AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

378.5694
C45
9901

המרכז למחקר בכלכלה חקלאי
THE CENTER FOR AGRICULTURAL ECONOMIC RESEARCH

Working Paper No. 9901

Intergenerational Transfers, Borrowing Constraints and Household Size

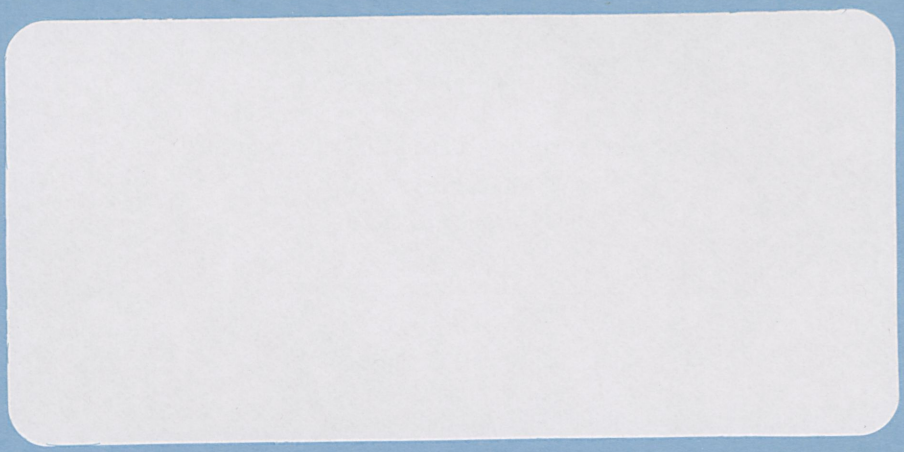
by

Edward J. Seiler

Waite Library
Dept. of Applied Economics
University of Minnesota
1994 Buford Ave - 232 ClaOff
St. Paul MN 55108-6040 USA

Rehovot, Israel. P.O.B. 12

רחובות, ת.ד. 12



The working papers in this series are preliminary and circulated for the purpose of discussion. The views expressed in the papers do not reflect those of the Center for Agricultural Economic Research.

מאמרי המחקר בסידרה זו הם דווח ראשוני לדיון וקבלת הערות. הדעות המובעות בהם אינם משקפות את דעות המרכז למחקר בכלכלה חקלאית.

378.5694
C4S
9901

Working Paper No. 9901

Intergenerational Transfers, Borrowing Constraints and Household Size

by

Edward J. Seiler

THE CENTER FOR AGRICULTURAL ECONOMIC RESEARCH
P.O. Box 12, Rehovot

Intergenerational Transfers, Borrowing Constraints and Household Size*

Edward J. Seiler†

The Hebrew University of Jerusalem

January 1999

Abstract

We examine the relationship between private transfers and household size in the presence of capital market imperfections by incorporating a two-sided dynastic utility specification into an overlapping generations life-cycle model with inter-vivos transfers. Our results show that the transfers young liquidity constrained individuals receive are negatively related to their contemporaneous earnings, positively related to their future earnings, and negatively related to the fertility rate under certain conditions. We find that transfers to the old are ambiguous in the fertility rate and that middle-aged savings for old age are positively related to household size if the elasticity of the "altruism multiplier" with respect to the fertility rate is greater than unity, but are negatively related if it is less than unity.

Keywords: Intergenerational Transfers, Fertility, Liquidity Constraints.

JEL Classifications: D11, J13.

*I am especially grateful to Robert Townsend for many helpful discussions. I also wish to thank Avner Ahituv, Hyeok Jeong, Lance Lochner, Yair Mundlak, Anna Paulson, Jean-Pierre Zigrand and members of the Theory and Development workshop and the Applications Lunch at The University of Chicago for their comments.

†Address: Department of Agricultural Economics, The Hebrew University of Jerusalem, P.O.Box 12, Rehovot 76100, Israel. Tel: 972-8-948-1376. Email: seiler@agri.huji.ac.il

1 Introduction

One of the features of less developed countries (LDCs) is the prominent role of informal private transfers between members of closely knit households. For example, Paulson (1994) finds that over forty percent of the sample households in the 1988 and 1990 socio-economic surveys from Thailand sent or received remittances, and that remittances constituted more than half of the total income in receiving households. Informal private transfer support systems are of particular importance in LDCs due to the fact that formal insurance markets are often missing (see Townsend (1994)), and alternative programs to care for the old (such as social security systems) are either non-existent or are very limited in their scope.

A second feature of LDCs is that they have high fertility rates (relative to developed countries), and in many cases, growing populations (in part as a result of recent decreases of infant mortality rates). The question of fertility rates has been studied in detail in the growth literature (for example, Becker, Murphy and Tamura (1990), Ahituv (1995)), but it has (more or less) been overlooked in the transfer literature, that has mainly focused on the motivations for, and the incidence and magnitude of private transfers and remittances.

In this paper we examine the interaction between these two features by integrating fertility into a three generation overlapping generations life-cycle model with *inter-vivos* transfers between the young and the middle-aged, and between the middle-aged and the old, so that we can examine several theoretical relationships. Specifically, we examine the relationships between (i) transfers to young liquidity constrained consumers and the number of siblings they have, (ii) transfers (or, remittances/gifts) to (or from) the old and the number of offspring they have, (iii) transfers and income (both for the receiving and sending parties), and (iv) transfers and saving. We also examine whether transfers are targeted to liquidity constrained consumers by imposing borrowing constraints on the young.[1]

The model we build is based on Guiso and Jappelli's (1991) and Altig and Davis' (1993) frameworks, in which there are three generations and borrowing constraints on young consumers.[2] In these models, private transfers are sent to smooth consumption over the life-cycle of an individual, and hence maximize lifetime utility. In order to integrate fertility into this setup we assume that the motivation for intergenerational transfers is altruism (following Becker (1974)), and adopt the dynastic utility specification of Becker and Barro (1988). The advantage of Becker and Barro's specification is that it captures not only the "pure altruism" of a parent to his/her children, but also incorporates a scaling factor for the number of children (that is, the parent also cares about

[1]The targeting of transfers to liquidity constrained consumers is not a new question in the literature, but we evaluate it due to its important policy implications, as first raised by Barro (1974), and since examined by various authors, for example Cox (1990). We will discuss the policy implications in greater detail in Section 3.

