Available online at www.sciencedirect.com
SCIENCE DIRECT®
Review of Economic Dynamics 6 (2003) 431–454
Review of Economic Dynamics
www.elsevier.com/locate/red

Intergenerational time transfers and childcare ☆

Emanuela Cardia [a] and Serena Ng [b,*]

[a] *Département de Sciences Économiques and CIREQ, Université de Montréal, PQ, Canada*
[b] *Department of Economics, Johns Hopkins University, 3400 N. Charles St., Baltimore, MD 21218, USA*

Received 3 November 2000; revised 9 December 2002

Abstract

Although intergenerational transfers of time in the form of grandparenting are substantial, little is known about their role and importance. In this paper, we calibrate an overlapping generations model extended to allow for both time and monetary transfers to the US economy. We use simulations to show that time transfers have important positive effects on labor supply and capital accumulation. We also find that subsidizing the time of the retired spent grandparenting is the most effective child care policy when time transfers are allowed, while subsidizing child care expenses is the most effective when time transfers are not. They both lead to higher levels of child care with positive effects on output and capital accumulation.

JEL classification: J1; J2; D9

Keywords: Intergenerational transfers; Time use; Child care; Home production; Grandparenting; Overlapping generations

1. Introduction

Monetary transfers have traditionally been the focal point of the literature on intergenerational links.[1] Monetary transfers are of theoretical and empirical interest because operative intergenerational transfers can neutralize the effects of some government polices (cf. Barro (1974)). From a macroeconomic perspective, monetary transfers are

☆ This paper was previously circulated as 'How important are intergenerational transfers of time? A macroeconomic analysis.'

* Corresponding author.
E-mail address: serena.ng@jhu.edu (S. Ng).

[1] Monetary transfers here indicate all intergenerational transfers of goods produced in the market economy.

1094-2025/03/$ – see front matter
doi:10.1016/S1094-2025(03)00009-7

generally accepted as a motive for saving, and as such, their role in capital accumulation is worthy of scrutiny.[2]

In this paper we suggest that intergenerational transfers of time in the form of grandparenting are substantial and can have important macroeconomic implications. Our analysis is motivated by the fact that young adults are often confronted with the need to deal with the issue of child care should they choose to work,[3] and that a widely used child care arrangement is provided by grandparents. Data from both the United States and Canada suggest that time transfers in the form of grandparenting are fairly substantial. In the Health and Retirement Survey (HRS), for example, grandparenting averages eight hours a week. An interesting aspect of time transfers is that they are available to all agents regardless of their income and wealth positions. Except for those with extremely high income, a larger fraction of the households in the HRS made more time than money transfers. In contrast, inheritances and *inter vivos* monetary transfers are made by only a small percentage of middle to upper income families.[4]

Our analysis is also motivated by the fact that demographers take as the starting point that intergenerational transfers take place in the form of space (such as coresidence), time (such as the provision of services), and money (such as assistance in the form of cash and goods).[5] Although it is apparent that time is scarce and hence time transfers which relax the time constraint should have economic implications, there is little work in the economics literature on the role and implications of time transfers.[6]

To analyze the role and importance of time transfers, we consider a two-period overlapping generations model with altruistic agents.[7] Agents consume a market good and a home produced good. The home good consumed by the young is interpreted as child care, and the home good consumed by the old is interpreted as old age care. Time and market goods are used in home production. The unique feature of our model is that parents and grandparents both contribute their time to child care. We refer to time spent grandparenting as an intergenerational transfer of time. Grandparenting has two effects: it relieves the time constraint of the working generation by allowing them to devote more time to market work, and it relaxes the budget constraint by reducing the demand for purchased child inputs such

[2] This is in spite of some dispute over the size of money transfers. See Kotlikoff and Summers (1981), Bernheim (1991), Cox and Raines (1985), Gale and Scholz (1994), Modigliani (1988), and Laitner (1997) for the motives and magnitudes of money transfers.

[3] In 1990, 68 percent of married women with children under age six worked, with 42 percent working full time.

[4] Gale and Scholz (1994) report that only about 10% of the SCF respondents provide intergenerational transfers in excess of 3000 dollars, and that 58.2% of these donors are in the top net worth decile.

[5] See Soldo and Hill (1995) and the references therein.

[6] Altonji et al. (1996) analyzed how wealth and income affect money and time transfers in the PSID data.

[7] Becker (1988) discusses but does not provide a formal framework for many of the issues addressed in this paper. Altig and Davis (1992) and Lord and Rangazas (1991) both allow a formal role for the family, but neither analysis considers the time aspect of intergenerational transfers. As well, Altig and Davis assumed capital market imperfections.

as day care and nannies.[8] Agents are one-sided altruistic. They raise children and work in period one; they retire, make monetary transfers to their children, and/or help them raise the grandchildren in period two.

We calibrate the steady state of the model to match some basic stylized facts of the US economy. To examine the effects of transfers, we compare the base case with economies in which time or money transfers are not operational. We find that although both time and money transfers affect capital accumulation positively, they affect work effort rather differently. Monetary transfers directly translating into higher income which increases savings and capital accumulation. But as higher income discourages labor supply, this effect will partially offset and can even outweigh the intertemporal substitution effect brought about by capital accumulation. In contrast, time transfers increase labor supply unambiguously since the only way the young can translate the time transfers into higher purchasing power is to increase work effort.

The model's focus on time transfers and child care makes this framework appropriate to study the macroeconomic effects of child care policies. To this end we study the steady-state effects of three child care policies. We find that subsidizing the time of the old spent grandparenting, or subsidizing child care expenses, can raise the level of child care without adverse general equilibrium effects on output and capital. In contrast, subsidizing the working young to spend more time on child care reduces labor supply and thus the productive capacity of the economy. When time transfers are not allowed, subsidizing child care expenses is still more effective than subsidizing the working young to spend more time on child care.

The rest of the paper is structured as follows. Section 2 presents some stylized facts on the use of time. Section 3 describes the model and calibration is discussed in Section 4. In Section 5, we examine the role and implications of time transfers. Three child care policies are evaluated in Section 6. Section 7 concludes.

2. Some stylized facts

This section consists of two parts. Section 2.1 presents data on time use to show that child care demands a non-negligible fraction of time of the working generation. In Section 2.2 we show that in the US economy there are important intergenerational transfers of time from the old to the young. This information will subsequently be used to calibrate the model.

2.1. Time use by the work force

The most comprehensive study on time use was conducted by the Institute for Social Research of the University of Michigan (hereafter the Michigan Time Use Survey). Based on data from the 1981 survey, Juster (1985a) reports that there are roughly 100 hours of

[8] These are transfers of time which have close but imperfect market substitutes. Cox (1987) analyzed the exchange motive of time transfers but he only considered time transfers which do not have close market substitutes.

non-personal care time per week available for discretionary use by those in the age group 25 to 44.[9] Of this, 35.88 hours are spent on market work, and 23.21 hours are spent on household work. The remaining are leisure hours. Household work is further decomposed into male type work (1.84 hours), female type work (6.82 hours), and others (14.56 hours). Child care is listed under the "others" category.[10,11] In a more precise breakdown of time use by the survey respondents, Hill and Stafford (1985) report that young households (depending on their education level) spend between 381 and 813 minutes per week on child care.

Three additional sources of information about time spent on children are available. First, Hotz and Miller (1988) estimated that the amount of time required to care for a newborn is about 660 hours per year, or 12.69 hours per week. Second, the time budget data analyzed in Leibowitz (1974b) suggest 144.51 minutes per day of an average couple in the survey are spent on physical care of the child, while 131.6 minutes are spent on educational care. These two types of child care add up to 4.6 hours per day. Third, data according to the General Social Survey used by the Canadian National Child Care Study show that for those age 25 to 44, around 5.0 hours per day are spent on paid work, 3.5 hours per day are spent on unpaid work, and 10.6 hours on personal care activities. Unpaid work in the Canadian survey is the analog of household work (which includes child care) in the US survey.

Data on the sources considered therefore suggest that a significant amount of non-sleeping time of the working age population is spent on child care. It should be noted that in spite of the time intensive nature of child care, parents actually enjoy time spent with children. Juster (1985b) finds the top four out of thirty activities which yield the highest 'process benefit' in the Michigan survey are all child care related activities.[12] The problem is how to balance time spent on child care with market work. Gronau (1973) and Angrist and Evans (1996) among many others have analyzed the interaction between fertility decision and female labor supply. See Browning (1992) for a survey of the issues involved.

