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RESEARCH ARTICLE

Yang-Ming Chang

Transfers and bequests: a portfolio analysis in a Nash game

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Abstract This paper develops a two-stage non-cooperative Nash game framework of parental–children interactions to explain the *equal division puzzle* in bequests. In the analysis, a portfolio approach is adopted for characterizing how altruistic parents allocate their inheritable wealth between *inter-vivos* transfers and *post-mortem* bequests. The model includes elements of strategic altruism, exchange of family-specific merit goods, transfer-seeking behavior by competing siblings, and parents' "post-mortem reputation" in bequest division. Allowing for children's heterogeneity and interactions, we find that inter-vivos transfers are unevenly distributed between the children, despite an equal degree of parental altruism. Moreover, we show the compatibility of unequal inter-vivos transfers and equal bequests, regardless of earnings differentials across children.

Keywords *Inter-vivos* transfers · *Post-mortem* bequests · Sibling rivalry · Merit goods · Portfolio analysis

JEL Classification Numbers D10 · D31 · D64

1 Introduction

Issues on *inter-vivos* transfers and *post-mortem* bequests within the family have long been of interest to economists. Among the major theories of private intergenerational transfers are altruism and exchange. The altruism models contend that the transfer motives behind bequests and inter-vivos gifts are fundamentally not much different. The works of Becker (1974, 1981), Becker and Tomes (1979), and Tomes (1981) stress the important role that altruism plays in intra-family resource

Y.-M. Chang
Department of Economics, Kansas State University, 319 Waters Hall,
Manhattan, KS 66506-4001, USA
E-mail: ymchang@ksu.edu

distribution, and predict that parental transfers will be negatively correlated with a recipient child's earnings. The exchange models of Bernheim et al. (1985) and Cox (1987) contend that parents-to-children transfers are tied strategically to the children's consumption of particular goods or services that the parents value. In other words, parental transfers are "payments" for services rendered by children (Kotlikoff and Morris 1989). The exchange models predict that transfer amounts and recipient earnings may be positively related (e.g., Cox and Rank 1992).[1]

In contrast to inter-vivos transfers, equal division of bequests has been observed as a dominant rule of wealth transfers for families in some modern societies. For example, Menchik (1980, 1988) documents that in Connecticut (1930–1945) and in Cleveland, Ohio (1964, 1965), equal division of large estates was a prevailing practice. Wilhelm (1996) finds that in the United States (1982), more than two-thirds of families divided their estates exactly equally among their children, and more than four-fifths of families divided their estates approximately equally. Laitner (1997) contends that social norms play an important role in explaining why parents often split bequests equally among children. These observations pose a challenge to the altruism and exchange models of the family concerning the motives and determinants of wealth transfers across generations.

Why do many parents give unequal inter-vivos transfers to their children yet divide their bequests equally among children? This pattern of private intergenerational transfers constitutes a long-standing puzzle in the literature. Although parent–child conflicts and sibling rivalry have been widely recognized as imperative factors in influencing the intergenerational behavior,[2] relatively little theoretical research has formally model conflicts and sibling interactions within the family. Theoretical models of intergenerational transfers frequently consider families with a single child and hence do not allow for possible interactions between siblings. Though some models consider families with multiple children, they either treat all children as homogeneous in preferences and earning abilities, or rule out active interactions between heterogeneous siblings.[3]

Allowing for children's heterogeneity and interactions, this paper sets up a Nash game to explain why unequal inter-vivos transfers and equal bequests may constitute an optimal mix for parents in allocating inheritable wealth to their children, and why the choice is not inconsistent with altruistic and exchange motives. The elements of the model include strategic altruism, exchange, transfer-seeking behavior by siblings, and their parents' "post-mortem reputation" or "inner-feelings" in bequest division. An important feature of the analysis is that inter-vivos transfers and post-mortem bequests may exhibit different roles in affecting an endogenous relationship between parents and their children.

[1] There is a positive relationship between the child's earnings and the transferred amount in exchange models when the parents' price elasticity of the demand for the services of the child is low.

[2] On the first page of his seminal book, *A Treatise on the Family*, Becker (1981) remarks that "Conflict between the generations has become more open, and parents are now less confident that they can guide the behavior of their children." In his interesting book, *Envy: A Theory of Social Behavior*, Schoeck (1987) considers sibling rivalry as a frequently observed behavior of envy within the family.

[3] Laferrere and Wolff (2006) present an excellent literature review of micro-models of intergenerational transfers.

Parents can make inter-vivos gifts during their lifetime. They can also make transfers post-mortem in the form of bequests by establishing their wills. Thus there are two possible modes of transfers: (1) "compensated" gifts during life and (2) "noncompensated" gifts after death. In the analysis, we propose a portfolio approach to altruistic parents' inheritable wealth distribution problem, in which inter-vivos transfers and post-mortem bequests are treated differently. Specifically, we assume that parents make inter-vivos transfers (i.e., gifts during life) as pecuniary incentives strategically to induce their children to supply them with non-substitutable, family-specific "merit goods" such as companionship and attention while they are still alive (Bernheim et al. 1985; Cox 1987; Bergstrom 1989; Chami 1998). In distributing bequests post-mortem (i.e., gifts after death), parents may care about their own inner-feelings in that they do not want children to have the perception that they are treated asymmetrically (Stark 1998; Lundholm and Ohlsson 2000; Bernheim and Severinov 2003). That is, there may involve "utility costs" of post-mortem reputation on the part of the parents if they divide bequests unevenly. Besides, hard feelings and stranded relationships between siblings are likely to occur when bequests are not divided equally. We attempt to characterize explicitly the endogeneity of an optimal portfolio choice that may include all lifetime gifts as well as gifts after death. We further link the choice to a systematic set of variables. These variables include the earnings of children, children's provision of services or parental care, two-sided altruism (parents' altruism toward their children and children's altruism toward their parents), and the amount of wealth that parents prepare to transfer to their heirs.

