HOW IMPORTANT ARE INTERGENERATIONAL TRANSFERS OF TIME? A MACROECONOMIC ANALYSIS

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Abstract

This paper examines the implications of intergenerational transfers of time and money for labor supply and capital accumulation. Although intergenerational transfers of time in the form of grandparenting are as substantial as monetary transfers in the data, little is known about the role and importance of time transfers. 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 capital accumulation and that these effects can be as significant as those of monetary transfers. However, while time transfers increase the labor supply of the young, monetary transfers produce an income effect that tends to decrease work effort. We also find that child care tax credits have little impact on parental time and money transfers, but that a universal child tax credit would increase the welfare of the rich while the poor would benefit from a means-tested program.

Keywords: intergenerational transfers, time use, child care, home production, grandparenting, overlapping generations.

JEL Classification: J1, J2, D9.

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1 Introduction

Monetary transfers have traditionally been the focal point of the economic literature on intergenerational links. Monetary transfers are of theoretical and empirical interest because operative intergenerational transfers can neutralize the effects of some government polices [c.f. Barro (1974)]. From a macroeconomic perspective, monetary transfers are generally accepted as a motive for saving, and as such, their role in capital accumulation is worthy of scrutiny.[1]

In this paper we suggest that another type of intergenerational transfer with macroeconomic implications can exist whether or not monetary transfers are important. In particular, we allow altruistic agents to make transfers of time in the form of grandparenting. Grandparenting is an intergenerational transfer in two dimensions: 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 as day care and nannies.[2]

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, more households in the HRS made 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 three "currencies": the currency of space (such as coresidence), time (such as the provision of services), and money (such as goods and money).[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

[1] 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.

[2] 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.

[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.

implications of time transfers.[6]

To analyze the role and importance of time transfers, we consider a general equilibrium model which allows for interaction between members of the family.[7] We use a two-period overlapping generations model in which time is a primary input in the home production of a good which, when consumed by the young, is interpreted as child care and when consumed by the old, is interpreted as old age care. In the model, the homogeneous 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. Since the old retire from the labor force, the different valuations of leisure between the young and the old along with altruism provide the impetus for intergenerational transfers of time. A unique feature of our model is that child care is produced by using the parents' and the grandparents' time. This joint production of home goods by family members of different generations provides an intergenerational link which can exist whether or not monetary transfers are present. We calibrate the steady state of the model to match some basic stylized facts of the US economy. We use simulations to examine the effects of these transfers on work effort, capital accumulation and welfare. The model is also used to analyze the steady-state effects of government child care subsidies on the economy. Our framework allows us to understand whether and to what extent these programs crowd out transfers from the old to the young. To study the redistributive effects of child care subsidies, the model is extended to allow households to be heterogeneous in terms of their earning abilities so as to assess the effects of means-tested and universal child care subsidies.

Our simulations show that while time transfers have important effects on capital accumulation with magnitudes similar to those of monetary transfers, the mechanisms by which capital is affected are different. Monetary transfers encourage saving, decrease the interest rate and increase the capital stock via the usual mechanism emphasized by Kotlikoff and Summers (1981). In contrast, the only way the young can benefit from time transfers is to increase work effort. The resulting income effect encourages saving.

A key finding of our analysis is that time and money transfers have different qualitative and quantitative effects on labor supply. Specifically, monetary transfers have an income effect that is negative, and an intertemporal substitution operating through higher saving that is positive. Therefore, depending on whether the intertemporal substitution effect is present, the effect of monetary transfers is either negative, or positive but small. Time transfers, on the other hand,

[6] Altonji, Haysahi and Kotlikoff (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.

have effects on labor supply that are positive because the only way the young can translate the time transfers into higher purchasing power is to increase work effort. This reinforces the positive intertemporal substitution effect on work effort. Thus, labor supply is always higher for those who receive time transfers.