2.2. Intergenerational transfers

The Health and Retirement Study (HRS) provides extremely useful information about the extent of time and monetary intergenerational transfers from the old to the young[13] in the US economy. The respondents in the survey were born between 1931 and 1941 (and

[9] See Juster (1985a, Table 12.1). Non-personal care time is total time less sleeping and napping time, washing/dressing, plus activities not classified. Benhabib et al. (1991) used a similar concept of non-personal care (or discretionary) time. See Hill (1985, Table 7.A.1) for data on the population as a whole.

[10] This estimate might appear low for those who have been directly involved in child care. This is because the estimate represents the sample average, and hence assign a value of zero to those who have no children.

[11] The following activities are listed under 'other' category: indoor cleaning, miscellaneous tasks, shopping and obtaining services, travel connected with shopping, caring for children, talking, playing and reading to children, medical care to children and travel connected with children.

[12] Process benefit is the flow of psychological satisfaction derived from the process of carrying out an activity.

[13] The transfers from the young to the old are of fairly small magnitude. For example, McGarry and Schoeni (1995, Table 1) find that 7.1% of the HRS respondents receive cash transfers (with a mean of $2126) from their children, while 5.4% of the respondents received time transfers (with a mean of 1028 hours). These conclusions are consistent with the data contained in the HRC–NBER child survey analyzed by Kotlikoff and Morris (1987).

were hence between 51 and 61 years old at the time of the first survey in 1990). In one module of the 1992 HRS survey, 7547 households were interviewed about the structure of the family and family transfers. The questions pertinent to our analysis are:[14]

1. (E35) Have you (and your (husband/partner)) given (your child/any of your children) financial assistance totaling 500 or more in the past twelve months?[15]
2. (E37) About how much money did that assistance amount to altogether in the past 12 months?
3. (E42) In the past 12 months, have you (or your (husband/partner)) spent 100 or more hours altogether taking care of the (grandchild/grandchildren)?
4. (E42a) About how much time altogether did you spend taking care of the grandchildren?
5. (E42b) About how much time altogether did your (husband/partner) spend taking care of the (grandchild/grandchildren)?

Based on an earlier release of the HRS, McGarry and Schoeni (1995) and Soldo and Hill (1995) suggested that over 25% and as many as 40% of the respondents made cash transfers to their children. Soldo and Hill (1995) also reported that 45.9% of married wives spent 100 or more hours caring for grandchildren.[16]

Relevant statistics on transfers using the 1992 release of the HRS data are summarized in Table 1. As we can see, 42.5% of households with at least one child and grandchild transferred more than 100 hours, while 33.9% of households transferred more than $500. Excluding households who could not quantify their transfers exactly or reported zero transfer, the mean for time and money transfers are 1177 hours and $4443.37, respectively. Attributing a value of zero hours/dollars to these observations yield a reweighted mean of 459 hours and $1494.39, respectively. The means for the whole sample (including the ones who do not have children) are 325 hours and $1868.93, respectively.[17]

For those in the HRS data that have at least one child and one grandchild, the decomposition of time and money transfers by income class is given in Table 2. About 45% of middle income households made time transfers, and the percentage is only slightly lower for the very rich and very poor. There is no visible relationship between the number of households making time transfers and income. In results not reported, statistics for time transfers by wealth reveal the same pattern. Thus, time transfers are made irrespective of households' income and wealth. The poor tend to transfer more time than the rich. Note,

[14] Of the 7547 households surveyed, 6955 households have (a total of 24,697) children with an average age of 28.8 years. 5001 of these children live at home (or are temporarily away at school), and 15,990 work more than 30 hours a week. 13,393 of the respondent's children have children. That is, the respondent households have 28,863 grandchildren. The care of these grandchildren are the primary focus of our analysis.

[15] Financial assistance includes giving money, helping pay bills or covering medical expenses, insurance, schooling costs, rent etc. It does not include shared housing or shared food.

[16] See Soldo and Hill (1995, Tables 5 and 6), respectively.

[17] The results using the household weights provided by the HRS to evaluate the mean are similar.

Table 1
Time and money transfers in the Health and Retirement Study (HRS-Wave 1) of 1992

Time transfers			
% of households with at least one child and one grandchild transferring time	Mean time transfer conditional on transfer > 100 hours (2268 households)	Mean time transfer for all households with at least one child and one grandchild (5341 households)	Mean time transfer for total sample (7547 households)
42.5%	1177 hours	459 hours[a]	325 hours[b]
Money transfers			
% of households with at least one child and one grandchild transferring money	Mean money transfer conditional on transfer > $500 (1812 households)	Mean money transfer for all households with at least one child and one grandchild (5341 households)	Mean money transfer for total sample (7547 households)
33.9%	$4443.37	$1494.39[a]	$1868.93[b]

[a] Mean values of time/monetary transfers (first and second row, respectively) for households with at least one child and one grandchild. A zero weight is given to households who spent less than 100 hours/$500 on their grandchildren/children.

[b] Mean values of time/monetary transfers (first and second row, respectively) for all households (and therefore may include households without children and/or without grandchildren). As before a zero weight is given to households who spent less than 100 hours/$500 on their grandchildren/children.

Table 2
Transfers of time and money by income class in the Health and Retirement Study (HRS-Wave 1) of 1992

Household income (in dollars)	Number of households[a]	Number of households transferring time	Mean/(Median) time transfer[b] for the transferring households (in hours)	Number of households transferring money	Mean/(Median) money transfer[b] for the transferring households (in dollars)	Number of households transferring both time and money	Number of households with no forward transfers
[−1078, 10,000]	610 (11.65%)	213 (34.92%)	1449.19 (700)	62 (10.16%)	$2938.98 ($1000.00)	33 (5.41%)	368 (60.33%)
[10,000, 20,000]	814 (15.55%)	305 (37.47%)	1190.20 (625)	167 (20.52%)	$2169.07 ($1200.00)	87 (10.69%)	429 (52.70%)
[20,000, 30,000]	854 (16.32%)	362 (42.39%)	1231.32 (600)	227 (26.58%)	$3323.38 ($1700.00)	117 (13.70%)	382 (44.73%)
[30,000, 40,000]	693 (13.24%)	311 (44.88%)	1128.32 (600)	258 (37.23%)	$3243.28 ($1500.00)	141 (20.35%)	265 (38.24%)
[40,000, 50,000]	654 (12.50%)	310 (47.40%)	1150.77 (500)	260 (39.76%)	$3159.38 ($1900.00)	148 (22.63%)	232 (35.47%)
[50,000, 60,000]	457 (8.73%)	208 (45.51%)	1129.90 (600)	191 (41.79%)	$5433.96 ($2200.00)	111 (24.29%)	169 (36.98%)
[60,000, 70,000]	325 (6.21%)	149 (45.85%)	1168.66 (600)	156 (48.00%)	$5489.26 ($3000.00)	84 (25.85%)	104 (32.00%)
[70,000, 80,000]	251 (4.80%)	122 (48.61%)	1268.40 (636)	128 (51.00%)	$5743.81 ($2100.00)	72 (28.69%)	73 (29.08%)
[80,000, 90,000]	181 (3.46%)	83 (45.86%)	964.84 (600)	100 (55.25%)	$4636.51 ($2700.00)	49 (27.07%)	47 (25.97%)
[90,000, 100,000]	120 (2.29%)	48 (40.00%)	807.96 (684)	77 (64.17%)	$5861.04 ($4000.00)	34 (28.33%)	29 (24.17%)
[100,000, 600,000]	275 (5.25%)	113 (41.09%)	979.44 (500)	156 (56.73%)	$9161.36 ($4600.00)	75 (27.27%)	81 (29.45%)
Mean income: $42,553.57	Total: 5234* households (100.00%)	Total: 2224 households (42.49%)	1173.91 (600)	Total: 1782 households (34.05%)	$4459.87 $2000.00	Total: 951 households (18.17%)	Total: 2179 households (41.63%)

[a] Only the households with income numbers for the last year and with at least one child and one grandchild are reported in the table.

