approach to parental–children interactions in which the children are treated as independent decision-makers. The use of both the transfer rule and the three-stage game permit us to deal with the creditability and enforceability problems (Bernheim et al. 1985).[19] Our model may provide a theoretical underpinning to support the empirical findings that there is a disincentive effect of transfers on the labor supply of children. Interestingly, strategic transfers imply that children's equilibrium income and their parents' income are positively correlated. This suggests that, other things being equal, income inequality across families in one generation is likely to be preserved as income inequality among the next generation.

The analysis with the paper indicates that parents make transfers to children but are not dollar-for-dollar equivalent to redistributive public transfers from the children to their parents. In the utility maximization model with endogenous services, labor supply, and leisure, we show that Ricardian equivalence breaks down because children's labor supply and labor earnings are responsive to both family and public transfers. Based on the theoretical model, we find that government's intergenerational income redistributions have a negative effect on income and consumption of the family. Nevertheless, such redistributive income transfers may improve family relationships when generations are linked by altruistically and strategically motivated transfers. Becker (1974, 1981) contends that parental altruism shields family members from being affected by government's intergenerational income redistribution policies. Specifically, Becker (1993) indicates that "exogenous redistributions of resources from an altruist to her beneficiaries (or vice versa) may not affect the welfare of anyone because the altruist would try to reduce her gifts by the amount redistributed" (p. 398). Our theoretical findings lend a strong support to the empirical results of Künemund and Rein (1999), that family bonds may be strengthened by intergenerationally redistributive fiscal policies or welfare provisions.

[19] Bergstrom (1989) is among the first to propose the use of a two-stage noncooperative Nash game to examine parent-child interactions within the family. Manski (2000) points out that the use of noncooperative game theory as a set of tools for the study of market and non-market interactions in microeconomics may be the "defining event of the late twentieth century" (p. 116). Manski further contends that the use of game theory has transformed labor economics from "a field narrowly concerned with work for pay into one broadly concerned with the production and distributional decisions of families and households" (p. 116).

Limitations of the present paper and hence potentially interesting extensions of the model should be mentioned. Given that this paper is theoretical in nature, policy implications of the model should be taken as suggestive. Several assumptions have been made in deriving the reduced-form solutions for the model for analytical simplicity. These include the preference functions of a Cobb–Douglas form, the homogeneity of children, and the assumption of flat taxation. The simple assumptions of the model may be relaxed for future research. The paper ignores the dynamic aspects of family interactions over time. It would be interesting to understand the relationships between government's intergenerational income redistributions and their effects on the well-being of family members across generations. Intergenerational exchange and interactions are of vital importance to family bonds, and families are important units in a social network of support. Second, the paper ignores the fact that families are changing in terms of fertility, marital behavior and labor market participations of family members, aging population, and rules of inheritance. A more thorough theoretical analysis of tax-financed welfare programs to the elderly and the resulting impacts on intergenerational family bonds should embrace these elements. The simple model of transfers and parental-children interactions may be extended to allow for these important elements associated with the family.

Acknowledgements I thank Alessandro Cigno, the Editor, and two anonymous referees for valuable comments and suggestions. I also thank Isaac Ehrlich, Zijun Luo, and Shane Sanders for helpful comments on an earlier version of this paper. The usual caveat applies.

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