Our simulations also indicate that child care tax credits have a negative, albeit small, effect on intergenerational time and monetary transfers. When there is heterogeneity in earnings ability, a means-tested child tax credit improves the welfare of the poor. A universal child care tax credit, on the other hand, improves the welfare of the higher income group at the expense of the lower income group. This result arises because the higher income group consumes more child care and the lower income group implicitly subsidizes the consumption of the rich. Furthermore, a unit increase in labor supply generates more income to the more efficient (the rich) than to the less efficient (the poor). In general equilibrium, the rich get richer as intergenerational monetary transfers by the rich increase while that by the poor fall. For the parameters considered in our simulations, a universal child care policy aggravates income inequality.

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. Calibration of the model is discussed in Section 4. In Section 5, results are presented for simulations used to study the role and implications of time transfers for the economy. We close the analysis with directions for further research.

2 Some Stylized Facts

This section consists of two parts. Subsection 1 presents data on time use to show that child care demands a non-negligible fraction of time of the working generation. In subsection 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) report that there are roughly 100 hours of non-personal care time per week available for discretionary use by those in the age group 25 to 44[8]. 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

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

(6.82 hours), and others (14.56 hours). Child care is listed under the "others" category[9],[10]. 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 (1985c) finds the top four out of thirty activities which yield the highest 'process benefit' in the Michigan survey be all child care related activities.[11] 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[12] in the US economy. The respondents in the survey were born between 1931 and 1941 (and were hence between 51 and 61 years old at the time of the first survey in 1990). In one module of the HRS survey, 7547

[9] 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.

[10] 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.

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

[12] 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 $2,126) from their children, while 5.4% of the respondents received time transfers (with a mean of 1,028 hours). These conclusions are consistent with the data contained in the HRC-NBER child survey analyzed by Kotlikoff and Morris (1987).

households were interviewed about the structure of the family and family transfers. The questions pertinent to our analysis are:[13]

1. (E35) Have you [and your (husband/partner)] given (your child/any of your children) financial assistance totalling 500 or more in the past twelve months[14]?

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 earlier releases 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 in the year preceding the survey.[15]

To further understand the nature of transfers from the old to the young, we investigated into the final release of the HRS data. The basic statistics 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 1,177 hours and $4,443.37 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.[16]

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

[13] Of the 7547 households surveyed, 6955 households have (a total of 24697) children with an average age of 28.8 years. 5001 of these children live at home (or are temporarily away at school), and 15990 work more than 30 hours a week. 13393 of the respondent's children have children. That is, the respondent households have 28863 grandchildren. The care of these grandchildren are the primary focus of our analysis.

[14] 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.

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

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

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, however, that because the low-income households have more grandchildren, the mean time transfer per grandchild actually increases with income.[17]

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 which asked whether 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.[18] 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. This suggests that households find it easier to make intergenerational time 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 (2,224 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

[17] 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.

[18] 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.

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). Thus, intergenerational time transfers, which are usually neglected in economic analysis, are as substantial as monetary *inter vivos* transfers.

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[19] 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

In this section, we examine the importance of time and monetary transfers using a two-period overlapping generations model extended to allow for home production. There is no uncertainty in the model. Throughout, n denotes the rate of population growth and $g = \lambda_{t+1}/\lambda_t - 1$ as the rate of (Harrod-neutral) productivity growth, where λ_t is the level of technical efficiency at time t.

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

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. Specifically, an agent of age 1 (the young) is taken to mean the working parents and an agent of age 2 (the old) is taken to mean the grandparents. Individuals work when they are age 1 and they retire from market activities when they are age 2.[20] For this section, agents of the same age are homogeneous in all respects. We treat the household as the consumer unit. Agents derive utility from leisure, the consumption of a market good and a home produced good. We assume households are one-sided altruistic, and hence as in Barro (1974), they maximize their utility and the utility of their immediate descendants:

$$V_t = U^1(\bar{C}_t^1, L_t^1) + \beta U^2(\bar{C}_{t+1}^2, L_{t+1}^2) + \gamma\beta V_{t+1} \tag{1}$$

where for $i = 1, 2$, $\bar{C}_t^i$ is a composite good comprising of a consumed market good, $C_t^i - Z_t^i$, and a home produced good, Q_t^i. More precisely, C_t^i is the nondurable market good purchased by an individual of age i at time t, Z_t^i is purchased inputs used to produce the non-market good Q_t^i, and L_t^i is leisure. The parameter γ measures the extent to which one generation cares about the next, and β is the subjective discount factor. Hence $\gamma\beta$ is the factor at which the utility of future generations is discounted. If $\gamma = 1$ the old discount their children's utility in the same way as their own. With $\gamma = 0$ parents make no transfers and the model reduces to the life-cycle model.