[b] Because of missing values coming from the fact that members of some transferring households could not quantify exactly their time and money transfers, the total transfers reported by these households can be below 100 hours or $500. Thus, only the households that precisely reported transferring at least 100 hours or $500 were included in the computation of the means.

however, that because the low-income households have more grandchildren, the mean time transfer per grandchild actually increases with income.[18]

The amount of time spent grandparenting should depend on how far the respondents reside from their children. The only information in the HRS relating to distance is a question that asked whether the respondents live 10 or more miles away from their children. To obtain an idea of the relationship between time transfers and distance, we restrict the sample to households with only one child 18 years or older and who is not living with his/her parents. This leaves a sub-sample of 1650 households. 55% of these households live within ten miles of their offsprings and made a mean time transfer of 1191 hours. For the 45% of the households who live further than 10 miles from their child, mean time transfers is 992.3 hours. Thus, while time transfers decrease with distance somewhat, the fact that average time transfers is as high as 1000 hours appear not to be sensitive to small variations in distance of around 10 miles.

The pattern for money transfers is quite different from time transfers. While close to 60% of households in the top 20% of the income distribution made money transfers, the number drops to below 25% for those in the bottom 20% of the income distribution. The richer households transfer twice as much as the poor. Because of this asymmetry, the median money transfer is well below the mean. This positive relationship between intergenerational money transfers and income is also documented in several other studies.[19] Notice also that the distributions for time transfers are less skewed than for money transfers. For the lowest income group, 34.92% of households make time transfers while only 10.16% of households make monetary transfers.

The joint distribution for time and money transfers for the 5234 households in the HRS survey can be seen from the bottom of Table 2. Of those who made time transfers (2224 households), less than half (42.76%) also made money transfers, and of the 1782 households who made money transfers, 53.36% also made time transfers. Only 18% (or 951 households) made both time and money transfers. Table 2 also suggests that the proportion of households that transfer time to care for their grandchildren is slightly higher than the proportion of households that transfer money to their children (2224 versus 1782 households). If we use a conservative estimate for time cost of \$6.0 per hour, then a transfer of 325 hours has a value of \$1,950, which is quite close to the sample mean of \$1868 for monetary transfers (see Table 1). Evidently, intergenerational time transfers are as substantial as monetary *inter vivos* transfers in the sample considered. Yet, such transfers are usually neglected in economic analysis.

[18] The average number of grandchildren for the first income bracket is 7.37, for the second is 6.43. For the richest, the average number of grandchildren is around 4. Additional information on these statistics are available on request.

[19] See, for example, Gale and Scholz (1994) and the references therein. Gale and Scholz (1994) use the Survey of Consumer Finances (SCF) and report that only 10% of the interviewed made transfers greater than \$3000. In our study 25% of households made transfers greater or equal to \$5600. This discrepancy can be explained by the different structure of the sample of households interviewed and by what is considered a money transfer. In particular, in the SFC study households are 25 years or older (in the HRS the households are 51 to 61 years old) and educational expenses are excluded (while they are included in the HRS). For our study (that uses a two-period overlapping generations model) the HRS study is a more appropriate source of information because it describes intergenerational transfers from the old to the young.

Other data sources also suggest a non-trivial intergenerational transfer of time. Using data in SIPP (Survey of Income and Program Participation) and the 1977 CPS (Current Population Survey), a study by the US government[20] finds that in 1993, 15.9% of pre-schoolers were cared for by fathers, 6.2% by mothers, 16.5% by grandparents, 8.8% by relatives, 21.6% by family day care (i.e., day care run by non-relatives), and 29.9% by organized centers while the mothers were at work. Compared to the data in 1977, the percentage of children cared for by mothers is on a declining trend, and the percentage cared for by day care centers is on an upward trend. The percentage of children cared for by grandparents is relatively stable over time and stands at an average of 15%. Citing a testimony by O'Connell before the US Senate Committee for finance Presser (1989a) reports that in 1985, 8% of children were cared for by working mothers, 16% by fathers, and 24% by other relatives while the mothers were at work. Furthermore, using data from the National Longitudinal Survey of Labor Market Experience, Presser (1989b) finds that care by grandmothers is the most common (23.9%) type of care arranged for preschool children, averaging 27.1 hours per week. Thus, different data sources suggest that a non-negligible role is played by grandparents in child care in the US.

Data from Canadian sources also suggest an important role for child care by non-working, elderly relatives. According to the Canadian National Child Care Study, the percentage of children aged 0 to 17 months cared for by a relative at home is 12.3% for an average of 17.1 hours, and by a relative not at home (such as a grandparent's home) is 17.7% for an average of 16.0 hours. Indeed, children cared for by relatives not at home is the predominant arrangement for infants in the Canadian data. This type of arrangement remains important even for slightly older children who attend kindergarten.

3. The model

The overlapping generations framework with altruism as the motive for monetary transfers has been used to analyze many intergenerational issues especially in relation to capital accumulation. In this section, we extend a two-period overlapping generations model to allow for time transfers.

3.1. Consumers

Consider a population of three cohorts: the children, the young (i.e., the working parents), and the old (i.e., the grandparents). We suppose that children do not make decisions concerning the allocation of resources, so that economic decisions are only made by the young and the old. Therefore, although there are three cohorts of agents, the notation is set up as though agents live only two periods. Individuals work when they are age 1 and they retire from market activities when they are age 2.[21] An agent of age 1 (the young) is referred to as the working parent and an agent of age 2 (the old) is referred to as the

[20] Source: Current Population Reports, Series P70-53, March 1996.

[21] In a recent paper, Lumsdaine (1998) analyzed the effects of grandparenting on the retirement decision. We take the retirement decision as fixed in this analysis.

grandparent. A retired relative will also be considered as a grandparent in our framework. Agents of the same age are homogeneous in all respects. We treat the household as the consumer unit. As a matter of notation, variables for the young are given a superscript 1, while those for the old have a superscript 2. We assume population grows at rate n and productivity grows at rate g. All variables are in growth adjusted form.

Denote by c_t^i the nondurable market good purchased by a household of age i at time t. Of this, z_t^i is used to produce a home good q_t^i,[22] and the rest is consumed directly. Agents derive utility from leisure L_t^i, and $\bar{c}_t^i$, where $\bar{c}_t^i$ is a composite of the home produced good (q_t^i) and of the part of the market good not used in home production ($c_t^i - z_t^i$). We assume households are one-sided altruistic, and hence as in Barro (1974), they maximize their utility and the utility of their immediate descendants:

$$v_t = U\big(\bar{c}_t^1, L_t^1\big) + \beta U\big(\bar{c}_{t+1}^2, L_{t+1}^2\big) + (1+n)\gamma\beta v_{t+1}. \tag{1}$$

The parameter γ measures the extent to which one generation cares about the next. If $\gamma = 1$ the old discount their children's utility in the same way as their own. If $\gamma = 0$ the model reduces to the life-cycle model. The parameter β is the effective discount factor whose relation with the subjective discount factor and the growth rate will depend on the choice of the utility function.

In our analysis, the two home goods q_t^1 and q_t^2 are given the unique interpretation of child care and old age care, respectively. Authors such as Hill and Stafford (1974), Gronau (1973), Ben-Porath (1973), Angrist and Evans (1996) among others have adapted the framework of Becker (1965) and modeled child care as a home-produced good using two inputs: the parents' time and market inputs.[23] Denote by H_t^{ij} the time spent by those that are age i in the production of the home good that is consumed by those that are age j at time t. Then in the absence of intergenerational linkages, child care can be modeled as a function of a purchased input, z_t^1, and of the time the young spend on their own children, H_t^{11}. Similarly, old age care would be a function of a market good, z_t^2, and of the time the old spend on home production, H_t^{22}. Time transfers are explicitly modeled by modifying the technology for home production to allow the time of the old to be an input in child care. More formally,

$$q_t^1 = \Gamma^1\left(H_t^{11}, \frac{H_t^{21}}{1+n}, z_t^1\right) \equiv \Gamma^1\big(H_t^{1*}, z_t^1\big), \tag{2}$$

$$q_t^2 = \Gamma^2\big(H_t^{22}, z_t^2\big), \tag{3}$$

where H_t^{21} is the time spent grandparenting. The factor input H^{1*} is thus a composite of hours from both generations.

In practice, a key obstacle to enabling time transfers (however altruistic agents might be) is the spatial separation between the young and the old. We assume a cost of τ_t to

[22] There are two ways to think about the presence of the market good in the production of q_t^1. The first interpretation treats market goods as purchased child inputs including such spending as education. However, the market goods can also be child care services (such as day care and nannies) provided by the private or the public sector. The market good used in the production of q_t^2 could be medicare, but it can also be payment to services provided by nursing homes, for example.