[2]These in turn are based on Cox's two generation overlapping generation model (1987) that he later expanded in order to investigate whether transfers are targeted to liquidity constrained households (1990). We also mention that we are specifically looking at the F-type economy in Altig and Davis (1993).

the number of children he/she has).

The structure of the paper if as follows: In Section 2 we develop an overlapping generations model with transfers and fertility, and carry out comparative static exercises to demonstrate the theoretical relationships discussed above. In Section 3 we discuss the results and their policy implications, and conclude the paper.

2 A Model of Intergenerational Transfers

The framework that we build to examine the relationship between transfers and household size with capital market imperfections is an overlapping generations model with two-sided altruism. The model is similar in structure to the one used by Guiso and Jappelli (1991), but in addition, it incorporates the effects of fertility on transfer decisions and amounts by integrating the dynastic framework of Becker and Barro (1988), in which parents not only care about their children but also the number of children they have. Guiso and Jappelli abstract from the possibility of population growth in their formulation since their model is used to describe Italy - an economy that is essentially without population growth and with a steady fertility rate. However, when describing economies in less developed countries (for example, Thailand, as in Seiler (1999)) we need to include fertility issues and positive population growth (see Ahituv (1995) for a more detailed discussion), and as such we adopt a recursive structure that reflects this aspect.[3]

The setup of the model is as follows: the economy consists of identical individuals that belong to a dynasty. In order to keep the model tractable we abstract from marriage (i.e. the union of different dynasties) and assume that there is only one parent per household. Each person lives for three periods, during which he/she is "young," "middle-aged" and "old," respectively. Each person inelastically supplies one unit of homogeneous labor in each period. Labor income for a worker of age i who is a member of generation t is denoted by e_{it}. In order to obtain a hump-shaped profile of earnings corresponding to the regular lifecycle earnings profile we assume that $e_{1t} < e_{2t}$ and $e_{2t} \geq e_{3t}$.[4]

We assume that individuals maximize discounted lifetime utility that depends on their own consumption and the maximum attainable utility of their parent and of their children. Consumption smoothing tendencies combined with a low value of e_{1t} causes optimal consumption by the young to exceed their current labor income. We assume that the young cannot borrow because of asymmetric information about their willingness or ability to repay loans when middle-aged to outside credit

[3]Looking at the data (source: World Bank Social Indicators of Development 1996) we see that the Total Fertility Rate (TFR) (the number of children per female at childbearing age) has been steady in Italy in the last decade (1987=1.28 and 1992=1.30). The Total Fertility Rate has been falling in Thailand from 4.27 in 1977 to 2.57 in 1987 and 2.10 in 1992. This still represents a growing population, but we note that the TFR is approaching 2.0, i.e. a zero population growth.

[4]The second relationship (between the earnings at middle-age and when old) is presented as a weak inequality since Paxson (1995) documents that this may well be the case in certain countries, for example, in Thailand.

sources e.g. moneylenders or credit agencies. However, we assume that there is full information between parents and children. This form of capital market imperfection is common in the literature, e.g. Stiglitz and Weiss (1981), Guiso and Jappelli (1991). If children are sufficiently altruistic toward their parents, implicit contracts within the household may be self-enforcing, and we assume this in this case. Thus, consumption of a generation t member at period 1 of his life c_{1t},[5] is constrained by the sum of his disposable income from wages e_{1t}, and from parental transfers τ_{t-1}.

At age 2, the individual earns e_{2t} which is divided into consumption c_{2t}, transfers to the young $n\tau_t$, transfers/remittances to the old g_t, and savings s_{2t}. Since the total transfers are $n\tau_t$ (and n is the number of children that are born to an individual at the beginning of the second period of his/her life) we are also assuming that each child receives the same transfer amount (or, that the parent loves each child the same as his/her siblings). Moreover, inasmuch as that there is only one parent in the setup, n may also be looked upon not only as the number of children that an individual has, but also as the (gross) growth rate in the total population (since we are assuming that all households behave identically). Finally, we assume that the middle aged are not liquidity constrained, and can also take consumption loans (if we were to assume a no-loan economy then $s_{2t} \geq 0$).

At age 3, the consumption of the old comes from their earnings e_{3t}, their savings $(1+r)s_{2t}$ (where r is the exogenously determined interest rate on savings), and from transfers from their children ng_{t+1} (note that if g_{t+1} is negative then the old are transferring resources *to* their middle-aged children). Thus, the sequence of budget constraints faced by the generation t individual is:

$$c_{1t} = e_{1t} + \tau_{t-1} \tag{1}$$

$$c_{2t} + n\tau_t + g_t + s_{2t} = e_{2t} \tag{2}$$

$$c_{3t} = (1+r)s_{2t} + e_{3t} + ng_{t+1} \tag{3}$$

We now describe the preferences of the agents in the setup. In order to motivate intergenerational transfers in the model we assume that an individual's total utility V, is derived from his own consumption, and the discounted utility of his parents and children. We are therefore maximizing the dynastic utility of the individual, and motivating the transfers through altruistic linkages.[6]

A generation t individual derives direct utility from own lifetime consumption according to the time separable utility function

$$u_t = u(c_{1t}) + \beta u(c_{2t}) + \beta^2 u(c_{3t}) \tag{4}$$

[5]Consumption at age i for a member of generation t is denoted by c_{it}.

[6]The altruistic motivation for transfers has been found to be the case for certain data sets (for example, Ravallion and Deardon (1988) for Java), but we feel that it is important to mention that there are also other explanations offered in the transfer literature - for instance, transfers as a mechanism of exchange (as in Cox (1987)), or even transfers as a combination of these two (e.g. Lucas and Stark (1985) for remittances in Botswana that they call "tempered altruism or enlightened self-interest").

where β ($\epsilon(0,1)$) is the time discount factor. We assume that u_t is twice continuously differentiable, increasing and concave in each argument so that for $i = (1,2,3)$

$$u_{it}^{'} = \frac{\partial u}{\partial c_{it}} > 0$$

and

$$u_{it}^{''} = \frac{\partial^2 u}{\partial c_{it}^2} < 0$$

We further assume Inada conditions i.e. $\lim_{c_{it}\to\infty} u_{it}^{'} = 0$ and $\lim_{c_{it}\to 0} u_{it}^{'} = \infty$. A member of generation t also derives utility from the well-being of his parents and children. Defining V_{it} as the total utility of a member of generation t at age i, and using the formulation of Becker and Barro (1988), we obtain relationships for old, middle-aged and young.