We assume an age-invariant period utility[21]:

$$\begin{aligned} U(\bar{C}_t, L_t) &= \frac{(\bar{C}^b L^{1-b})^{1-\nu}}{1-\nu} \qquad \nu \neq 1, \\ &= b\log(\bar{C}_t) + (1-b)\log(L_t) \qquad \nu = 1. \end{aligned}$$

where $1/\nu$ 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

$$\bar{C}_t^i = [a(C_t^i - Z_t^i)^e + (1-a)Q_t^{ie}]^{1/e}. \qquad e \leq 1, \, i = 1, 2 \tag{2}$$

By construction, $\bar{C}_t^i$ is homogeneous of degree one in λ_t[22].

[20] 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.

[21] 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, Rogerson and Wright (1993).

[22] Rupert, Rogerson and Wright (1994) also used a CES function with Q_t interpreted as the home produced good.

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] This suggests that in the absence of intergenerational linkages, child care can be modelled as a function of purchased inputs (Z_t^1) and the time of the young (H_t^{11}). That is, $Q_t^1 = \widetilde{\Gamma}^1(\lambda_t H_t^{11}, Z_t^1)$.[24] Similarly, old age care would be a function of time (H^{22}) and market goods (Z_t^2) with $Q_t^2 = \widetilde{\Gamma}^2(\lambda_t H_t^{22}, Z_t^2)$.[25] 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, $Q_t^1 = \Gamma^1(\lambda_t H_t^{11}, \lambda_t \frac{H_t^{21}}{1+n}, Z_t^1) \equiv \Gamma^1(\lambda_t H_t^{1*}, Z_t^1)$, where H_t^{21} is the time spent grandparenting. The factor input H^{1*} is thus a composite of hours from both generations. We assume:

$$H_t^{1*} = [(H_t^{11})^{m_1} + (\frac{d_1 H_t^{21}}{(1+n)})^{m_1}]^{1/m_1}, \qquad m_1 \leq 1.$$

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. We assume CES functions for Γ^1 and Γ^2. Hence,

$$Q_t^1 = \Gamma^1(\lambda_t H_t^{1*}, Z_t^1) \quad = \quad [p_1(\lambda_t H_t^{1*})^{\phi_1} + p_2(Z_t^1)^{\phi_1}]^{1/\phi_1}, \qquad \phi_1 \leq 1. \tag{3}$$

$$Q_t^2 = \Gamma^2(\lambda_t H_t^{22}, Z_t^2) \quad = \quad [p_3(\lambda_t H_t^{22})^{\phi_2} + p_4(Z_t^2)^{\phi_2}]^{1/\phi_2} \qquad \phi_2 \leq 1. \tag{4}$$

The elasticity of substitution between hours and market goods in home production is $1/(1-\phi_i)$, i =1,2 respectively. The parameters p_1 to p_4 are free parameters for calibrating the model to the data.[26]

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 Υ_t to be paid by the old on per unit time transferred, and thus total transportation cost is $\Upsilon_t \cdot H_t^{21}$. When the transportation cost becomes prohibitively costly, time transfers will be inoperative. The assumption that the old pay for the transportation cost is without lost of generality, a point that will soon become apparent.

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

[24] 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.

[25] 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.

[26] 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 allow us to focus on the implications of grandparenting.

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

$$H_t^{11} + L_t^1 + H_t^w = 1 \tag{5}$$

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

$$H_t^{22} + H_t^{21} + L_t^2 = 1 \tag{6}$$

We assume that the government can give a child care subsidy to the young. The subsidy is financed by a lump-sum tax on the young (T^1) and/or the old (T^2). The child care subsidy takes the form of a rebate (i.e. a subsidy of rate θ^1) on purchased market inputs relating to child care (i.e. Z^1 in the model).