[23] We consider a representative household and do not distinguish between the wife's and the husband's time.

be paid by the old on per unit of time transferred. When the transportation cost becomes prohibitively high, time transfers will be inoperative. The assumption that the old pay for the transportation cost is without loss of generality, a point that will soon become apparent.

The endowment of time is normalized to 1, so that for the young at time t:

$$H_t^{11} + L_t^1 + H_t^w = 1 \tag{4}$$

where H_t^w is time spent on work. For the old at time t, the allocation of time satisfies:

$$H_t^{22} + H_t^{21} + L_t^2 = 1. \tag{5}$$

Agents take the real interest rate r_t and the real wage w_t as given. The first and second period budget constraints are, respectively:

$$\begin{aligned} &c_t^1 + s_t = H_t^w w_t + b_t^{21}, \\ &c_{t+1}^2 + (1+n)b_{t+1}^{21} + (1+n)\tau_{t+1} \cdot H_{t+1}^{21} = (1+r_{t+1})\frac{s_t}{1+g} \end{aligned} \tag{6}$$

where s_t and $H_t^w w_t$ are the savings and the labor income of agents who are age 1 at time t. The quantity $b_t^{21} \geqslant 0$ is the (*inter vivos*) transfer received at the beginning of time t by each member who is currently age 1 from a family member who is age 2 at time t. Although there is no money in the model, b_t^{21} will be referred to as a monetary transfer with a slight abuse of terminology. The transfer is of the *inter vivos* type because the young can spend the transfer while the old are still alive. In contrast, bequests enter the budget constraint of the young only after the old have deceased. Note that we have assumed that the young do not pay their parents for the help they receive in looking after their children (H_t^{21}). Interpreting b_t^{21} as the monetary transfer net of payment for services rendered by the old will not change the solution to the model.

The representative consumer maximizes (1) subject to (2), (3), (4), (5) and the budget constraints. There are eight first-order conditions. For a function F, denote F_x as the derivative of F with respect to x. Then the first-order conditions are:

$$\begin{aligned}
&\text{(FOC1)} \quad s_t: && (1+g)U_{c1}(t) = (1+r_{t+1})\beta U_{c2}(t+1), \\
&\text{(FOC2)} \quad L_t: && U_{c1}(t)w_t^1 = U_{L1}(t), \\
&\text{(FOC3)} \quad H_t^{11}: && U_{c1}(t)w_t^1 = U_{q1}(t)\Gamma_{H11}^1(t), \\
&\text{(FOC4)} \quad H_{t+1}^{22}: && U_{L2}(t+1) = U_{q2}(t+1)\Gamma_{H22}^2(t+1), \\
&\text{(FOC5)} \quad z_{t+1}^2: && U_{c2}(t+1) = U_{q2}(t+1)\Gamma_{z2}^2(t+1), \\
&\text{(FOC6)} \quad z_t^1: && U_{c1}(t) = U_{q1}(t)\Gamma_{z1}^1(t), \\
&\text{(FOC7)} \quad b_{t+1}^{21} \geqslant 0: && U_{c2}(t+1) \geqslant \gamma U_{c1}(t+1), \\
&\qquad\quad b_{t+1}^{21} > 0: && \qquad\quad = \gamma U_{c1}(t+1), \\
&\text{(FOC8)} \quad H_{t+1}^{21} \geqslant 0: && \left[U_{L2}(t+1) + U_{c2}(t+1)(1+n)\tau_{t+1}\right] \\
&&& \quad \geqslant \gamma U_{q1}(t+1)\Gamma_{H21}^1(t+1), \\
&\qquad\quad H_{t+1}^{21} > 0: && \left[U_{L2}(t+1) + U_{c2}(t+1)(1+n)\tau_{t+1}\right] \\
&&& \quad = \gamma U_{q1}(t+1)\Gamma_{H21}^1(t+1).
\end{aligned}$$

The first two conditions are the intertemporal Euler equations for consumption and leisure. The third condition says that the ratio of the marginal utility of a unit of time spent at home

and at work should equal the wage rate. Condition 4 says that at the margin, the utility from home production when old should equal the utility from leisure. A unit of market good not consumed can be used in the production of the home good. The marginal utility of the market good from the two modes of consumption are set equal by conditions 5 and 6.

Condition 7 is the first order condition for monetary transfers. Optimality obtains upon equating the discounted marginal utility of consumption across generations, unless we are at a corner solution. Unique to our model is the introduction of time transfers from the old to the young. For transfers of time to be operative, the gain of a unit time spent helping the young (the right-hand side of FOC8) should be equal to the loss induced by time transfers (the left-hand side of FOC8). The cost includes the reduction in leisure as well as the transportation costs which reduce the consumption of the old. In the special case of no transportation cost, it can be shown (using FOC4) that

$$U^2_{q2}(t+1)\Gamma^2_{H22}(t+1) = \gamma U^1_{q1}(t+1)\Gamma^1_{H21}(t+1). \tag{7}$$

Without transportation costs, transfers of time equalize the marginal product of the time of the old, valued in terms of the marginal utility of the home good consumed by the two generations. In contrast, monetary transfers equate the marginal utility of consumption of the market good across generations as seen from FOC7.

3.2. Firms

Competitive firms use a Cobb–Douglas production function

$$y_t = H_t^{w\alpha} k_t^{(1-\alpha)} \tag{8}$$

to produce the sole market good in the economy. Profit maximization implies that factors are paid the value of their marginal product, and hence

$$w_t H_t^w = f(k, H^w) - kf'(k), \qquad r_t = f'(k) - \delta,$$

where δ is the depreciation rate of capital.

3.3. Equilibrium

A stationary equilibrium is defined as values of c_t^1, c_t^2, z_t^1, z_t^2, q_t^1, q_t^2, L_t^1, H_t^{11}, H_t^{22}, H_t^{21}, L_t^2, w_t, r_t, and b_t^{21} which are the same for all t and are such that in each period, the goods and the capital market clear. Goods market equilibrium is given by the aggregate resource constraint

$$k_t + f\left(k_t, H_t^w\right) = k_{t+1}(1+g)(1+n) + \delta k_t + c_t^1 + \frac{1}{1+n}c_t^2 + \tau H_t^{21}. \tag{9}$$

As is standard of overlapping generations models, capital market equilibrium is summarized by

$$k_{t+1} = \frac{s_t}{(1+n)(1+g)}, \tag{10}$$

so that savings by the young becomes productive capital next period. The non-market good clears by construction with $q_t^1 = \Gamma^1(H_t^{11}, H_t^{21}/(1+n), z_t^1)$, and $q_t^2 = \Gamma^2(H_t^{22}, z_t^2)$.

When an interior solution for b_{t+1}^{21} obtains, the first order conditions for s_t and b_{t+1}^{21} can be used to deduce that, in a stationary state:

$$(1+r) = \frac{(1+g)}{\gamma\beta}. \tag{11}$$

For the interest rate to be positive, the condition that $\gamma\beta < (1+g)$ must be satisfied. As discussed in Blanchard and Fischer (1989), the market interest rate is pinned down by the degree of altruism and the discount factor when agents are altruistic and when monetary transfers are operative. Indeed, provided monetary transfers are operative, the steady state real interest rate will be given by Eq. (11) whether or not time transfers are operational. However, if time transfers are operative but monetary transfers are not, the equilibrium market interest rate will be:

$$(1+r) = \frac{(1+g)}{\gamma\beta(1-\theta^1)} \frac{\Gamma_{z1}^1}{\Gamma_{H21}^1} \left[\frac{\Gamma_{H22}^2}{\Gamma_{z2}^2} + \tau(1+n) \right]. \tag{12}$$

While the degree of altruism and the rate of time preference still play a role in the determination of the real interest rate, the technology of home production and transportation cost will also matter. Most importantly, the level of the interest rate will depend on the values of the endogenous variables. Taste and technology parameters are no longer sufficient to pin down the interest rate.

4. Calibration

We assume an annual growth rate of the population of 1%, an annual growth rate of technical progress of 1.5%, and an annual rate of time preference equal to 0.01. The calibration proceeds with the assumption that a household consists of a representative couple that has two children. After 30 years of participating in market work, both household members retire; their children form a new household and have children and they become grandparents. At this point they split their time between leisure, home production, or help raise their grandchildren. They also split their resources between their own consumption and giving money to their children (now grown-ups).[24] With this time line in mind, parameters are set to match some key stylized facts.