The analysis of inheritable wealth distribution is closely related to recent contributions to the literature concerning the *equal division puzzle* in bequests. Stark (1998) introduces the notion of relative deprivation cost associated with unequal bequests, Lundholm and Ohlsson (2000) develop an asymmetric information model, and Bernheim and Severinov (2003) develop a signaling model, all of which attempt to provide a rationale for explaining why parents split their bequests among their children equally. The analysis of the present paper departs from these studies in some important aspects. First, we characterize not only *inter*-generational interactions between parents and children, but also *intra*-generational interactions between the children. As such, the model allows for transfer-seeking activities by competing siblings and has implications for rent-seeking behavior within the family, an interesting issue originally discussed by Buchanan (1983).[4] Second, we stress differences between gifts during life and gifts after death in affecting an endogenous parental–children relationship in terms of the supply of family merit goods (e.g., children's caregiving to their parents). Besides showing how altruistic parents allocate their inheritable wealth between inter-vivos transfers and post-mortem bequests, we link the portfolio problem of the parents to two-sided altruism and children's earnings. Third, we show that unequal inter-vivos transfers and equal bequests are endogenously coexistent in a two-stage non-cooperative Nash game. Despite these points of departure, our heterogeneous-sibling model complements those of Stark (1998), Lundholm and Ohlsson (2000), and Bernheim

[4] I thank James Buchanan who, in a personal correspondence, links the sibling rivalry model of Chang and Weisman (2005) to his classic 1983 paper on noncompensated transfers and rules of succession, viewed from the perspective of rent seeking.

and Severinov (2003) in that all the studies investigate the equal bequest puzzle via alternative approaches.

We show conditions under which inter-vivos transfers are compensatory. This finding is consistent with the altruism models of Becker (1974, 1981) and Becker and Tomes (1979), despite the fact that the models do not allow for merit goods, sibling rivalry, and parental–children interactions. For the case where there is two-sided altruism, we find that inter-vivos transfers may be positively related to a recipient child's income. The positive transfer–income relationship is consistent with the exchange models of Bernheim et al. (1985) and Cox (1987), despite the fact that the models do not explicitly consider interactions between siblings. Thus strategic inter-vivos transfers may be either compensatory or counter-compensatory, which suggests that a dichotomy between altruism-motivated transfers and exchange-motivated transfers appears to be unwarranted.

We further present a theoretical underpinning to explain why unequal inter-vivos transfers and equal bequests are inherently consistent to each other. In the transfer-seeking game we consider, the ratios of unequal inter-vivos transfers to children divided by the (unequal) time spent rendering services to their parents are shown to be *identical* in equilibrium, despite earnings differentials across the children. Because of the unique "equilibrium price" for services when making inter-vivos transfers, coupled with the choice of equal bequests, the parents are indeed non-discriminating or equally altruistic toward their children. This finding has an implication for empirical studies on private intergenerational transfers and parental–children relationships. Information on transfer amounts and recipient children's earnings alone is insufficient to make references concerning whether or not "parents play favorites," without examining additional information on such variables as the children's supply of merit goods to their parents.

The remainder of the paper is structured as follows. Section 2 sets up a portfolio framework of inheritable wealth that has the components of inter-vivos gifts and post-mortem bequests. In this section, we adopt a contest approach to characterizing sibling rivalry for inter-vivos gifts in a two-stage Nash game. We further discuss the endogeneity of parental–children interactions in terms of the parents' choice of wealth distribution and the children's supply of merit goods. Section 3 summarizes and concludes.

2 A portfolio analysis of inheritable wealth in a Nash game

2.1 Inheritable wealth distribution and a game of sibling rivalry

We consider a family in which two children compete for financial transfers from their parents. The parents have W_{p} dollars worth of wealth to distribute to their children. The parents, however, do not make their financial transfers unconditionally. Rather, the parents wish to make a utility-maximizing choice by dividing the total inheritable wealth $W_{\mathrm{p}}(> 0)$ into two components.

The first component of the portfolio is "compensated gifts during life" or so-called inter-vivos transfers (i.e., transfers between living members of the family). The word "compensated" means that the parents expect to receive direct compensation such as attention, visits, or care in return from their children when making such a financial transfer. Specifically, the parents allocate T dollars worth of wealth

to inter-vivos transfers for the purpose of orchestrating a "transfer-seeking contest" between the two siblings. The parents set the rule of the contest whereby a sibling's inter-vivos transfer share depends on the proportion of time that each sibling expends in rendering services to their parents. The second component of the portfolio is "uncompensated gifts after death" or so-called post-mortem bequests. The parents bequeath the remaining portion of the inheritable wealth to their children in the form of bequests. Assume that child $i\,(i = 1, 2)$ receives $B_i\,(\geq 0)$ dollars of bequests. It remains to be determined whether or not the bequeathed amounts are positive and equal.

As in Stark (1998), Lundholm and Ohlsson (2000) and Bernheim and Severinov (2003), we focus on the division of inheritable wealth and abstract from the situations where the parents may consume some part of the wealth.[5] The parents' portfolio allocation of the transferable or bequeathable wealth thus satisfies the following condition: $W_{\mathrm{p}} = T + B_1 + B_2$ This implies that the total amount of financial resources available for *inter-vivos* transfers is $T = W_{\mathrm{p}} - B_1 - B_2$.

Given that parents are altruistic toward their children, the inheritable wealth W_{p} that the parents transfer to the two siblings may take many forms. The above simple specification permits us to concentrate the wealth division on two different forms: inter-vivos transfers and post-mortem bequests. This portfolio approach is, in essence, similar to that adopted by Faith and Tollison (2001). In analyzing rent-seeking implications of different institutional rules of private intergenerational transfers, Faith and Tollison assume that parents partition their inheritable wealth into inter-vivos gifts and bequests. Siblings may compete to engage in rent-seeking to move wealth from the "inter-vivos gifts pool" to the "bequest pool," or vice versa, depending on their relative shares in the two pools.

In the analysis, we follow Chang and Weisman (2005) and consider the scenario in which parents strategically orchestrate a "transfer-seeking contest." Specifically, let g_i denote the amount of service time that child i devotes to his parents. For child i, the inter-vivos transfer share, s_i, is assumed to be

$$s_i = \frac{g_i}{g_i + g_j}, \quad \text{where } i \neq j, i = 1, 2, \text{ and } j = 1, 2. \tag{1}$$

Equation (1) is a "contest success function" (CSF) similar to those widely used in the rent-seeking or conflict literature as a mechanism for distributing a contested object (e.g., Tullock 1980; Skaperdas 1996). The incorporation of a transfer-seeking contest into the analysis is consistent with the observations by Bernheim et al. (1985). In their pioneering work on strategic transfer motive, the authors contend that parents with a *single* beneficiary is constrained by "considerations of credibility" because they cannot "credibly threaten universal disinheritance" (p. 1046). Bernheim et al. further remark that as long as there are *two* children, it is possible for parents to devise an appealing sharing rule that "overcomes the problems of credibility." In the simple model of sibling rivalry we consider, the contest success functions appear to be an appealing choice. The contest serves as an incentive mechanism for inducing services from the children. Moreover, the contest works as an attractive rule or strategy for distributing a financial transfer between the

[5] Bergstrom (1996) presents an excellent review on the functioning of the family and explains, from the perspectives of economics and biology, why there is a downward transmission of resources from parents to their offspring.

siblings. We will show that both siblings do indeed have an economic incentive to participate in the contest.