We start by discussing the relationship for the old of generation $t-1$. They receive utility from their own consumption in the last period of their lifetime and from the utility of their children who are middle-aged members of generation t. The parent-to-child altruistic factor $an^{-\epsilon}$ is a constant elasticity function and consists of two parts, the pure constant altruistic factor a, and the scaling factor from the number of children with constant elasticity ϵ. We assume that $a > 0$ and that $0 < \epsilon < 1$ so that the parent's utility is increasing and concave in the number of children. We also assume that the parent loves each child equally, and thus for n children the total altruistic factor is $an^{1-\epsilon}$. The relationship for the old is thus given by

$$V_{3t-1} = u(c_{3t-1}) + an^{1-\epsilon}V_{2t} \tag{5}$$

We next examine the relationship for the middle-aged. The specification that we use for this is similar to Tcha (1995), with altruistic dynasties in both directions. We use this to avoid certain problems that can arise in the one-sided (i.e. only to the descendants) dynastic case.[7] For example, if a grandparent cares about his/her grandchildren (in the one-sided dynastic case) he/she cannot influence the middle-aged parent to change his/her behavior towards his/her children, since the middle-aged parent only cares about the grandparent's consumption and not his/her total utility. In order to use the two-sided dynastic approach we have to put extra conditions on the altruistic factors in order to rule out "Hall of Mirror" effects and unbounded utility. In order to illustrate what is meant by hall of mirror effects we provide a simple example: If I eat a hamburger, I not only receive utility from its consumption, but also I get some extra utility from knowing that my parents and children are happy that I'm happy. This extra happiness thus makes my parents and children more happy that I'm happy that they are happy that I'm happy, and so on. The conditions we add to rule out these effects are based on Kimball (1987) and are: $\alpha an^{1-\epsilon} < \frac{1}{4}$ and $\alpha + an^{1-\epsilon} < 1$. The

[7]We note that Guiso and Jappelli (1991) assume that the child cares about the utility of consumption of the parent, and not the parent's total utility. This follows Buiter and Carmichael's (1984) specification of the utility function with two-sided altruism (that is dynastic for descendants but not for previous generations).

first of these says that the product of the altruistic factor to one's parent and the altruistic factor to one's children must be small enough to rule out the hall of mirror effects discussed above. The second states that the sum of the two factors is less than one so that the dynastic utility function will not be unbounded. Finally, with regards to the middle-aged relationship, we note that we assume that the child-to-parent altruistic factor α (> 0) does not change as the number of siblings increases, i.e. irrespective of the number of siblings the child loves the parent the same amount.

Thus, we can write the relationship for the middle-aged individual as the sum of the utility he receives from consumption in the current period and when he is old, the discounted utility of his old parents who belong to generation $t-1$, and the utility of his young generation $t+1$ children, i.e.

$$V_{2t} = u(c_{2t}) + \beta u(c_{3t}) + \alpha V_{3t-1} + an^{1-\epsilon} V_{1t+1} \tag{6}$$

Finally, we look at the young of generation $t+1$. We assume that they derive utility from their lifetime consumption, from the utility if their parents and from their future children. This is summarized in the following relationship

$$V_{1t+1} = u(c_{1t+1}) + \beta u(c_{2t+1}) + \beta^2 u(c_{3t+1}) + \alpha V_{2t} + \beta an^{1-\epsilon} V_{1t+2} \tag{7}$$

In order to solve the model we want to convert the above three equations for old, middle-aged and young into a recursive structure. It is worth noting that *all* decisions (i.e. transfers to the young, gifts to the old and savings) are taken at middle-age, and as such we are looking for a relationship between V_{2t} and V_{2t+1}, i.e. the total utility of the middle-aged born in t and the middle-aged born in $t+1$. Solving the above system of three equations we obtain:[8]

$$\begin{aligned} V_{2t} &= \Gamma[u(c_{2t}) + \beta(1-\alpha an^{1-\epsilon})u(c_{3t}) + \alpha u(c_{3t-1}) + an^{1-\epsilon}u(c_{1t+1}) + \\ &\quad + \beta an^{1-\epsilon}(1-\alpha an^{1-\epsilon})V_{2t+1}] \end{aligned} \tag{8}$$

where $\Gamma = \frac{1}{1-2\alpha an^{1-\epsilon}}$. Following Tcha (1995), we label Γ as the multiplier effect of reciprocal altruism. For convergence of this dynastic utility function we require that $0 < \Gamma\beta an^{1-\epsilon}(1-\alpha an^{1-\epsilon}) < 1$.

2.1 Necessary Conditions for the Consumer's Problems

The problem facing the household is to choose consumption in the middle period, and transfers to the old and the young in order to maximize (8) subject to the budget constraints (1), (2) and (3) and the non-negativity constraint $\tau_t \geq 0$.[9] The non-negativity constraint precludes the possibility

[8] The way we solve these simultaneous equations is as follows: first we substitute the relationships for the old and the young into the one for the middle-aged, and are left with an relationship between V_{2t} and V_{1t+1}. We then bring the original middle-aged equation forward one period and substitute this into the new one in order to replace V_{1t+1} with V_{2t+1} and V_{3t}. Finally, we bring the original equation for the old forward one period, and use this to replace V_{3t} with an expression with V_{2t+1}.