4.1. Household preferences

We assume an age-invariant period utility:[25]

$$U(\bar{c}_t, L_t) = \begin{cases} \dfrac{(\bar{c}^b L^{1-b})^{1-\nu}}{1-\nu}, & \nu \neq 1, \\ b\log(\bar{c}_t) + (1-b)\log(L_t), & \nu = 1, \end{cases}$$

[24] While the assumption that after 30 years both members of the households fully retire may seem unrealistic, it is quite reasonable for the average household since it is often the case that one member of the household withdraws from market activities to raise children or works part-time. Our choice of a 30 year period versus 25 or 35 has no consequences on the results of the simulations.

[25] The specification of the utility function is standard in representative agent models with home production. See Ríos-Rull (1993), Benhabib et al. (1991), Greenwood and Hercowitz (1991), and McGrattan et al. (1993).

Table 3
Base case parameter values

Household preferences	Altruism	γ	1
	Discount factor	$\beta*$	$\frac{1}{(1+0.01)^{30}}$
	Effective discount factor	β	$\beta^*(1+g)^{b(1-v)}$
	$U(\bar{c}, L) = \frac{(\bar{c}^b L^{1-b})^{1-v}}{1-v}$	b	0.42
		v	4
	$\bar{c} = \left[a(c-z)^e + (1-a)q^e\right]^{1/e}$	a	0.7
		e	0.3
Child production function	$q^1 = \left[p_1(H^{1*})^{\phi_1} + p_2(z^1)^{\phi_1}\right]^{1/\phi_1}$	ϕ_1	0.6
		p_1	1
		p_2	1
	$H^{1*} = \left[(H^{11})^{m_1} + \left(\frac{d_1 H^{21}}{1+n}\right)^{m_1}\right]^{1/m_1}$	d_1	0.4
		m_1	0.9
Old care production function	$q^2 = \left[p_3\left(H^{22}\right)^{\phi_2} + p_4\left(z^2\right)^{\phi_2}\right]^{1/\phi_2}$	ϕ_2	0.5
		p_3	0.5
		p_4	0.6
	Distance	τ	0.005
Technology	$y = H^{w\alpha} k^{1-\alpha}$	α	0.7
	Depreciation rate	δ	$(1+0.01)^{30} - 1$
	Growth rate	g	$(1+0.015)^{30} - 1$
	Population growth	n	$(1+0.01)^{30} - 1$

where $1/v$ is the intertemporal elasticity of substitution, b and $1-b$ are the share parameters for consumption and leisure, respectively, in the utility function. The utility function ensures that hours worked are constant along the balanced growth path. Furthermore, a CES functional form is assumed for $\bar{c}_t^i$, so that[26]

$$\bar{c}_t^i = \left[a\left(c_t^i - z_t^i\right)^e + (1-a)q_t^{ie}\right]^{1/e}, \qquad e \leqslant 1,\ i = 1, 2. \tag{13}$$

The parameter v in the utility function is the reciprocal of the intertemporal elasticity of substitution. Empirical studies such as Auerbach and Kotlikoff (1987) have found values for v that are close to 4, which is the value we adopt. The parameter b in the utility function is chosen to be 0.42 so that households work for paid compensation 35% to 40% of their discretionary time when young and withdraw from the labor force when old (see Section 2.1). We set $e = 0.3$ in the utility function of both generations. This implies a fairly low elasticity of substitution between the consumption of the market good and child care, consistent with the estimates suggested by the literature.[27]

[26] Rupert et al. (1994) also used a CES function with q_t interpreted as the home produced good.

[27] Leibowitz (1974b) analyzed time budget data and found that "more educated women spend more of their own time in child care in spite of the higher price of their time." Hill and Stafford (1974) reported a similar finding. Leibowitz interpreted this as partly due to a low substitution elasticity between time and other inputs.

We assume:

$$H_t^{1*} = \left[\left(H_t^{11}\right)^{m_1} + \left(\frac{d_1 H_t^{21}}{(1+n)} \right)^{m_1} \right]^{1/m_1}, \quad m_1 \leqslant 1.$$

The elasticity of substitution between hours of the young and the old in H^{1*} is $1/(1-m_1)$. When $m_1 = d_1 = 1$, H_t^{11} and $H_t^{21}/(1+n)$ are perfect substitutes. The parameter d_1 controls for the efficiency of the hours of the old relative to that of the young in the production of q_t^1. For example, d_1 would take on a low value if the old suffer from health problems.

There are various sources (such as discussed in Section 2) that provide estimates of time spent on child care by the young. Our benchmark for H^{11} is based on Hill and Stafford (1985) that young households (depending on their education level) spend between 381 and 813 minutes per week on child care. We take the mean value of about 600 minutes, or about 10 hours a week. Given that total discretionary time is 100 hours, we calibrate H^{11} to 0.10. Calibration for H^{22} is based on our interpretation of q^2 as old age care. As discussed earlier, in the data, the older generation spends about 15% more time on personal care than the young. Because we assume both generations have the same amount of discretionary time in the model, this implies $H^{22} \simeq 0.15$. We then choose a so that young households spend about 10% of discretionary time on child care when young and 15% of time on home work when old.

For H^{21}, our discussion of Section 2 suggests time transfers are between 5 and 10 percent of discretionary time depending on the study. Our benchmark is based on the HRS sample, which suggests that grandparents spend an yearly amount of 458.83 hours (on average) to help care for their grandchildren, or 8.82 hours a week. Thus, H^{21} is calibrated to be around 0.08 by setting τ to 0.005. This, together with the assumptions made earlier leave about 50% of the time for leisure when young (i.e., L^1), and 80% when old (i.e., L^2).

4.2. Production

The market good is produced using a Cobb–Douglas production technology. We assume as in most of the real business cycle literature that $\alpha = 0.7$. Capital is assumed to depreciate at an annual rate of one percent. We assume CES functions for Γ^1 and Γ^2:

$$q_t^1 = \Gamma^1\left(H_t^{1*}, z_t^1\right) = \left[p_1\left(H_t^{1*}\right)^{\phi_1} + p_2\left(z_t^1\right)^{\phi_1}\right]^{1/\phi}, \quad \phi_1 \leqslant 1,$$
$$q_t^2 = \Gamma^2\left(H_t^{22}, z_t^2\right) = \left[p_3\left(H_t^{22}\right)^{\phi_2} + p_4\left(z_t^2\right)^{\phi_2}\right]^{1/\phi_2}, \quad \phi_2 \leqslant 1.$$

The elasticity of substitution between hours and market goods in home production is $1/(1-\phi_i)$, $i = 1, 2$, respectively, and p_1 to p_4 are free parameters for calibrating the model to the data.[28] As noted earlier, we view q^1 as household work relating to child care. This is taken to exclude activities such as cooking and reading. The expense on market inputs to child care (i.e., z^1) are assumed to include all goods and services relating to child care as

[28] We considered two-sided altruism at an early stage of this project and allowed transfers of time from the young to the old. Abstracting from such transfers allows us to focus on the implications of grandparenting.

Table 4
Steady state values (base case)

	$b^{21} \geqslant 0$ $H^{21} \geqslant 0$ $\tau = 0.005$	$b^{21} \geqslant 0$ $H^{21} = 0$ $\tau = 0.2$	$b^{21} = 0$ $H^{21} \geqslant 0$ $\tau = 0.005$	$b^{21} = 0$ $H^{21} = 0$ $\tau = 0.2$
k	0.0141	0.0133	0.0131	0.0100
y	0.1390	0.1310	0.1362	0.1197
$Saving/y$	0.1386	0.1386	0.1314	0.1143
c^1	0.0697	0.0694	0.0677	0.0627
c^2	0.0669	0.0586	0.0675	0.0584
q^1	0.1546	0.1480	0.1554	0.1493
q^2	0.0494	0.0542	0.0490	0.0542
z^1	0.0041	0.0042	0.0039	0.0036
z^2	0.0045	0.0037	0.0046	0.0036
H^{11}	0.0935	0.1199	0.0928	0.1238
H^{22}	0.1322	0.1546	0.1306	0.1548
H^{21}	0.0864	0.0000	0.0928	0.0000
H^w	0.3707	0.3494	0.3715	0.3468
L^1	0.5358	0.5307	0.5357	0.5294
L^2	0.7814	0.8453	0.7766	0.8452
b^{21}	0.0020	0.0057	0.0000	0.0000
r	2.6986	2.6986	2.8608	3.3287
$w \cdot H^w$	0.0973	0.0917	0.0953	0.0838
$(r+\delta) \cdot k$	0.0417	0.0393	0.0408	0.0359
k/y	0.1014	0.1014	0.0961	0.0836
U_1	−21.1302	−22.0238	−21.5550	−23.8472
$\beta \cdot U_2$	−7.6365	−7.2004	−7.6857	−7.2241

well as education expenses,[29] but exclude food and housing expenses induced by children on the household budget. We choose d_1, p_1, p_2, and τ (transportation costs), so that H^{21} is around 8 percent (see above), and that z^1 is about 3% of the income of the young. For old age care, the parameters ϕ_2, p_3, and p_4 are varied to yield H^{22} in the neighborhood of 0.15 and z^2 around 5 percent of the income of the old.