According to equation (1), child i's inter-vivos transfer share of T, depends positively on his time of services, g_i, and negatively on the service time of the other child, g_j. It can easily be verified that the marginal effect of service time g_i on the inter-vivos transfer share s_i, $s_i^{'} \equiv \partial s_i/\partial g_i = g_j/\left(g_i + g_j\right)^2$, is positive but is subject to diminishing returns.

In what follows, we employ a two-stage non-cooperative Nash game to characterize the endogeneity of parental–children interactions in terms of children-supplied services and the parents' portfolio of transfers and bequests. The timing of the two-stage game is as follows. In the first stage, the parents set the rule of contest according to the contest success function as discussed above. The parents commit to allocate a total amount of T dollars to the inter-vivos transfer pool. Meanwhile, they distribute $B_i\,(\geq 0)$ dollars worth of wealth to child $i\,(i = 1, 2)$ in bequests. It is assumed that the parents credibly commit not to reverse their decision. In the second stage of the game, the children compete for parental wealth by simultaneously choosing the amounts of service times that maximize their objective functions. Wealth transfers or inter-vivos transfers will not be made until after children's services have been rendered, that is, until each child's inter-vivos transfer share is realized. This two-stage approach parallels the important idea that Hirshleifer (1977) stressed that parents have the "last word." [6]

As with a standard rent-seeking or conflict model in a non-cooperative Nash game, we assume that information is common knowledge to all parties. As also standard in game theory, we use backward induction to solve for the subgame perfect equilibrium in the sequential game. Consistent with backward induction, we first solve for the children's non-cooperative equilibrium choice of services, given the parents' rule of contest and their portfolio decision. We then solve for the portfolio allocation of W_{p} to $\{T, B_1, B_2\}$ that the parents commit and will in the first stage of the two-stage game. Given that the non-cooperative Nash equilibrium is derived under the condition that each player's choice is a "best response" to the choice of other players, the subgame perfect equilibrium is *self-enforcing* in nature.[7]

2.2 Children's decisions on the supply of merit goods

We begin with the analysis of children's decisions. As in Chang and Weisman (2005), we assume that each child is risk neutral in preferences and has L units of time available for providing services to the parents and for working outside of

[6] Hirshleifer (1977) argues the importance of parents' "last word" in decision-making to discipline "rotten" kids as discussed by Becker (1974). Bergstrom (1989) proposes the use of a two-stage non-cooperative Nash game to deal with the "Rotten Kids Theorem" of Becker.

[7] Alternative approaches include the use of a cooperative or bargaining game. Nevertheless, these two games generally require a well-defined mechanism for "contract" enforcement because there is no endogenously determined incentive mechanism to move to the cooperative or bargaining solution.

the family.[8] Let the two children's market wage rates be ω_1 and ω_2, respectively. Different earnings or earning capabilities of the children can be reflected by their unequal wage rates that they command in the labor markets. This assumption allows for sibling heterogeneity.

Given that the parents determine $\{T, B_1, B_2\}$, the children in the second stage of the game simultaneously choose their service allocations that maximize their individual expected incomes:

$$Y_1 = (L - g_1)\omega_1 + \alpha_1 g_1 + s_1(g_1, g_2)T + B_1 - \theta(B_2 - B_1); \quad (2a)$$

$$Y_2 = (L - g_2)\omega_2 + \alpha_2 g_2 + [1 - s_1(g_1, g_2)]T + B_2 - \theta(B_1 - B_2), \quad (2b)$$

where $T = W_p - B_1 - B_2$, the altruism coefficient, α_i, represents the monetary valuation that child i places on each unit of time spent with the parents, θ is a positive constant, and $\theta(B_j - B_i)$ reflects child i's monetary valuation of "hard feelings" when B_j is greater than B_i. The hard feelings are assumed to be getting worse when the difference in bequeathed amounts increases.[9] Note that if $\alpha_i > 0$, child i "enjoys" expending services to the parents. To ensure an interior solution ($g_i > 0$), we assume that $\omega_i > \alpha_i \geq 0$. The first-order conditions (FOCs) for child 1's and child 2's optimization problems are:

$$\frac{\partial Y_1}{\partial g_1} = \frac{g_2}{(g_1 + g_2)^2}(W_p - B_1 - B_2) - (\omega_1 - \alpha_1) = 0; \quad (3a)$$

$$\frac{\partial Y_2}{\partial g_2} = \frac{g_1}{(g_1 + g_2)^2}(W_p - B_1 - B_2) - (\omega_2 - \alpha_2) = 0. \quad (3b)$$

The FOCs indicate that each child's service time is optimally chosen so that the expected marginal benefit of expending one more unit of service time equals its marginal cost (in terms of wage income forgone) net of the altruistic coefficient. That is, $s_i'(g_1, g_2)T = \omega_i - \alpha_i$ for $i = 1, 2$.[10] The sufficient, second-order conditions for a maximum are satisfied as a result of the strict concavity of the contest success functions.

Using the FOCs in (3a) and (3b), we solve for the Nash equilibrium service times by the children as follows:

$$g_1 = \frac{(\omega_2 - \alpha_2)(W_p - B_1 - B_2)}{[(\omega_1 - \alpha_1) + (\omega_2 - \alpha_2)]^2}; \quad g_2 = \frac{(\omega_1 - \alpha_1)(W_p - B_1 - B_2)}{[(\omega_1 - \alpha_1) + (\omega_2 - \alpha_2)]^2}. \quad (4)$$

[8] This assumption is borrowed from Chang and Weisman (2005). The approach in this paper further extends the inter-vivos transfer model of Chang and Weisman to include post-mortem bequests as part of the portfolio.

[9] When $B_j > B_i$, other things being equal, child i is worse off and child j is better off in terms of bequests and changes in utilities associated with the unequally bequeathed amounts. This approach of "relative loss or gain" is analogous to Stark's (1998) notion of "relative deprivation" in children's utility resulting from unequal division of bequests.