[9] In an earlier version of the model we assumed that $g_t \geq 0$, however it is pretty common to borrow from one's parents throughout one's life, not only when young. The dropped constraint also implied that parents could not transfer bequests to their children while they were still living, thus it was dropped.

that the middle-aged generation imposes negative transfers on the younger generation. The first order conditions for the maximization problem are:

$$an^{-\epsilon}u'_{1t+1} \leq u'_{2t} \text{ with equality if } \tau_t > 0 \tag{9}$$

$$\alpha n u'_{3t-1} = u'_{2t} \tag{10}$$

$$u'_{2t} = \beta(1+r)(1-\alpha a n^{1-\epsilon})(1+\alpha a n^{1-\epsilon}\Gamma)u'_{3t} \tag{11}$$

We will write (11) as $u'_{2t} = \Phi\beta(1+r)u'_{3t}$. It can be shown that $\Phi > 1$. This Euler equation states that the consumer is indifferent between consuming one extra unit today or one extra unit tomorrow. The return on saving in this case $(1+r)\Phi$, is higher than the "usual" Euler equation (with return $(1+r)$). This follows because, if the middle-aged consumer saves one more unit he must take into account the changes in the utility of the young and the old, and the amount the middle-aged in the next period will have to transfer to him when he is "old." As such, we label Φ as the "altruism multiplier."

The first of the first order conditions determines if transfers to the young are operative. If at the optimun $\tau_t > 0$, then (9) holds with equality. The Euler equation states that at the optimum the consumer is indifferent between consuming one unit himself or deriving utility from the consumption of one extra unit by his child. The second equation (10) states that at the optimum the middle-aged are indifferent between consuming one extra unit themselves, or transferring it to their parents. This formulation assumes that when a child gives a gift to his parent he assumes that his siblings behave identically. Abel (1987) notes that this can be interpreted as if each sibling acts as if he has $1/n$ parents and decides to buy a joint gift with his siblings for their common parent. Alternatively, if we assume that a child transfers gifts to his parent irrespective of his sibling's behavior then the first order condition for gifts, (10), becomes

$$\alpha u'_{3t-1} = u'_{2t} \tag{12}$$

We now want to employ these Euler equations to see how transfers are affected by changes in the observable characteristics of the population, particularly earnings and fertility. We first turn our attention to earnings. Euler conditions (9) and (10) imply that transfers are operative, i.e. $\tau_t > 0$ and $g_t > 0$ if the following inequalities hold:

$$z_1 = an^{-\epsilon}u'_{1t+1} - u'_{2t} > 0 \tag{13}$$

$$z_2 = u'_{2t} - \alpha n u'_{3t-1} < 0 \tag{14}$$

The latent variable z_1 evaluated at $\tau_t = 0$ is a measure of the net marginal gain of the younger generation receiving a transfer from their parents. An alternative way of looking at the latent variable is to rewrite it (by manipulaing the Euler conditions) as

$$z_1 = an^{-\epsilon}u'_{1t+1} - \frac{\beta(1+r)\Phi}{\alpha n}u'_{2t+1} > 0 \tag{15}$$

This says that at $\tau_t = 0$ the marginal utility of the first period exceeds that in the second period. This is true for all liquidity constrained consumers, and since we have full information between parents and children together with parent-to-child altruism there will be a transfer.

Examining (15), we see that if the recipient's income (e_{1t+1}) increases, the probability of receiving a transfer decreases. However if his future income (e_{2t+1}) increases the probability of receiving a transfer also increases, other things being equal. These results follow from the concavity of the utility function. The intuition behind them is as follows: If e_{1t+1} (the young's current income) goes up, the borrowing constraint on the young is relaxed and the middle-aged parent is less likely to make a transfer. However, if future income increases, due to consumption smoothing tendencies, this raises the desired consumption of the young and the borrowing constraint is more stringent, thus raising the likelihood that the parent will make a transfer.

From (13) we see that if e_{2t}, the middle-aged generation's current income increases, *ceteris paribus*, then the probability of receiving a transfer (by the young, from the middle-aged) increases.

Turning our attention to transfers to the older generation, we note that (14) evaluated at $g_t = 0$ measures the net marginal gain in utility of making a transfer/remittance to the older generation. The transfer occurs if the loss in utility by the age 2 household is less than the gain from transferring one unit of consumption to parents. If the middle-aged donor's income, e_{2t} increases then the value of z_2 decreases, and if the recipient's income, e_{3t-1} increases then so too does the value of z_2. This means that an increase in the donor's earnings (or a decrease in the recipient's earnings) will raise the probability of a transfer from the middle-aged to the old.

In order to look at transfer amounts we have to do comparative static exercises. These are done in Appendix A, with the results summarized beneath. It is interesting to note that the results are the same as the ones above for the probability of incidence of transfer to the young and the old (albeit the results for savings behavior of the middle-aged that are not discussed above).

Result 1 *An increase in the earnings of the young will (i) decrease transfers to the young, (ii) increase transfers to the old, and (iii) be ambiguous in middle-aged savings.*

Result 2 *An increase in the earnings of the middle-aged will (i) increase transfers to the young, (ii) increase transfers to the old, and (iii) be ambiguous in middle-aged savings.*

Result 3 *An increase in the earnings of the old will (i) increase transfers to the young, (ii) decrease transfers to the old, and (iii) be ambiguous in middle-aged savings.*

We now look at the effects of fertility on transfers. The comparative statics to examine the effects on transfers to the young, transfers to the old and savings are presented in Appendix B. The results are presented below.

Result 4 *If* $\tau n > g$ *and* $\frac{d log(\Phi)}{d log(n)} > 1$ *then* $\frac{d\tau}{dn} < 0$, *otherwise* $\frac{d\tau}{dn}$ *is ambiguous.*

This result states that the transfer to *each* child will decrease if the total transfers of a middle-aged individual to his children is greater than the transfer than he is giving to his parent, *and* if the elasticity of Φ (the additional return required on middle-aged savings) with respect to the number of children is greater than unity. Otherwise the effect of the birth rate on transfers to young is ambiguous.