The steady state properties of the model are described in the first column of Table 4. Using the selected parameters, the model reproduces quite well some important stylized facts of the US economy. The interest rate for the 30-year period is 2.6986 which implies an annual interest rate of approximately 4.5%. In the base case, the young spend 36% of the time on market work and 10% of the time on child care. The savings rate is around 14 percent with a capital-output ratio of 0.1014 (or 3.21 if one period was one year). Time transfers are about 8% of discretionary time while money transfers constitute approximately 5% of the income of the old. We performed extensive analyses on the sensitivity of the results to the parameters of the model. Additional results are available on request.

[29] For child care expenses we used information contained in Douthitt and Fedyk (1990).

5. How important are time and money transfers?

In our base case and as in the data, time and money transfers are both positive. To assess the economic effects of these transfers, we ask the following: what would the economy be like if time and/or money transfers had not been operational? To this end, we consider three other economies. In model 2, transportation costs are prohibitively high so it is optimal for agents to make zero time transfers.[30] In model 3, we assume that households do not consider b^{21} as a choice variable and make no monetary transfer. In model 4, neither monetary nor time transfers are seen as choice variables and households in this economy behave like life cycle consumers. Note that when time transfers are absent, the steady state real interest rate is determined by (12) rather than (11).[31]

The results reported in Table 4 show that both monetary and time transfers had contributed importantly to capital accumulation. The base case in which time and money transfers are both operational has 30% more capital (recalling that one period is 30 years) than economy 4 in which neither monetary nor time transfer is available. Introducing a time (money) transfer generates only a small increase to capital accumulation when money (time) transfer is already present. This suggests that what is crucial for capital accumulation is that some form of intergenerational transfer is operational, and not the nature of the transfer per se. This observation is important because traditionally, monetary transfers have been identified as an important source of capital accumulation. But since monetary transfers are made predominantly by the rich and the wealthy, this would seem to suggest that the behavior of only a small fraction of the population matters for capital accumulation. Our result suggests that operational time transfers are just as important for capital accumulation. As discussed in Section 2, data from the HRS indicate that time transfers are important at all levels of income. Thus, even though time is sometimes the only type of transfer that less wealthy families can make, these families still play an important role in capital accumulation.

Time and money transfers also affect capital accumulation and labor supply in different ways. The fundamental difference between time and money transfers is that time transfers are not tradable and therefore do not affect the intertemporal budget constraint in the same way monetary transfers do. Monetary transfers increase capital accumulation by making households save more (compare Economy 2 with 4). Although the resulting reduction in the interest rate induces an intertemporal substitution that increases work effort, the income effect due directly to money transfer is negative (provided leisure is a normal good). The net effect of monetary transfers on labor supply is thus ambiguous a priori, though for the parameters used in the simulations, the two opposing effects result in a small positive effect on labor supply. In contrast, time transfers have a strong positive effect on labor supply because the only way for the young to translate the time transferred from their parents into purchasing power is to work more. The income effect engendered by higher

[30] In the simulations, this amounts to setting $\tau = 0.2$ compared to the base case of 0.005. The results would be the same had we chosen to make time transfers very small by simply making grandparents very inefficient at taking care of their grandchildren (by decreasing d_1).

[31] This explains why the capital-labor ratio is different from the base case. For the parameters considered, the real interest rate increases and the capital-labor ratio decreases relative to the base case.

labor supply encourages saving and enhances capital accumulation. As can be seen from our simulations, time transfers indeed have a much stronger effect on labor supply (H^w increases from 0.3468 to 0.3715) than monetary transfers (H^w increases from 0.3468 to 0.3494).

Time transfers also have implications for money transfers. Time transfers relaxes the time constraint of the young, and the higher labor income reduces the amount of monetary transfers required to equate the marginal utility of consumption across generations. Thus, time transfers tend to lower the magnitude of money transfers. The reduction in monetary transfers in turn allows the old to consume more market goods. In consequence, consumption is more evenly distributed over the life-cycle.

Time transfers have in the past been overlooked as a linkage between generations. The results in this section suggest time transfers have had important effects on labor supply, capital accumulation, and money transfers. In the next section, we consider the role in which time transfers might play in the design of child care policies.

6. Child care policies

An issue that has received significant policy interest is child care policies. There are many facets of quality child care: living and learning environments that provide children with the best opportunities for development, and parental and family involvement. At the center of policy debates is how to relieve the high cost of acquiring the market goods and services involved in child care, and which are the best policies that allow parents to work while providing care for their children. The framework developed in this paper allows us to examine and compare different types of policies and to understand how they affect the labor supply of the young, the overall economy, and intergenerational arrangements.

Government support for child care takes many forms. In the US, the dependent care tax credit, for example, allows taxpayers with a child under age 13 to offset up to $2400 of annual child care expenses (and up to $4800 per year for a family with two or more children). The credit is income-based but most poor families gain nothing from this program since the tax credit is not refundable. Child care subsidies seem more important for the poor. There has been an increased interest since the 1980s by policy makers to publicly subsidize child care provided by relatives. As discussed in Collins and Carlson (1998), an increased amount of subsidies are now going to 'kith and kin caregivers' instead of the parents.[32] Thus, the government can broadly be seen as attempting to reduce the cost of market inputs into child care on the one hand, and encouraging the use of family time in child care on the other.

In formulating our experiments we take the base case level of child care as given and assume that the government wants to increase this by 10%. For our case (see Table 4, column 1) this means increasing q_t^1 from 0.1546 to 0.17. Given that q_t^1 is produced by market goods, time of the young, and time of the old, we consider three policies that encourage their usage. The first policy involves the government giving a rebate for child

[32] This is partly a result of the 1996 federal welfare law.

care expenses, z_t^1. That is, for every dollar of z_t^1 purchased, the government reimburses the young by θ^1, where θ^1 is set such that the target of 0.17 is reached. The next two policies involve the government paying the young or the old a fraction of market wage for every unit of time spent on child care. More precisely, with policy 2, the government makes a payment of $wH^{21}t^{21}$ to the old, with t^{21} set such that the target of $q^1 = 0.17$ is achieved. In policy 3, the government pays $wH^{11}t^{11}$ to the young, with t^{11} set to achieve the target. In all three cases, the government support is financed by lump sum taxation. With these policies, the first and second period budget constraints become, respectively:

$$
\begin{aligned}
&T_t^1 + c_t^1 + s_t = H_t^w w_t + b_t^{21} + \theta^1 z_t^1 + t^{11} H_t^{11} w_t^1,\\
&T_{t+1}^2(1+n) + c_{t+1}^2 + (1+n)b_{t+1}^{21} + (1+n)\tau_{t+1} \cdot H_{t+1}^{21}\\
&\quad = (1+r_{t+1})\frac{s_t}{1+g} + (1+n)t^{21} H_{t+1}^{21} w_{t+1}^1
\end{aligned}
$$

where T_t^1 and T_{t+1}^2 are lump sum taxes. Three of the first order conditions are modified as follows:

$$
\begin{aligned}
&\text{(FOC3)} \quad H_t^{11}: && U_{c1}(t)w_t^1 = U_{q1}(t)\Gamma_{H11}^1(t) + U_{c1}(t)t^{11}w_t^1,\\
&\text{(FOC6)} \quad z_t^1: && U_{c1}(t)\big(1-\theta^1\big) = U_{q1}(t)\Gamma_{z1}^1(t),\\
&\text{(FOC8)} \quad H_{t+1}^{21} \geqslant 0: && \big[U_{L2}(t+1) + U_{c2}(t+1)(1+n)\tau_{t+1}\big]\\
&\qquad\qquad && \quad \geqslant \gamma U_{q1}(t+1)\Gamma_{H21}^1(t+1) + U_{c2}(t+1),\\
&\qquad\qquad H_{t+1}^{21} > 0: && \big[U_{L2}(t+1) + U_{c2}(t+1)(1+n)\tau_{t+1}\big]\\
&\qquad\qquad && \quad = \gamma U_{q1}(t+1)\Gamma_{H21}^1(t+1) + U_{c2}(t+1)
\end{aligned}
$$

For both parents and grandparents, the marginal utility of time spent on child care is higher in the presence of the government time subsidies. As well, the child tax credit distorts the allocation between the use of market and non-market goods.