[10] As indicated by an anonymous referee, the children have different "effective wages": $\omega_1 - \alpha_1 \neq \omega_2 - \alpha_2$, where ω_i is child i's monetary wage and α_i is how much the child likes his parents in monetary terms (i.e., is willing to provide service for fee). The different effective wages do not imply that the parents face a different price for the service of each child. Rather, they imply that the children's "opportunity costs of time" are different. Despite the different effective wages, the contest success functions imply that the parents offer an *identical* price for the service of each child. That is, $T_1 = [g_1/(g_1 + g_2)]T$ and $T_2 = [g_2/(g_1 + g_2)]T$ imply that $T_1/g_1 = T_2/g_2 = T/(g_1 + g_2)$, where T_i is the amount of inter-vivos transfer to child i. I am grateful to the referee for the insightful comments.

It is easy to verify that $\partial g_i/\partial B_i < 0$, which indicates that each child's service decreases with post-mortem bequests. Given that $T = W_p - B_1 - B_2$, it follows from (4) that $\partial g_i/\partial T > 0$. Thus the supply of service increases with the total amount of inter-vivos transfers.

Substituting g_1 and g_2 into the objective functions in (2a) and (2b) yields each child's after-transfer income:[11]

$$\tilde{Y}_1 = L\omega_1 + \frac{(\omega_2 - \alpha_2)^2(W_p - B_1 - B_2)}{[(\omega_1 - \alpha_1) + (\omega_2 - \alpha_2)]^2} + B_1 - \theta(B_2 - B_1); \tag{5a}$$

$$\tilde{Y}_2 = L\omega_2 + \frac{(\omega_1 - \alpha_1)^2(W_p - B_1 - B_2)}{[(\omega_1 - \alpha_1) + (\omega_2 - \alpha_2)]^2} + B_2 - \theta(B_1 - B_2). \tag{5b}$$

It should be noted that even for the case where post-mortem bequests are zero ($B_1 = B_2 = 0$), the after-transfer income is higher than income before transfer for each child, i.e., $\tilde{Y}_i > L\omega_i$, provided that the inheritable wealth W_p is positive. The siblings thus have a financial incentive to participate in the rent-seeking contest for inter-vivos transfers. This result suggests that transfer-seeking behavior is relevant within the family (Buchanan 1983; Faith and Tollison 2001).

The next step is to examine the conditions under which the optimal amounts of transfers and bequests are positive. Furthermore, we wish to investigate the important issue concerning whether equal division of bequests is a subgame perfect equilibrium solution to the two-stage Nash game, even among families for which children's earnings or earning capabilities are unequal.

2.3 Parents' optimal decision on the portfolio of gifts and bequests

Before we specify the objective function of the altruistic parents, it is necessary to discuss several interesting studies concerning parental altruism toward children and parents' motivation behind bequest division.

Stark (1998) proposes the concept of the relative deprivation cost in children's utility associated with non-equal bequests. He finds that the equal division of bequests and the altruistic bequest model are inherently compatible, rather than mutually exclusive. Lundholm and Ohlsson (2000) contend that bequests affect the reputation of altruistic parents after their death. Specifically, this reputation is assumed to be getting worse in the difference in amounts bequeathed.

Bernheim and Severinov (2003, p. 734) raise an interesting question that if parents simply feel that equal bequest division is necessary for achieving fairness, then the distribution of gifts should also be based on the same principle. The observations of equal bequests and unequal gifts thus give rise to the "equal division puzzle." To develop a rationale for resolving the puzzle, Bernheim and Severinov develop a model in which altruistic parents divide bequests by wanting their children to believe that they are loved equally. In their model, bequests serve as signs of parental affection to children in relation to their competing siblings. Moreover, the altruistic parents consider "the possibility that an unequal bequest may cause

[11] Detailed derivations of these and all other equations in the paper are available upon request from the author.

the children to infer that they are loved either more or less than their siblings." (Bernheim and Severinov 2003, p. 735)

In the analysis of inheritable wealth distribution, we assume that the altruistic parents enjoy services rendered by their children. Also, the parents care about the well-being of the children. We further assume that the parents consider their "inner feelings" in the division of bequests to their children. Unequal division of bequests may generate conflicts between siblings which hurt the feelings of the altruistic parents. Based on the aforementioned studies and the above assumptions, we postulate that the parents, in determining an optimal portfolio choice, have the following collective altruistic function:

$$U = \ln(g_1 + g_2) + \alpha_{\mathrm{p}}(\gamma \tilde{Y}_1) + \alpha_{\mathrm{p}}(\gamma \tilde{Y}_2) - \lambda(B_1 - B_2)^2, \tag{6}$$

where g_i is the amount of child i's services that the parents enjoy, α_{p} $(0 < \alpha_{\mathrm{p}} < 1)$ is the altruism coefficient attached to each child's utility, γ represents the utility valuation that the parents place on each child's after-transfer income$(\tilde{Y}_i)$ as shown in equations (5a) and (5b), λ is a positive constant, and $\lambda(B_1 - B_2)^2$ reflects the "utility costs" of post-mortem reputation resulting from an unequal bequest distribution. [12] The inner feelings are assumed to be getting worse when the difference in bequeathed amounts increases. Note that the utility function indicates that the parents apply the same altruism coefficient, α_{p}, to each child and hence are equally altruistic toward the children.

In the specification of the altruistic function in (6), children's services are assumed to be homogeneous in "quality" to the parents. This assumption implies that service times are equally valued. Using (4), the total amount of service times supplied by the children is

$$g_1 + g_2 = \frac{(W_{\mathrm{p}} - B_1 - B_2)}{(\omega_1 - \alpha_1) + (\omega_2 - \alpha_2)}. \tag{7}$$

It follows from (7) that

$$\frac{\partial(g_1 + g_2)}{\partial B_i} = -\frac{1}{(\omega_1 - \alpha_1) + (\omega_2 - \alpha_2)} < 0 \quad \text{and} \quad \frac{\partial(g_1 + g_2)}{\partial B} < 0, \tag{8}$$

where $B = B_1 + B_2$. Thus each child's service time decreases as the amounts of wealth allocated to the bequest pool increase. This result implies that, other things being equal, post-mortem bequests have a *disincentive* effect on the children's supply of services. The economic explanation is straightforward. An increase in B_i lowers the amount of wealth in the inter-vivos transfer pool, with the consequence that each child's transfer-seeking investment (measured in terms of service time) decreases. In contrast to inter-vivos transfers that require children to provide "costly" merit goods to their parents, bequests to be made to the children are essentially "free." Even though post-mortem bequests are "noncompensated," we

[12] This approach follows the notion of social norms (Laitner 1997) and that of post-mortem reputation (Lundholm and Ohlsson 2000). That is, the analysis with the paper takes into account norm of fairness and "psychic costs" of unequal bequests. Future research might consider the endogeneity of social norms in bequest division instead of treating norms as an additional constraint. I thank the anonymous referee for this valid point.

will show that altruistic parents who are wealthy enough make intended bequests to their children.