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:

$$\begin{aligned} T_t^1 + C_t^1 + S_t &= H_t^w w_t + B_t^{21} + \theta^1 Z_t^1, \\ T_{t+1}^2 + C_{t+1}^2 + (1+n)B_{t+1}^{21} + (1+n)\Upsilon_{t+1} \cdot H_{t+1}^{21} &= (1+r_{t+1})S_t \end{aligned} \tag{7}$$

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. $B_t^{21} \geq 0$ 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}). As will become clear, 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.

For a variable X_t, define $x_t = X_t/\lambda_t$ as the normalized value which expresses X_t in effective terms, noting that Υ_t in effective terms is denoted by τ_t. The maximization problem in terms of the stationary variables becomes:

$$v_t = U(\bar{c}_t^1, L_t^1) + \beta^* U(\bar{c}_{t+1}^2, L_{t+1}^2) + \gamma^* \beta^* v_{t+1}, \tag{8}$$

where $v_t = \lambda^{-b(1-\nu)} V_t$, $\gamma^* = \gamma(1+n)$. The effective discount factor is $\beta^* = \beta(1+g)^{b(1-\nu)}$ given the specification of the utility function. Let

$$W_t = U\left[\bar{c}_t^1, L_t^1\right] + \beta^* U\left[\bar{c}_{t+1}^2, L_{t+1}^2\right]. \tag{9}$$

The optimization problem is well defined if the sum $v_t = \sum_{i=0}^{\infty} (\gamma^* \beta^*)^i W_{t+i}$ converges, and hence when the necessary condition $\gamma^* \beta^* < 1$ is satisfied. The representative consumer maximizes (8) subject to (3),(4),(5),(6) and the budget constraints. For a function F, denote F_x as the derivative of F with respect to x. The first order conditions are:

$$\begin{array}{llccc}
FOC1: & s_t: & (1+g)\ \ U_{c1}(t) & = & (1+r_{t+1})\beta^* U_{c2}(t+1), \\
FOC2: & L_t: & U_{c1}(t)w_t^1 & = & U_{L1}(t), \\
FOC3: & H_t^{11}: & U_{c1}(t)w_t^1 & = & U_{q1}(t)\Gamma^1_{H11}(t), \\
FOC4: & H_{t+1}^{22}: & U_{L2}(t+1) & = & U_{q2}(t+1)\Gamma^2_{H22}(t+1), \\
FOC5: & z_{t+1}^2: & U_{c2}(t+1) & = & U_{q2}(t+1)\Gamma^2_{z2}(t+1), \\
FOC6: & z_t^1: & U_{c1}(t)(1-\theta^1) & = & U_{q1}(t)\Gamma^1_{z1}(t), \\
FOC7: & b_{t+1}^{21} \geq 0: & (1+n)U_{c2}(t+1) & \geq & \gamma^* U_{c1}(t+1), \\
 & b_{t+1}^{21} > 0 & & = & \gamma^* U_{c1}(t+1), \\
FOC8 & H_{t+1}^{21} \geq 0: & [U_{L2}(t+1) + U_{c2}(t+1)\,(1+n)\,\tau_{t+1})] & \geq & \gamma^* U_{q1}(t+1)\Gamma^1_{H21}(t+1)/(1+n), \\
 & H_{t+1}^{21} > 0 & & = & \gamma^* U_{q1}(t+1)\Gamma^1_{H21}(t+1)/(1+n).
\end{array}$$

The first two conditions are the intertemporal Euler equations for consumption and leisure and are standard. 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 (after subsidy) marginal utility of the market good from the two modes of consumption are set equal by conditions 5 and 6. Notice that the child tax credit distorts the allocation between the use of market and non-market goods. Condition 7 equates the discounted marginal utility of consumption across generations, unless we are at a corner solution.

Condition 8 is unique to our problem. Because of altruism, assisting the young in the production of their home good generates utility to the old, and it is discounted by $\gamma^*\beta^*$to arrive at utility as of age 1. However, this act of altruism reduces leisure of the old, and having to pay for transportation costs when making time transfers also reduce the consumption of the old. The total cost to the old is discounted at β^*. Condition 8 says that when transfers of time are operative, the marginal utility of a unit time spent helping the young should be equal to the net marginal utility of leisure when old.