The results of the policy experiments are reported in columns 3 to 5 of Table 5. The base case of no subsidy is repeated in column 1 for the sake of comparison. The target of $q^1 = 0.17$ is achieved by setting θ^1 to 0.405 in policy 1, t^{21} to 0.352 in policy 2, and t^{11} to 0.1035 in policy 3. Policy 2, which uses the time of the old to promote child care, is apparently the more effective of the three policies, in the sense that the target level of child care can be achieved with the largest positive impact on output and capital. Output and capital are almost 15% higher than in the base case. The reason why such a policy is so effective is that by assumption, the old are fully retired. A unit of their time spent on child care does not come at the expense of productive activities. In contrast, the subsidy to H^{11} distorts the allocation of time of the young between market work and home production. Because of the adverse labor supply effects, the productive capacity of the economy actually shrinks. Although the target level of child care is achieved under policy 3, the economy in fact has less capital and output than if the government policy was absent.

The next best policy is 1, which subsidizes child care expenses. While policy 1 is not as effective as policy 2, it is more desirable than policy 3 in terms of aggregate output and capital. Cheaper z^1 induces substitution for H^{11}. This relaxes the time constraint of the young, allowing them to spend more time on market work. This, along with the capital

Table 5
Child care policies (time transfers, $\tau = 0.005$)

	Base case	Subsidizing z^1 $\theta_1 = 0.405$	Subsidizing H^{21} $t^{21} = 0.352$	Subsidizing H^{11} $t^{11} = 0.1035$
k	0.0141	0.0149	0.0161	0.0135
y	0.1390	0.1468	0.1589	0.1335
$Saving/y$	0.1386	0.1386	0.1386	0.1386
c^1	0.0697	0.0771	0.0681	0.0672
c^2	0.0669	0.0660	0.0906	0.0640
q^1	0.1546	0.1700	0.1700	0.1700
q^2	0.0494	0.0494	0.0385	0.0506
z^1	0.0041	0.0134	0.0037	0.0037
z^2	0.0045	0.0044	0.0075	0.0042
H^{11}	0.0935	0.0808	0.0436	0.1173
H^{22}	0.1322	0.1330	0.0834	0.1384
H^{21}	0.0864	0.0848	0.2998	0.0634
H^w	0.3707	0.3915	0.4237	0.3560
L^1	0.5358	0.5276	0.5328	0.5267
L^2	0.7814	0.7822	0.6168	0.7982
b^{21}	0.0020	0.0002	0.0185	0.0009
r	2.6986	2.6986	2.6986	2.6986
$w \cdot H^w$	0.0973	0.1028	0.1112	0.0934
$(r+\delta) \cdot k$	0.0417	0.0440	0.0477	0.0400
k/y	0.1014	0.1014	0.1014	0.1014
U_1	−21.1302	−21.2794	−20.7336	−21.3819
$\beta \cdot U_2$	−7.6365	−7.7149	−9.6590	−7.5754

accumulated as households become richer, expand the productive capacity of the economy by about 5%. Policies 1 and 2 have rather different quantitative implications for time use, however. While policy 1 reduces parental time spent on child care by 14%, policy 2 reduces it by over 50%. Thus, under policy 2, the young will be spending significantly less time with their children.

The various government policies also have rather different implications for intergenerational transfers. Policy 1 reduces money transfers with little impact on time transfers. This result arises because the young have more resources at their disposal as the productive capacity of the economy expands, which reduces the need for money transfers. Under policy 2, money and time transfers are both higher, reflecting the additional resources that the old receive from the government subsidy on grandparenting. Under policy 3, time and money transfers are both reduced. The need for time transfers is naturally reduced when the government subsidizes the young to spend more time on child care. As output falls with labor supply, the economy is less well-off, and money transfers also fall. Thus, of all the policies, policy 2 also has the most impact in terms of strengthening intergenerational linkages.

While subsidizing H^{21} serves the purpose of relieving the time constraint of the young, the policy is not without drawbacks. Evidently, time spent on grandparenting comes at the cost of leisure of the old. Thus, while the utility of the young is highest with policy 2, the utility of the old is correspondingly lowest. Policy 2 will also not be desirable for a

Table 6
Child care policies (no time transfers, $\tau = 0.2$)

	Base case $\theta_1 = t^{11} = 0$	Subsidizing z^1 $\theta_1 = 0.405$	Subsidizing H^{11} $t^{11} = 0.1035$
k	0.0133	0.0141	0.0129
y	0.1310	0.1392	0.1275
$Saving/y$	0.1386	0.1386	0.1386
c^1	0.0694	0.0770	0.0669
c^2	0.0586	0.0579	0.0579
q^1	0.1480	0.1629	0.1649
q^2	0.0542	0.0542	0.0542
z^1	0.0042	0.0137	0.0837
z^2	0.0037	0.0036	0.0036
H^{11}	0.1199	0.1061	0.1377
H^{22}	0.1546	0.1552	0.1551
H^{21}	0.0000	0.0000	0.0000
H^w	0.3494	0.3713	0.3401
L^1	0.5307	0.5225	0.5222
L^2	0.8453	0.8448	0.8449
b^{21}	0.0057	0.0069	0.0032
r	2.6986	2.6986	2.6986
$w \cdot H^w$	0.0917	0.0975	0.0893
$(r+\delta) \cdot k$	0.0393	0.0418	0.0383
k/y	0.1014	0.1014	0.1014
U_1	−22.0238	−22.1232	−22.1118
$\beta \cdot U_2$	−7.2004	−7.2863	−7.2773

government that has a strong desire for intergenerational equity. From an implementation point of view, the policy would not be feasible without the old being willing to sacrifice their time. For this, altruism is necessary. It should also be reminded that one reason why policy 2 is so effective is that the grandparents in our model are retired, and thus have a low opportunity cost of time. This is less restrictive than it seems, as any retired member of the extended family and who are altruistic can essentially play the grandparent role. Nevertheless, the caveat remains that for policy 2 to be effective if the old were allowed to work, their opportunity cost of market work must be lower than that of the young so that relieving the time constraint of the young remains desirable.

The results thus far suggest that subsidizing H^{21} is the most desirable. But what if time transfers cannot be made? What is the relative effectiveness of subsidizing H^{11} vis-á-vis child care expenses in economies that do not have operational time transfers? To this end, we reassess the two policies in economies with transportation costs high enough that time transfers become undesirable. The purpose of this experiment is to see whether a model that abstracts from time transfers would produce different policy recommendations. The results are reported in Table 6. The results still favor subsidizing child care inputs over subsidizing H^{11}. Whereas subsidizing child care expenses encourages labor supply, subsidizing H^{11} discourages it. Thus, as in the previous analysis, subsidizing H^{11} leads to lower output and capital, even though the target for child care is achieved.

The result that subsidizing child care expenses remains more desirable than subsidizing H^{11} when time transfers are not operational suggests that time transfers are not strongly affected by the subsidy even when such transfers can be made. This finding is important because if time transfers were strongly reduced by a subsidy to child care expenses, the labor supply effect might not have been positive. Disabling time transfers enables us to see that the positive labor supply effect of subsidizing child care expenses does not depend on the time use of the old.

The results of this section can be summarized as follows. Many policies can be designed to achieve the same target level of child care. But for a child care policy to have non-negative effects on output and capital, child care has to increase without discouraging labor supply. Subsidizing child care expenses is the second best policy when time transfers are allowed, and a better alternative than subsidizing the young to spend time on child care when time transfers are not allowed. The family evidently has an influence on what options are open to the government.

7. Conclusion

This paper differs from other intergenerational studies in that it focuses on time transfers. This type of transfer has received little or no attention in the literature. Data from the HRS suggest that intergenerational time transfers in the form of grandparenting are important and that a significant fraction of the households make time transfers but do not make monetary transfers.