The objective of the parents is to choose B_1 and B_2 that maximize their altruistic utility in (6), where $(g_1 + g_2)$ is given by (7) and $\{\tilde{Y}_1, \tilde{Y}_2\}$ are given by (5a) and (5b). The parents' FOCs with respect to B_1 and B_2 are given respectively by

$$\frac{\partial U}{\partial B_1} = \frac{1}{g_1 + g_2}\left(\frac{\partial g_1}{\partial B_1} + \frac{\partial g_2}{\partial B_1}\right) + \alpha_{\mathrm{p}}\gamma\left(\frac{\partial \tilde{Y}_1}{\partial B_1} + \frac{\partial \tilde{Y}_2}{\partial B_1}\right) - 2\lambda(B_1 - B_2) = 0; \tag{9a}$$

$$\frac{\partial U}{\partial B_2} = \frac{1}{g_1 + g_2}\left(\frac{\partial g_1}{\partial B_2} + \frac{\partial g_2}{\partial B_2}\right) + \alpha_{\mathrm{p}}\gamma\left(\frac{\partial \tilde{Y}_1}{\partial B_2} + \frac{\partial \tilde{Y}_2}{\partial B_2}\right) + 2\lambda(B_1 - B_2) = 0. \tag{9b}$$

The FOCs indicate that the amount of bequests to child i is optimally chosen when the marginal benefit of giving one more dollar of bequests to the child, $\partial \ln(g_1 + g_2)/\partial B_i + \partial(\tilde{Y}_1 + \tilde{Y}_2)/\partial B_i$, is equal to the marginal damage to inner-feelings resulting from unequal division, $\partial[\lambda(B_i - B_j)^2]/\partial B_i$. Using equations (5a), (5b), (7), and the FOCs in (9a) and (9b), we derive the equilibrium bequests, B_1^* and B_2^*. Interestingly, the optimal amounts bequeathed to the children are exactly equal:

$$B_1^* = B_2^* = \frac{1}{2}W_{\mathrm{p}} - \frac{[(\omega_1 - \alpha_1) + (\omega_2 - \alpha_2)]^2}{4\alpha_{\mathrm{p}}\gamma(\omega_1 - \alpha_1)(\omega_2 - \alpha_2)}. \tag{10}$$

For altruistic parents who leave their children positive amounts of bequests post-mortem, i.e., $B_i^* > 0$, the parents' total inheritable wealth W_{p} must be large enough to satisfy the following sufficient condition:

$$W_{\mathrm{p}} > \frac{[(\omega_1 - \alpha_1) + (\omega_2 - \alpha_2)]^2}{2\alpha_{\mathrm{p}}\gamma(\omega_1 - \alpha_1)(\omega_2 - \alpha_2)}. \tag{11}$$

Financial constraints facing parents will limit their abilities to make bequests to their heirs. In this case, the sufficient condition (11) is not satisfied. This result may explain a proportion of parents who do not leave bequests to their children. To analyze implications of equal bequest division and its association with inter-vivos transfers, we assume that the sufficient condition holds. It is easy to verify the following comparative-static derivatives:

$$\frac{\partial B_i^*}{\partial W_{\mathrm{p}}} > 0; \quad \frac{\partial B_i^*}{\partial \alpha_{\mathrm{p}}} > 0. \tag{12}$$

Based on the findings of the above analyses, we have

Proposition 1 (Equal Division of Bequests) *In a two-stage, non-cooperative Nash game in which altruistic parents determine a portfolio of inter-vivos transfers and post-mortem bequests, where inter-vivos transfers are used as incentives strategically to induce children to supply services according to a contest success function, we have the following results:*

(i) *The parents choose to split their bequests equally between their children, regardless of earnings differentials across the children.*
(ii) *Other things being equal, the equilibrium bequests increase with the parents' inheritable wealth,* W_p.

Proposition 1 implies that the choice of equal bequests is a way for parents to avoid potential conflicts between children and to attain post-mortem reputation. In making their bequest decision, parents believe that hard feelings and strained relationships between siblings are more likely to arise when bequests are not divided equally. Our finding of equal bequest division complements those of Stark (1998), Lundholm and Ohlsson (2000), Bernheim and Severinov (2003), and Faith and Tollison (2001). In particular, Faith and Tollison predict that initial bequest distributions will tend toward equal division once rent-seeking activities and costs incurred by children are explicitly spelled out in parental–children interactions and transfers.

Earlier empirical studies on bequests such as those by Menchik and David (1983) and Bernheim (1991) used the Longitudinal Retirement Household Survey and showed that bequests are intentional. In addition to the frequently cited findings of Menchik (1980, 1988) and Wilhelm (1996), the empirical evidence of recent studies on intergenerational wealth transfers also indicates that equal bequest division is a widely observed practice. Using the Asset and Health Dynamics among the Oldest Old (AHEAD) survey data, Dunn and Philips (1997) find that parents divide various assets differently among their children. Parents target inter-vivos transfers of cash to less-endowed children, but bequests to be made after death tend to be distributed to *all* children regardless of income differences among the children. McGarry (1999) uses data from the Health and Retirement Survey and the Asset and Health Dynamics Survey. She finds that more inter-vivos transfers are distributed to children with lower earnings, but intended bequests tend to be divided equally across children. In their recent contribution, Light and McGarry (2004) test empirically whether mothers intend to divide their estate bequests *unequally* among their children. Among 45–80-year-old mothers who participate in the 1999 National Longitudinal Surveys (NLS) of Young Women and Mature Women, *relatively few* mothers intend to make bequests unequally (Light and McGarry 2004, p. 1679).