Result 5 $\frac{dg}{dn}$ *is ambiguous.*

Result 6 $\frac{ds}{dn}$ *is negative if* $\frac{dlog(\Phi)}{dlog(n)} < 1$, *and is positive if* $\frac{dlog(\Phi)}{dlog(n)} > 1$, *otherwise it is ambiguous.*

This last result is interesting, and in a way complements Result 4. It states that if the elasticity of the additional return required on middle-aged savings with respect to the number of children is less than unity, then as the number of children increases, the amount of middle-aged savings decreases. The intuition behind this statement is as follows: as a parent has more children her total utility from them increases, and she also receives more utility from their consumption. She also takes into account the extra transfers she may receive in his old age from having extra children.[10] Thus, she will save less if the return on saving is less than the extra return from having extra children. This result is switched if the elasticity is greater than unity. This result is complemented by Result 4 since one of the conditions that transfers to the young will decrease with the number of children is the same elasticity (of Φ with respect to n) being greater than unity.

3 Discussion and Conclusions

In this paper we have examined the theoretical relationship between private transfers and household size in the presence of credit market imperfections by incorporating a two-sided dynastic utility specification (à la Becker and Barro (1988)) into an overlapping generations life-cycle model with *inter-vivos* transfers. Specifically, we have examined the relationships between transfers to young liquidity constrained consumers and the number of siblings they have, transfers to (or from) the old and the number of their offspring, transfers and income (both for the receiving and sending parties), transfers and saving, and we have also investigated whether transfers are targeted within families to liquidity constrained consumers.

Our results suggest that there is a negative relationship between young liquidity constrained consumers' contemporaneous earnings and the transfers they receive, but a positive relationship between the transfers they receive and their future earnings. They also show that as middle-aged consumers' earnings increase there will be increased transfers to the young and the old, and that as the old consumers' earnings increase they will receive smaller transfers, but the young will receive larger transfers (other things equal).

[10] n.b. the word "may" is important in this sentence since we know from Result 5 that $\frac{dg}{dn}$ is ambiguous.

The targeting of resources to liquidity constrained individuals is of great interest in less developed countries (LDCs) due to the fact that important policy issues concerning the way credit agencies allocate limited resources to constrained individuals are formulated (in part) depending on whether there is targeting or not. The targeting result we find has also been found by other authors (for example Cox (1990) and Guiso and Jappelli (1991)) in the context of life-cycle models, but we must be careful in using such a theoretical result for policy purposes without careful empirical evidence (as in Cox and Jimenez (1992) and Seiler (1998, 1999)) since other types of models suggest that this is not a particularly steadfast theoretical finding (as in Seiler's (1998) risk sharing environment), and furthermore, the life-cycle model may not even be the best framework when analyzing LDCs (Deaton (1989)).

The relationship that we find between transfers to the young and household size is not straightforward (i.e. positive or negative), but depends on the elasticity of the "altruism multiplier" with respect to the fertility rate. In general, consumers allocate resources across time by equating discounted marginal utilities of consumption in the next period to those today. However, in our model consumers also have to take into account the effects of additional saving on their parent's and children's utility as well as on their own (due to the two-sided altruistic preferences). As such, the return that is required for savings in the Euler saving condition is higher (than without altruism), and we label this multiplicative affect as the "altruism multiplier." We find that if the (above) elasticity is greater than unity, then as the fertility rate increases so do middle-aged savings. Furthermore, if this is the case and total transfers to the young are greater than those to the old, then transfers to young individuals will be decreasing in the fertility rate. This result (for the possible negative relationship between the fertility rate and transfers to young individuals) is of importance in that it suggests that smaller households may provide more resources to young liquidity constrained individuals that may be used to acquire skills (human capital) that further act to enhance development.

The last result we discuss is (unfortunately) inconclusive, in that we do not find a clear relationship between transfers to the old and the fertility rate. However, we note that one of the assumptions in our framework is that individuals take into account the number of identical siblings they have when transferring to their parent, and that all the siblings behave identically. A different assumption concerning sibling behavior may well change this result (for instance, by including bequests and bequest strategies in the model (as in Bernheim, Shleifer and Summers (1985)), we may find that transfers to the old are increasing in the fertility rate. Thus, we need further empirical investigation on how a decrease in fertility affects the resource amounts transferred to the old, and its inherent policy implications.

Appendix A. Comparative Static Results for Earnings

In the case where the non-negativity constraint on τ_t is non-binding, differentiation of the first order conditions (9)-(11) together with the budget constraints (1)-(3) yields a system of 3 equations in 4 unknowns (τ_t, g_t, g_{t+1}, s_{2t}). In order to solve we thus make use of the property that the exogenous variables and parameters are stationary, and so the economy will be stationary and repeat itself in every generation. This means that $g_t = g_{t+1}$, and we are left with 3 equations in 3 unknowns, that we can write as $Ax = b$, or

$$\begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} b_1 \\ b_2 \\ b_3 \end{bmatrix}$$

where

$$a_{11} = an^{-\epsilon}u_1'' + nu_2''$$
$$a_{12} = a_{13} = a_{23} = u_2''$$
$$a_{21} = a_{31} = nu_2''$$
$$a_{22} = \alpha n^2 u_3'' + u_2''$$
$$a_{32} = \beta(1+r)\Phi n u_3'' + u_2''$$
$$a_{33} = \beta(1+r)^2\Phi u_3'' + u_2''$$

Earnings of the Young. In order to solve the comparative statics for changes in the earnings of the young (e_1), we solve the system with $x_1 = d\tau/de_1$, $x_2 = dg/de_1$ and $x_3 = ds/de_1$, and receive

$$b_1 = an^{-\epsilon}u_1''$$
$$b_2 = b_3 = 0$$

In order to solve this system we use Cramer's rule. Define A_j as matrix A with column j replaced by b, and $|A|$ as the determinant of A. Thus, $d\tau/de_1 = |A_1|/|A|$, $dg/de_1 = |A_2|/|A|$, and $ds/de_1 = |A_3|/|A|$. First we look at $|A|$:

$$\begin{aligned} |A| &= an^{-\epsilon}u_1''[\beta(1+r)^2\Phi u_3''(\alpha n u_3'' n + u_2'')] + \\ &\quad + nu_2''[\beta(1+r)^2\Phi u_3'' \alpha n u_3'' n] \end{aligned} \tag{16}$$

Inspecting this expression we see that $|A|$ will is negative. Doing the same exercise for $|A_1|$ we find that

$$|A_1| = -an^{-\epsilon}u_1''u_3''\beta(1+r)^2\Phi[\alpha n^2 u_3'' + u_2'']$$

$|A_1|$ is positive and thus using Cramer's rule, we can conclude that $d\tau/de_1 < 0$. In order to find dg/de_1 we need to find $|A_2|$. We find that

$$|A_2| = an^{-\epsilon}u_1''[nu_2''\beta(1+r)^2\Phi u_3'']$$

This is negative, and since $|A|$ is also negative we conclude that $dg/de_1 > 0$. For ds/de_1 we need to find $|A_3|$, which we find to be equal to zero. Thus, we cannot conclude anything about the effect of a change in the young's earnings upon the savings behavior of the middle-aged.