Using an overlapping generations model that is calibrated to match some stylized facts of the US economy, it is shown that time transfers can play an important role in the determination of income and capital accumulation with effects that are comparable to those of monetary transfers. Monetary and time transfers, however, have different implications for work effort. Time transfers encourage labor supply since the only way in which the young can translate time transfers from the old into higher consumption is through an increase in time spent on market work. In contrast, monetary transfers have an income effect which discourages market work.

The model developed here lends itself to the study of the macroeconomic effects of child-care policies and their effects on time transfers. We found that subsidizing time spent grandparenting and child care expenses have positive effects on labor supply and capital accumulation. These policies dominate subsidizing the time of the young. When time transfers are disabled, subsidizing child care expenses continues to dominate subsidizing the time of the young. It appears that for child care policies to have non-negative effects on output and capital, child care has to increase without discouraging labor supply. It is important in evaluations of child care policies to also take such macroeconomic effects into account.

The general conclusion of this paper is that family decisions can have non-trivial macroeconomic consequences. In particular, time transfers can play a compensatory role in altruistic families which are prevented from making financial transfers because of market impediments. As well, in countries such as China, Japan, India, and Italy, families are arguably more closely knit than in the United States, suggesting that the extent of time

transfers could be even higher outside of North America. Casual evidence suggests that this is the case. In Japan, for example, coresidence of three generations takes place in one-third of the households. Ogawa and Ermisch (1996) find that female labor supply is higher when a married couple of childbearing age lives with their parents or in-laws, and suggested child care provided by the grandparents as the major reason for coresidence. In such cases, intergenerational transfers in the form of space and time could interact. A closer look at the relative importance of the three currencies of transfers (money, time and space) across countries with different economic and social infrastructure is in order.

Acknowledgments

The authors acknowledge grants from the Social Science and Humanities Research Council of Canada (SSHRC) and the Fonds de la Formation de Chercheurs et l'Aide à la Recherche du Québec (FCAR). We thank an anonymous referee, the editor (Richard Rogerson), Steve Ambler, Donald Cox, Robin Lumsdaine, Phillipe Michel, and seminar participants at Boston University, Federal Reserve Bank at Cleveland, Ohio State University, and Laval University for many helpful comments. Eric Belair provided excellent research assistance.

References

Altig, D., Davis, S.J., 1992. The timing of intergenerational transfers, tax policy, and aggregate savings. American Economic Review 82 (5), 1199–1220.

Altonji, J., Haysahi, F., Kotlikoff, L., 1996. The effects of income and wealth on time and money transfers between parents and children. NBER Working Paper No. 5522.

Angrist, J.D., Evans, W.N., 1996. Children and their parents' labor supply: evidence from exogenous variation in family size. NBER Working Paper No. 5778.

Auerbach, A., Kotlikoff, L., 1987. Dynamic Fiscal Policy. Cambridge Univ. Press, Cambridge.

Barro, R.J., 1974. Are government bonds net wealth. Journal of Political Economy 82 (6), 1095–1117.

Becker, G.S., 1965. A theory of the allocation of time. Economic Journal 75, 493–517.

Becker, G.S., 1988. Family economics and macro behavior. American Economic Review, 1–11.

Ben-Porath, Y., 1973. Economic analysis of fertility in Israel: point and counterpoint. Journal of Political Economy 81 (2), S202–S237.

Benhabib, J., Rogerson, R., Wright, R., 1991. Homework in macroeconomics: household production and aggregate fluctuations. Journal of Political Economy 99 (6), 1166–1187.

Bernheim, B.D., 1991. How strong are bequests motives? Evidence based on estimates of the demand for life insurance and annuities. Journal of Political Economy 99, 899–927.

Browning, M., 1992. Children and household economic behavior. Journal of Economic Literature 30, 1434–1475.

Collins, A., Carlson, B., 1998. Child Care by Kith and Kin. National Center for Children in Poverty.

Cox, D., 1987. Motives for private income transfers. Journal of Political Economy 95 (3), 508–546.

Cox, D., Raines, F., 1985. Interfamily transfers and income redistribution. In: David, M., Smeeding, T. (Eds.), Horizontal Euity, Uncertainty, and Economic Well-Being. NBER and Univ. of Chicago Press, Chicago.

Douthitt, R.A., Fedyk, J., 1990. The Cost of Raising Children in Canada. Butterworths, Canada.

Gale, W.G., Scholz, J.K., 1994. Intergenerational transfers and the accumulation of wealth. Journal of Economic Perspectives fall, 145–160.

Greenwood, J., Hercowitz, Z., 1991. The allocation of capital and time over the business cycle. Journal of Political Economy 99 (6), 1188–1214.

Gronau, R., 1973. The effect of children on the housewife's value of time. Journal of Political Economy 81 (2), S168–S201.

Hill, M.S., 1985. Pattern of time use. In: Juster, F.T., Stafford, F.P. (Eds.), Time, Goods, and Well-Being. Institute for Social Research, Univ. of Michigan, pp. 133–175.

Hill, R.C., Stafford, F.P., 1974. Allocation of time to preschool children and educational opportunity. Journal of Human Resources 9, 323–341.

Hill, R.C., Stafford, F.P., 1985. Parental care of children: time diary estimates of quantity, predictability and variety. In: Juster, F.T., Stafford, F.P. (Eds.), Time, Goods, and Well-Being. Institute for Social Research, Univ. of Michigan, pp. 415–437.

Hotz, J.V., Miller, R.A., 1988. An empirical analysis of life cycle fertility and female labor supply. Econometrica 56 (1), 91–118.

Juster, F.T., 1985a. A note on recent changes in time use. In: Juster, F.T., Stafford, F.P. (Eds.), Time, Goods, and Well-Being. Institute for Social Research, Univ. of Michigan, pp. 313–332.

Juster, F.T., 1985b. Investments of time by men and women. In: Juster, F.T., Stafford, F.P. (Eds.), Time, Goods, and Well-Being. Institute for Social Research, Univ. of Michigan, pp. 177–203.

Kotlikoff, L.J., Morris, J.N., 1987. How much care do the aged receive from their children? A bimodal picture of contact and assistance. NBER working paper No. 2391.

Kotlikoff, L.J., Summers, L.H., 1981. The role of intergenerational transfers in aggregate capital accumulation. Journal of Political Economy 89, 32–706.

Laitner, J., 1997. Intergenerational and interhousehold economic links. In: Rosenzweig, M., Stark, O. (Eds.), Handbook of Population and Family Economics. Elsevier, pp. 189–328.

Leibowitz, A., 1974b. Education and home production. American Economic Review 64, 243–256.

Lord, W., Rangazas, P., 1991. Savings and wealth in models with altruistic bequests. American Economic Review 81 (1), 289–296.

Lumsdaine, R.L., 1998. Caring for Grandchildren and the Retirement Decision. Mimeo. Brown University.

McGarry, K., Schoeni, R.F., 1995. Transfer behavior in the health and retirement study: measurement and the redistribution of resources with the family. Journal of Human Resources 30, S184–S223.

McGrattan, E.R., Rogerson, R., Wright, R., 1993. An equilibrium model of the business cycle with household production and fiscal policy. International Economic Review 38 (2), 267–290.

Modigliani, F., 1988. Measuring the contribution of intergenerational transfers to total wealth: conceptual issues and empirical findings. In: Kessler, D., Masson, A. (Eds.), Modeling the Accumulation and Distribution of Wealth. Clarendon, Oxford, pp. 21–52.

Ogawa, N., Ermisch, J.F., 1996. Family structure, home time demands, and the employment patterns of married women. Journal of Labor Economics 14 (4), 677–702.

Presser, H.B., 1989a. Can we make time for children? The economy, work schedules, and child care. Demography 26 (4), 523–543.

Presser, H.B., 1989b. Some economic complexities of child care provided by grandmothers. Journal of Marriage and the Family 51, 581–591.

Ríos-Rull, J.V., 1993. Working in the market, working at home and the acquisition of skills: a general equilibrium approach. American Economic Review 83 (4), 893–907.

Rupert, P., Rogerson, R., Wright, R., 1994. Estimating Substitution Elasticities in Household Production Models. Mimeo. Federal Reserve Bank of Cleveland.

Soldo, J.B., Hill, M.S., 1995. Family structure and transfer measures in the health and retirement study. Journal of Human Resources 30, S109–S137.