Interestingly, the empirical contributions by Dunn and Philips (1997), McGarry (1999), Light and McGarry (2004) mentioned above explicitly consider inter-vivos transfers and bequests as two alternative modes of parental transfers. The portfolio framework of "gifts before life" and "gifts after life" developed in this paper reflects, to a considerable extent, such as an empirical consideration.

Having discussed the altruistic parents' decision on equal bequests, our next step is to determine the size of the total "prize" for the transfer-seeking contest, the allocation of the prize (i.e., inter-vivos transfers) to the children, and their times of services.

Using B_1^* and B_2^* in (10), we calculate the equilibrium inter-vivos transfer:

$$T^* = \frac{[(\omega_1 - \alpha_1) + (\omega_2 - \alpha_2)]^2}{2\alpha_p \gamma (\omega_1 - \alpha_1)(\omega_2 - \alpha_2)}, \tag{13}$$

which is unambiguously positive. This equilibrium transfer T^* determines the total amount of financial resources for the transfer-seeking contest. A comparative-static analysis shows the following:

$$\frac{\partial T^*}{\partial \alpha_{\mathrm{p}}} < 0; \tag{14}$$

$$\frac{\partial T^*}{\partial \omega_i} < (>)0 \quad \text{if} \quad (\omega_i - \alpha_i) > (<)(\omega_j - \alpha_j); \tag{15}$$

$$\frac{\partial T^*}{\partial \alpha_i} > (<)0 \quad \text{if} \quad (\omega_i - \alpha_i) > (<)(\omega_j - \alpha_j). \tag{16}$$

Thus the total inter-vivos transfer decreases with parental altruism, but its association with wage rates and children's altruism toward their parents cannot be determined unambiguously.

To determine the equilibrium services by the children, we substitute T^* from (3) into (5) to get

$$g_1^* = \frac{1}{2\alpha_{\mathrm{p}}\gamma(\omega_1 - \alpha_1)} > 0; \quad g_2^* = \frac{1}{2\alpha_{\mathrm{p}}\gamma(\omega_2 - \alpha_2)} > 0, \tag{17}$$

which are transfer-seeking efforts or investments by the competing siblings. These results have implications for non-market care-giving activities by children within the family. It is straightforward to show the following:

$$\frac{\partial g_i^*}{\partial \alpha_{\mathrm{p}}} < 0; \quad \frac{\partial g_i^*}{\partial \omega_i} < 0; \quad \frac{\partial g_i^*}{\partial \alpha_i} > 0. \tag{18}$$

As expected, the equilibrium amount of service time decreases with parental altruism and the children's wage rates but increases with the children's altruism toward their parents.

Next, we calculate the equilibrium inter-vivos transfer to each child $i\,(i = 1, 2)$. To do so, we use (13), (17), and the CSF (see (1)) to get

$$T_1^* = \left(\frac{g_1^*}{g_1^* + g_2^*}\right) T^* = \frac{(\omega_1 - \alpha_1) + (\omega_2 - \alpha_2)}{2\alpha_{\mathrm{p}}\gamma(\omega_1 - \alpha_1)} \quad \text{and}$$

$$T_2^* = \left(\frac{g_2^*}{g_1^* + g_2^*}\right) T^* = \frac{(\omega_1 - \alpha_1) + (\omega_2 - \alpha_2)}{2\alpha_{\mathrm{p}}\gamma(\omega_2 - \alpha_2)}. \tag{19}$$

It follows that the difference in equilibrium inter-vivos transfers between the children is

$$T_1^* - T_2^* = \frac{[(\omega_2 - \alpha_2) - (\omega_1 - \alpha_1)][(\omega_1 - \alpha_1) + (\omega_2 - \alpha_2)]}{2\alpha_{\mathrm{p}}\gamma(\omega_1 - \alpha_1)(\omega_2 - \alpha_2)}.$$

Given the assumption that each child's "effective wage" is positive, i.e., $(\omega_i - \alpha_i) > 0$, the sign of $(T_1^* - T_2^*)$ depends crucially on that of $[(\omega_2 - \alpha_2) - (\omega_1 - \alpha_1)]$. The following are cases of interest:

(i) If $\omega_1 > \omega_2$ and $\alpha_1 \leq \alpha_2$ such that $(\omega_1 - \alpha_1) > (\omega_2 - \alpha_2)$, then $T_1^* < T_2^*$.
(ii) If $\omega_1 > \omega_2$ and $\alpha_1 > \alpha_2 + (\omega_1 - \omega_2)$ such that $(\omega_1 - \alpha_1) < (\omega_2 - \alpha_2)$, then $T_1^* > T_2^*$.

Thus, differences in inter-vivos transfers are directly related to the relative earnings or earning capabilities between the children, as well as their relative degree of altruism toward the parents. Cases (*i*) indicates that inter-vivos transfers and wage rates are negatively related. Hence, there is a negative relationship between inter-vivos transfers (T_i^*) and pre-transfer income ($L\omega_i$) when the siblings are equally altruistic toward their parents or when the low-wage child is more altruistic toward the parents than the high-wage child. Case (*ii*) indicates the possibility that the high-wage child receives a larger transfer, and hence a positive association between the transfer and the child wage that does not compensate the low-wage child. This happens when the high-wage child also really likes the parents (high α_1) so that the high-wage child's "effective wage" is lower: $(\omega_1 - \alpha_1) < (\omega_2 - \alpha_2)$.[13] Hence, it is also possible that there is a positive association between inter-vivos transfers and a recipient child's pre-transfer income. In the model with an exchange of merit goods, inter-vivos transfers can be interpreted as "payments" to children for their provision of services. But such an exchange motive does not necessarily imply that inter-vivos transfer amounts must be positively related to a recipient child's effective wage or earnings.

It is instructive to determine the ratio of each child's expected inter-vivos transfer T_i^* over his service time g_i^* as this ratio reflects the "equilibrium price" of service. Inspection of equations (17) and (19) yields

$$\frac{T_1^*}{g_1^*} = \frac{T_2^*}{g_2^*} = \sum_{i=1}^{2} (\omega_i - \alpha_i) > (\omega_i - \alpha_i).$$

Thus, in orchestrating a contest that leads their children to compete for a financial transfer, the parents are "unbiased" toward the children. This non-discrimination result derives from the fact that the "equilibrium price" of children's services – measured in terms of compensation to a child for each unit of time spent with the parents – is *identical* for the siblings.[14] Interestingly, the equilibrium price of service is greater than $(\omega_i - \alpha_i)$. This result comes as no surprise. When parents want services from their working children, the parents have to offer adequate incentives by paying a price higher than each child's market wage (i.e., opportunity costs of time) net of his altruism coefficient toward the parents. It should be noted that the parents do not choose the amounts of service times by the children in the non-cooperative Nash game. Moreover, the subgame perfect Nash equilibrium has the property of *self-enforcement* because each individual pursues behavior that maximizes self-interest.