Middle-Aged Earnings. In this case $x_1 = d\tau/de_2$, $x_2 = dg/de_2$ and $x_3 = ds/de_2$. We find that $b_1 = b_2 = b_3 = u_2''$. As with the young generation's earnings we employ Cramer's rule so that $d\tau/de_2 = |A_1|/|A|$, $dg/de_2 = |A_2|/|A|$, and $ds/de_2 = |A_3|/|A|$. The determinant of A_1 is

$$|A_1| = u_2''[\alpha n u_3'' n\beta(1+r)^2\Phi u_3'']$$

which is negative, and thus $d\tau/de_2 > 0$. We find that

$$|A_2| = an^{-\epsilon}u_1''u_2''\beta(1+r)^2\Phi u_3''$$

which is negative, and thus $dg/de_2 > 0$. $|A_3|$ is zero, and thus we cannot sign ds/de_2.

Earnings of the Old. In this case $x_1 = d\tau/de_3$, $x_2 = dg/de_3$ and $x_3 = ds/de_3$. We find that

$$b_1 = 0$$

$$b_2 = -\alpha n u_3''$$

$$b_3 = -\beta(1+r)\Phi u_3''$$

As with the earnings of the young and middle-aged we employ Cramer's rule so that $d\tau/de_3 = |A_1|/|A|$, $dg/de_3 = |A_2|/|A|$, and $ds/de_3 = |A_3|/|A|$. We find that

$$|A_1| = u_2''\alpha n u_3''\beta(1+r)^2\Phi u_3''$$

which is negative, and so $d\tau/de_3 > 0$. For transfers to the old we find

$$|A_2| = [an^{-\epsilon}u_1'' + nu_2''][-\alpha n u_3''\beta(1+r)^2\Phi u_3'']$$

which is positive, and thus $dg/de_3 < 0$. Regarding savings of the middle-aged we again find that $|A_3| = 0$ i.e. we cannot sign ds/de_3.

Appendix B. Comparative Static Results for Fertility

The comparative statics for fertility, n, are similar to those worked out for earnings in the previous appendix for earnings. We again have the stationary system $Ax = b$, where A is the same as before, $x_1 = d\tau/dn$, $x_2 = dg/dn$ and $x_3 = ds/dn$. We find in this case that

$$b_1 = \epsilon a n^{-\epsilon-1}u_1' - \tau u_2''$$

$$b_2 = -\alpha n g u_3'' - \alpha u_3' - \tau u_2''$$

$$b_3 = -\beta(1+r)\Phi g u_3'' - \beta(1+r)\frac{\partial \Phi}{\partial n} u_3' - \tau u_2''$$

In order to solve this system we use Cramer's rule. Define A_j as matrix A with column j replaced by b, and $|A|$ as the determinant of A. Thus $d\tau/dn = |A_1|/|A|$, $dg/dn = |A_2|/|A|$, and $ds/dn = |A_3|/|A|$. From the previous appendix we know that $|A|$ is negative. Calculating $|A_1|$ we find that

$$\begin{aligned} |A_1| &= \epsilon a n^{-\epsilon-1} u_1 [\beta(1+r)^2 \Phi u_3''(\alpha n u_3'' n + u_2'') + \\ &+ u_2'' \beta(1+r)\Phi\alpha[u_3'' u_3''(1+r)n(g-\tau n) + \\ &+ n u_3 u_3''(\mu - 1) + u_3 \Phi(1+r)u_2''] \end{aligned}$$

where μ is the elasticity of Φ with respect to n. We find that μ is positive. Thus, if $\tau n > g$ and $\mu > 1$ then $|A_1|$ is positive, otherwise the sign of it is ambiguous. Using Cramer's rule, we can conclude that if $\tau n > g$ and the elasticity of Φ with respect to n is greater than unity then $d\tau/dn$ is negative, otherwise its sign is ambiguous. This result is given in the main text.

In order to find dg/dn we need to find $|A_2|$. We find that $|A_2|$ will be negative if $\mu < 1$ and $au_3 + \alpha n u_3'' g + u_2'' \tau > 0$. Since we cannot sign the second expression, we conclude that $|A_2|$ is ambiguous, and hence so is dg/dn. For ds/dn we need to find $|A_3|$. We find that

$$\begin{aligned} |A_3| &= a n^{-\epsilon} u_1''[u_3 u_2''(\alpha - \beta(1+r)\frac{\partial \Phi}{\partial n}) + u_3 u_3'' \beta(1+r)\Phi\alpha n(1-\mu)] + \\ &+ n u_2'' u_3 u_3'' \beta(1+r)\Phi\alpha n(1-\mu) \end{aligned}$$

From this we see that $|A_3|$ will be positive if $\mu < 1$ i.e. ds/dn will be negative; if $\mu > 1$ then ds/dn will be positive; and if μ is unity then ds/dn is ambiguous.

References

[1] Abel, Andrew B., (1987), "Operative Gift and Bequest Motives," *American Economic Review* 77, 1037-1047.

[2] Ahituv, Avner, (1995), "Fertility Choices and Optimum Growth: A Theoretical and Empirical Investigation," University of Chicago, PhD Dissertation.

[3] Altig, David, and Steven J. Davis, (1993), "Borrowing Constraints and Two-sided Altruism with an Application to Social Security," *Journal of Economic Dynamics and Control* 17, 467-494.

[4] Barro, Robert J., (1974), "Are Government Bonds Net Wealth?" *Journal of Political Economy* 82, 1095-1117.