We summarize the findings of the analyses in the following proposition:

Proposition 2 (Unequal Inter-Vivos Transfers) *Unless children are identical in all relevant aspects such as pre-transfer earnings and altruism towards their parents, the parents' optimal decision on inter-vivos transfers is to distribute the transfers unequally. Specifically, we have the following comparative-static results:* [15]

[13] Due to the anonymous referee, the notion of effective wage is very helpful in explaining Case (*iii*).

[14] This finding is directly related to the contest success functions (1), an insightful observation by the anonymous referee (see also footnote 10).

[15] The findings in Proposition 2 are consistent with those of Chang and Weisman (2005). The analysis in this paper further explains why parents divide bequests equally as shown in Proposition 1.

(i) *If the siblings differ in earnings but are equally altruistic toward their parents, the parents transfer more (less) resources to the child whose wage rate or pre-transfer income is lower (higher).*
(ii) *If the high-wage child is sufficiently more altruistic toward the parents than the low-wage child, the parents transfer more resources to the high-wage child.*
(iii) *In the subgame perfect equilibrium of the two-stage game with a transfer-seeking contest, the inter-vivos transfer per unit of time of child services is equalized across the children.*

Will the equilibrium outcome of "unequal" inter-vivos transfers be inconsistent with Becker's assumption of parental altruism? In the transfer-seeking game we consider, Proposition 2(*i*) implies that parents compensate for labor earnings differentials resulting from ability and human capital differentials by transferring more financial resources to the less-endowed children. Consequently, inter-vivos transfers are unequivocally compensatory in the Beckerian sense. The economic intuition behind this finding is straightforward. The opportunity cost of rendering services to parents is higher for the high-wage child. Other things (e.g., children's altruism to parents) being equal, the high-wage child supplies proportionately less time in caring for the parents and concomitantly receives a lower inter-vivos transfer from the parents. The positive transfer–earnings relationship can be used to explain the findings of several empirical studies on inter-vivos transfers (e.g., Dunn and Philips 1997; McGarry 1999).

Proposition 2(*ii*) implies that there can be a *positive* relationship between inter-vivos transfers and the earnings of a recipient child when the high-ability child is sufficiently altruistic toward his parents. In this case, inter-vivos transfers are less compensatory and more reflective of simple payments to the child for services rendered to the parents. The positive association between inter-vivos transfers and recipient earnings is consistent with the findings of Cox and Rank (1992) and Lillard and Willis (1997). Stark and Zhang (2002) contend that a positive transfer–earnings relationship is counter-compensatory which, rather than being orthogonal to parental altruism, originates from such altruism. Cox (2003) further links intergenerational transfers to evolutionary motives and argues that parents tend to make more transfers to children who are more likely to promote survival of family genes. If children with high pre-transfer earnings or earning capabilities reflect, to a considerable degree, a high ability of promoting their parents' genes, then higher-wage children would receive disproportionately more transfers from their parents. In this case, the analysis of Cox (2003) is consistent with a positive relationship between parental transfers and a child's earnings or earning capabilities. As with most models of private transfers, the portfolio model abstracts from the consideration of evolutionary motives, which is an interesting dimension for future research.

The findings of the inheritable wealth allocation model thus imply that parental motives in making inter-vivos transfers may be explained by both altruism and exchange. Unequal distribution of inter-vivos transfers stems from differences in such factors as children's relative earnings and their altruism toward parents. A positive correlation between transfer amounts and recipient earnings is insufficient to undermine altruistic motives, nor will a negative transfer–earnings relationship necessarily invalidate exchange motives. This suggests that a dichotomy between altruism-motivated transfers and exchange-motivated transfers appears to

be unnecessary.[16] This point can best be described by the empirical findings of Light and McGarry (2004, p. 1670) that: "Among mothers who intend to divide their estates unequally, 25% provide an explanation that conforms to altruistic behavior, 25% give an exchange-related response, and 10% refer to the biological status of their children."

In the portfolio model of inheritable wealth we consider, does unequal inter-vivos transfers necessarily imply that "parents play favorites"? Given that children with differing time costs render different amounts of service times to their parents, the amounts of inter-vivos transfers distributed to the children differ. Nevertheless, the equilibrium price of services is exactly identical for the children. These theoretical findings provide a rationale for explaining why *unequal* inter-vivos transfers (due to parental altruism or strategic exchange) and *equal* bequests (due to equity and reputation) are inherently consistent to each other. Accordingly, the portfolio analysis of gifts and bequests predicts that, in equilibrium, the parents are equally altruistic to their children. This equilibrium outcome of non-discriminating or "equal altruism" in inheritable wealth distribution may have an interesting implication for empirical studies. Information on the relationships between transfer amounts and recipient children's earnings alone is insufficient for reaching the conclusion concerning whether parents play favorites, without analyzing additional information on the provision of family services from the children to their parents.

2.4 Effects of parental altruism and changes in inheritable wealth

Finally, two other questions might be of interest to the analysis of inheritable wealth distribution. The first concerns how the optimal mix of gifts and bequests would be affected by differences in parental altruism across families, other things being equal. These other things may include variables such as children's altruism toward their parents, the total amount of wealth for heirs, and aged parents' health conditions. The first question can be answered by equations (10) and (13), which imply that

$$\frac{\partial B_1^*}{\partial \alpha_p} = \frac{\partial B_2^*}{\partial \alpha_p} > 0 \quad \text{and} \quad \frac{\partial T^*}{\partial \alpha_p} < 0. \tag{20}$$

The second question concerns how the optimal mix of gifts and bequests would be affected by an exogenous change in the amount of inheritable wealth for heirs, W_p. It follows directly from the equilibrium bequests [see equation (10)] that

$$\frac{\partial B_1^*}{\partial W_p} = \frac{\partial B_2^*}{\partial W_p} = \frac{1}{2}; \quad \frac{\partial T^*}{\partial W_p} = 1 - \frac{\partial (B_1^* + B_2^*)}{\partial W_p} = 0. \tag{21}$$

We thus have

Proposition 3 *In the two-stage, non-cooperative Nash game of parental–children interactions, we have the following results:*

[16] This conclusion parallels the remark by Cox (1987, p. 519) that "information on transfer decisions alone is insufficient for making inferences about transfer motives."