[5] Becker, Gary S., (1974), "A Theory of Social Interactions," *Journal of Political Economy* 82, 1063-1093.

[6] Becker, Gary S., and Robert J. Barro, (1988), "A Reformulation of the Economic Theory of Fertility," *Quarterly Journal of Economics* 103, 1-25.

[7] Becker, Gary S., Kevin M. Murphy, and Robert F. Tamura, (1990), "Human Capital, Fertility, and Economic Growth," *Journal of Political Economy* 98, s12-s37.

[8] Bernheim, Douglas B., Andrei Shleifer, and Lawrence H. Summers, (1985) "The Strategic Bequest Motive" *Journal of Political Economy* 93, 1045-76.

[9] Buiter, Willem H., and Jeffry Carmichael, (1984), "Government Debt: Comment," *American Economic Review* 74, 762-765.

[10] Cox, Donald, (1987), "Motives for Private Income Transfers," *Journal of Political Economy* 95, 508-546.

[11] Cox, Donald, (1990), "Intergenerational Transfers and Liquidity Constraints,' *Quarterly Journal of Economics* 105, 187-217.

[12] Cox, Donald, and Emmanuel Jimenez, (1992), "Social Security and Private Transfers in Developing Countries: The Case of Peru," *The World Bank Economic Review* 6, 155-169.

[13] Deaton, Angus, (1989) "Saving in Developing Countries: Theory and Review," *Proceedings of the World Bank Annual Conference on Development Economics.*

[14] Guiso, Luigi, and Tullio Jappelli, (1991), "Intergenerational Transfers and Capital Market Imperfections: Evidence from a Cross-Section of Italian Households," *European Economic Review* 35, 103-120.

[15] Kimball, Miles S., (1987), "Making Sense of Two-Sided Altruism," *Journal of Monetary Economics* 20, 301-326.

[16] Lucas, Robert E. B., and Oded Stark, (1985), "Motivations to Remit: Evidence from Botswana," *Journal of Political Economy* 93, 901-918.

[17] Paulson, Anna L., (1994), "Insurance Motives for Migration: Evidence from Thailand," University of Chicago, PhD Dissertation.

[18] Paxson, Christina, (1995), "Saving and Growth: Evidence from Micro Data," *European Economic Review* 40, 255-288.

[19] Ravallion, Martin, and Lorraine Deardon, (1988), "Social Security in a "Moral Economy": An Empirical Analysis for Java," *Review of Economics and Statistics* 70, 36-44.

[20] Seiler, Edward J., (1998), "Transfers, Remittances and Borrowing in Village India," University of Chicago, PhD Dissertation.

[21] Seiler, Edward J., (1999), "Intergenerational Transfers: Evidence from Urban and Rural Households in Thailand," Hebrew University of Jerusalem, Manuscript.

[22] Stiglitz, Joseph E., and Andrew Weiss, (1981), "Credit Rationing in Markets with Imperfect Information," *American Economic Review* 71, 393-411.

[23] Tcha, MoonJoong, (1995), "Altruism, Household Size and Migration," *Economics Letters* 49, 441-445.

[24] Townsend, Robert M., (1994), "Risk and Insurance in Village India," *Econometrica* 62, 539-591.

PREVIOUS WORKING PAPERS

9101 Yoav Kislev and Willis Peterson - **Economies of Scale in Agriculture: A Reexamination of the Evidence.**

9102 van Dijk G. and C.P. Veerman - **The Philosophy and Practice of Dutch Co-operative Marketing.**

9103 Eli Feinerman and Ariel Dinar - **Economic and Managerial Aspects of Irrigation with Saline Water: The Israeli Experience.**

9104 Yoav Kislev - **Family Farms, Cooperatives, and Collectives.**

9105 Pinhas Zusman and Gordon C. Rausser - **Organizational Equilibrium and the Optimality of Collective Action.**

9106 Yoav Kislev - **The Economics of Water Resources - Principles and their Application** (Hebrew).

9107 Dan Yaron, Ariel Dinar and Hillary Voet - **Innovations on Family Farms: The Case of the Nazareth Region in Israel.**

9108 Pinhas Zusman - **A Conceptual Framework for a Regulatory Policy of the Israeli Water Resources** (Hebrew).

9109 Eitan Hochman and Oded Hochman - **A Policy of Efficient Water Pricing in Israel.**

9110 Dan Yaron - **Water Quota Allocation and Pricing Policy in Agriculture** (Hebrew).

9201 Yujiro Hayami - **Conditions of Agricultural Diversification for Economic Development.**

9202 Pinhas Zusman and gordon C. Rausser - **Endogenous Policy Theory: The Political Structure and Policy Formation.**

9203 Domingo Cavallo - **Argentina's Recent Economic Reform in the Light of Mundlak's Sectorial Growth Model.**

9204 Pinhas Zusman - **Participants' Ethical Attitudes and Organizational Structure and Performance.**

9205 Pinhas Zusman - **Membership Ethical Attitudes and the Performance and Survivability of the Cooperative Enterprise.**

9206 Yoav Kislev - **The Cooperative Experience in Agriculture: International Comparisons.**

9207 Robert M. Behr - **Developoment and Prospects of World Citrus Markets.**

9208 Zvi Lerman and Claudia Parliament - **Financing of Growth in Agricultural Cooperatives.**

9209 Claudia Parliament and Zvi Lerman - **Risk and Equity in Agricultural Cooperatives.**

9210 Csaba Scaki and Zvi Lerman - **Land Reform and Farm Sector Restructuring in the Former Soviet Union and Russia.**

9301 Zvi Lerman, Evgenii Tankhilevich, Kirill Mozhin and Natalya Sapova - **Self-Sustainability of Subsidiary Household Farms: Lessons for Privatization in Russian Agriculture.**

9302 Ayal Kimhi - **Optimal Timing of Transferring the Family Farm from Father to Son.**

9303 Ayal Kimhi - **Investment in Children, Selective Off-Farm Migration, and Human Capital of Future Farmers: A Dynastic Utility Model.**

9304 Meira S. Falkovitz and Eli Feinerman - **Optimal Scheduling of Nitrogen Fertilization and Irrigation.**

9305 Shlomit Karidi-Arbel and Yoav Kislev - **Subsidies and Planning in Broilers--the 1980s.** (Hebrew).

9401 Karen Brooks and Zvi Lerman - **Restructuring of Socialized Farms and New Land Relations in Russia.**

9402 Karen Brooks and Zvi Lerman - **Changing Land Relations and Farming Structures in Former Socialist Countries.**

9403 Vardit Heber and Yoav Kislev - **The Protection of Domestic Production in Agriculture - Three Product** (Hebrew).

9404 Eyal Brill and Eithan Hochman - **Allocation and Pricing of Water Under Common Property at the Regional Level** (Hebrew).

9405 Yacov Tsur and Eithan Hochman - **The Time to Adopt: Count-Data Regression Models of Technology Adopting Decisions.**

9406 Shuky Regev - **Farm Succession--The Legal Aspect** (Hebrew).

9407 Yoav Kislev - **A Statistical Atlas of Agriculture in Israel, 1994 Edition** (Hebrew).

9408 Eithan Hochman and Eyal Brill - **Homogeneity and Heterogeneity of Bio-Resources in Economic Models.**

9409 Eyal Brill and Eithan Hochman - **Allocation and Pricing of Water with Common Property at the Regional Level.**

9501 Kwang ho Cho - **An Economic Diagnosis and Decision Model of Dairy Farming.**

9502 Shuky Regev - **Farm Succesion in the Moshav - A Legal Examination.**

9503 Naomi Nevo - **Inter-Generational Transfer of Farms in Moshavei-Ovdim: An Ethnographical Enquiry.**

9504 Menahem Kantor - **Water Issues in Israel Towards the Next Century** (Hebrew).

9505 Ayal Kimhi - **Estimation of an Endogenous Switching Regression Model with Discrete Dependent Variables: Monte-Carlo Analysis and Empirical Application of Three Estimators.**

9506 Zvi Lerman - **New Style of Agriculture Cooperatives in the Former Soviet Union.**

9507 Dan Yaron - **Israel Water Economy - An Overview.**

9508 Israel Finkelshtain and Yoav Kislev - **Prices vs. Quantities: The Political Perspective.**

9509 Eyal Brill and Eithan Hochman - **Allocation of Common Resources with Political Bargaining.**

9601 Eyal Brill, Eithan Hochman and David Zilberman - **Allocation and Princing of Water at the Regional Level.**

9602 Eithan Hochman and Eyal Brill - **The Israeli Water Economy: Reform vs. Reality.**

9603 Yacov Tsur and Amos Zemel - **Pollution Control in an Uncertain Environment.**

9604 Claudio Pesquin, Ayal Kimhi and Yoav Kislev - **Old Age Security and Intergenerational Transfer of Family Farms.**

9605 Israel Finkelshtain and Yoav Kislev - **Economic Regulation and Political Influence.**

9606 Ayal Kimhi - **Household Demand for Tobacco: Identifying Reasons for Non-Purchases**

9607 Zvi Lerman and Karen Brooks - **Land Reform in Turkmenistan.**

9608 Zvi Lerman, Jorge Garcia-Garcia and Dennis Wichelns - **Land and Water Policies in Uzbekistan.**

9609 Zvi Lerman and Karen Brooks - **The Legal Framework for Land Reform and Farm Restructuring in Russia.**

9610 Ayal Kimhi - **Off-Farm Work Decisions of Farmers Over the Life Cycle: Evidence from Panel Data.**

9611 Tacov Tsur and Ariel Dinar - **On the Relative Efficiency of Alternative Methods for Pricing Irrigation Water and their Implementation.**

9612 Israel Finkelshtain and Yoav Kislev - **Political Lobbying, Individual Rationality, and Asymmetry of Taxes and Subsidies.**

9701 Israel Finkelshtain and Ziv Bar-Shira - **Two-Moments-Decision Models and Utility-Representable Preferences.**

9702 Yair Mundlak - **Agricultural Production Functions - A Critical Survey.**

9703 Israel Finkelshtain and Yoav Kislev - **Political Lobbying and Asymmetry of Pigovian Taxes and Subsidies.**

9704 Yair Mundlak - **The Dynamics of Agriculture.**

9705 Yoav Kislev & Evgeniya Vaksin - **The Water Economy of Israel—An Illustrated Review** . (Hebrew).

9706 Zvi Lerman - **Does Land Reform Matter? Some Experiences from the Former Soviet Union.**

9707 Yoav Kislev & Gadi Rosenthal - **The Watershed** (Hebrew).

9801 Yair Mundlak - **Land Expansion, Land Augmentation and Land Saving..**

9802 Yacov Tsur & Amos Zemel - **The Infinite Horizon Dynamic Optimization Problem Revisited: A Simple Method to Determine Equilibrium Structures.**

9803 Yacov Tsur & Amos Zemel - **Regulation of Intertemporal Public Projects.**

9804 Yoav Kislev - **The Economic Heritage of Ran Mosenson.**(Hebrew).

9805 Ehud Gelb, Yoav Kislev, Hillary Voet - **A Computer in the Milking Parlor.**

9806 Gahl Hochman & Eithan Hochman - **The Impact of Constitutional Changes on Privatization in a Transition Period: The Russian Case.**

9807 Yair Mundlak - **Production and Supply** (Handbook of Agricultural Economics, Vol. 1).

9808 Yoav Kislev and Alla Rakovshchik - **Prices of Agricultural Products: Local and International, for Producers and Consumers. (Hebrew).**

9809 Yacov Tsur & Amos Zemel - **Global Energy Tradeoffs and the Optimal Development of Solar Technologies.**

9810 Edward J. Seiler – **Consumption Smoothing in Village Economies: Intra-temporal Versus Inter-temporal Smoothing Mechanisms.**

9811 Yoav Kislev & Evgeniya Vaksin - **A Statistical Atlas of Agriculture in Israel** (Hebrew).

9812 Edward J. Seiler - **The Use of Remittances and Asset Accumulation in Consumption Smoothing: Evidence from Village India.**

9901 Edward J. Seiler - **Intergenerational Transfers, Borrowing Constraints and Household Size.**