(i) *The amount of inheritable wealth allocated to the bequest pool increases with parental altruism, ceteris paribus;*
(ii) *Nevertheless, the amount of inheritable wealth allocated to the inter-vivos transfer pool decreases with parental altruism, ceteris paribus;*
(iii) *The comparative-static effect of a change in W_p on inter-vivos transfers is zero, while that of a change in W_p on bequests to each of the two siblings is equal to one half.*

Based on the simple framework of portfolio, Proposition 3(*i*) indicates that, other things being equal, more altruistic parents allocate more of their inheritable wealth to the post-mortem bequest pool than less altruistic parents do. The increase in bequeathable amounts lowers the levels of services rendered by the children due to the fact that there is a disincentive effect associated with bequests [see equation (9)]. This is also because financial resources available for the transfer-seeking contest fall. Consequently, the amount of wealth allocated to the inter-vivos transfer pool decreases. This explains Proposition 3(*ii*). This suggests that the composition of wealth for heirs would be affected by different degrees of parental altruism across families.

Proposition 3(*iii*) implies that an exogenous shock that marginally changes the amount of inheritable wealth will not affect altruistic parents' decision on the equilibrium inter-vivos transfers. Instead, the parents adjust their portfolio completely through bequests by dividing the marginal change equally across the children. This is due to the specification of the parents' preferences where they have declining marginal utility of services but constant marginal utility of child income.[17] In terms of the notion of noncompensated gifts, the finding parallels the equal bequest rule discussed in Proposition 1.

One interesting remark on sibling rivalry for parental transfers, viewed from the perspective of rent seeking, should be mentioned. According to Buchanan (1983), "transfers that take the form of gifts or bequests are, on the surface, noncompensated. Some part of such transfers may, nonetheless, represent payment by the apparent donor for reciprocal services that has been or are to be rendered by the designated donee." (p. 72) In our model of inheritable wealth distribution, post-mortem bequests are noncompensated and hence are pure "rents" to the recipients. Inter-vivos transfers are compensated, however, in that they are payments to children for their services. From the parents' perspective, the children's time is not wasted; it produces something highly valued. Children may value time with their parents. Even if children do not want to be with their parents, they could view parental time analogous to "working," i.e., they are compensated for their time. Given that parents have complete discretion over wealth distribution when designing a pecuniary incentive scheme or orchestrating a transfer-seeking contest, rent-seeking behavior by competing siblings is not wasteful. This point can best be described by Buchanan's (1983) observation that: "Rent-seeking becomes wasteful only in those situations where those who control access to rents do not or cannot ensure direct compensation" (p. 73). We show that both noncompensated bequests and compensated transfers motivate rent-seeking behavior by siblings.

[17] I thank the anonymous referee for this point.

3 Concluding remarks

An extensive empirical study on inter-vivos transfers shows mixed conclusions in that optimal transferred amounts and the recipient children's earnings may be negatively or positively related. Empirical evidence further indicates that post-mortem bequests or estates tend to be divided equally among children. In this paper, we develop a stylized model to explain why unequal inter-vivos transfers and equal bequests are inherently compatible with both altruism and exchange. Allowing for children's heterogeneity, we pay considerable attention to the empirical literature and make an attempt to reconcile extant empirical findings with the theoretical model. Using a portfolio approach, we find that parents' allocation of inheritable wealth between inter-vivos gifts and post-mortem bequests is consistent with the observations of recent empirical studies (e.g., Dunn and Philips 1997; McGarry 1999; Light and McGarry 2004).

The simple model of parental–children interactions and transfers has the following features. First, unlike models of family transfers in which children are "passive" and altruistic parents make decisions for all family members, the analysis with the paper stresses the endogenous effort choices of the "egoistic" children. Second, the model is capable of reflecting inter-generational interactions between parents and children, as well as intra-generational interactions between the children in a two-stage Nash game. The game permits us to examine the mechanism through which the parents' distribution of inheritable wealth affects their offspring's care-giving behavior. Third, the model is able to characterize the nature of rivalry between heterogeneous siblings for financial resources from their parents, and link the parents' portfolio of gifts and bequests to the (pre-transfer) earnings of children. As such, the analysis with the paper shows explicitly the rent-seeking aspects of private transfers between generations (Buchanan 1983).

Wealth transfers while parents are still alive may be quite different from wealth transfers after death. This is because the former may work as pecuniary incentives to elicit merit goods that the parents value. Gifts that serve as payments for services are considered as *compensated* (inter-vivos) transfers, noting that such gifts may interchangeably be termed as strategic bequests. Gifts that serve as payments on buying reputation without involving services in return are considered as *noncompensated* (post-mortem) transfers, which are generally termed as bequests without much confusion. Based on the notions of compensation and noncompensation in gifts, we classify intended wealth transfers into inter-vivos transfers and post-mortem bequests and then examine their differences. These two financial "instruments" may work differently in affecting children's behavior toward their parents and the parents' preferences over the distribution of inheritable wealth.[18] Interestingly, inter-vivos transfers and post-mortem bequests are fundamentally different in terms of tax rules that apply to the two different modes of transfers (Joulfaian 2005). It is beyond the scope of this paper to address this issue. But a potentially interesting extension is to incorporate differing tax treatments for transfers and

[18] Bernheim and Severinov (2003) treat gifts and bequests differently in terms of their observability. In their analysis, the division of bequests is perfectly observable by children whereas that of gifts need not be the case. Bernheim and Severinov show that if gifts are made "secretly," children will have no perfect information about whether their parents' resources for gifts have been divided equally. Consequently, parents may make unequal division of gifts.

bequests into the portfolio model of inheritable wealth distribution. Within such an extended framework, one can examine whether differences in inter-vivos gift taxes and bequest taxes affect children's transfer-seeking behavior and the endogenous parental–children relationships differently. From the altruistic parents' perspective, equal bequest remains a financial option to resolve conflicts among siblings and to achieve "equity" for the distribution of the noncompensated gifts after death, as implicitly or explicitly suggested by empirical studies on bequest division. Whether the compatibility of parental altruism, strategic exchange, unequal inter-vivos transfers, equal bequests, and unequal earnings of children has its generality in theory requires further research.

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