Altruism has a second effect in our model as it induces time transfers, and it is instructive to consider the special case of no transportation cost. The first order conditions for H_{t+1}^{22} and H_{t+1}^{21} imply that, when τ=0,

$$(1+n)U_{q2}^2(t+1)\Gamma^2_{H22}(t+1) = \gamma^* U_{q1}^1(t+1)\Gamma^1_{H21}(t+1). \tag{10}$$

It follows that 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 non-market good consumed by the two generations. In contrast, monetary transfers equate the marginal utility of consumption of the market good across generations.

As noted earlier, b^{21} can be interpreted as transfers from the old to the young net of payment for time spent grandparenting. Suppose the young pays the old some fraction $0 \leq \epsilon \leq 1$ of the market wage w_t^1 for each unit time spent on grandparenting. The forgone consumption by the young (in terms of utility) is $\epsilon w_t^1 U_{c1}'$. But because the old care about the young, the marginal utility of the old is reduced by $\gamma \epsilon w_t^1 U_{c1}'$. The payment increases the utility of the old by $\epsilon w_t^1 (1+n) U_{c2}'$. But the first order condition for b^{21} requires that if money transfers are operative, $\gamma U_{c1}' - (1+n)U_{c2}' = 0$. Thus, the payment for grandparenting induces a zero sum cost to the utility of the old. In other words, because altruistic agents look at the resources of the family, a change in the distribution of the resources between family members has no real effects. Thus, payment for time transfers will only affect the level of money transfers leaving the other equilibrium values in the economy intact. Analogous arguments can be used to deduce that b^{21} will simply adjust if the young instead of the old pay for the transportation cost.

The Government The government faces a period budget constraint of

$$\theta^1 z_t^1 = t_t^1 + \frac{t_t^2}{1+n}$$

Firms Competitive firms use the Cobb-Douglas production function

$$y_t = H_t^{w\alpha} k_t^{(1-\alpha)} \tag{11}$$

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

$$\begin{aligned} w_t H_t^w &= f(k, H^w) - k f'(k), \\ r_t &= f'(k) - \delta, \end{aligned}$$

where δ is the depreciation rate of capital.

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:

$$k_t + f(k_t, H_t^w) = k_{t+1}(1+g)(1+n) + \delta k_t + c_t^1 + \frac{1}{1+n} c_t^2 + \tau H_t^{21} \tag{12}$$

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

$$k_{t+1} = \frac{s_t^1}{(1+n)(1+g)}, \tag{13}$$

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:

$$(1+r) = \frac{(1+n)(1+g)}{\gamma^* \beta^*} = \frac{(1+g)}{\gamma \beta^*}. \tag{14}$$

For the interest rate to be positive, the condition that $\gamma^* \beta^* < (1+n)(1+g)$ 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 equation (14) 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 determined by:

$$(1+r) = \frac{(1+n)(1+g)}{\gamma^* \beta^* (1-\theta^1)} \frac{\Gamma_{z1}^1}{\Gamma_{H21}^1} \left[\frac{\Gamma_{H22}^2}{\Gamma_{z2}^2} + \tau(1+n) \right]. \tag{15}$$

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

In our analysis, one period is treated as 30 years. The model's growth rate of population is $n = (1+n')^{30} - 1$ where n' is the annual rate of population growth. Similarly, g' is the annual rate of technical progress and $\beta = 1/(1+\beta'')$, where $\beta'' = (1+\beta')^{30} - 1$, β' is the annual rate of time preference. We assume $n' = .01$, $g' = .015$, and $\beta' = .01$.

Household Preferences 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).[27] With this time line in mind, the preference parameters are set to match some key stylized facts. We now describe the choice of these parameters.

The parameter ν 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 ν that are close to 4, which is the value we adopt. We set $\beta' = .01$ so that the savings rate is about 15%. The parameter b in the utility function is chosen to be .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[28].

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 .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 $H^{22} \simeq .15$. 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 .08. 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).

Production Technology As noted earlier, we view q^1 as household work relating to child care. This excludes activities such as cooking and reading, and is narrower than what is usually referred to as home production in the equilibrium representative agent models cited above. This treatment

[27]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.

[28]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.

can be justified by assuming that non-child care activities are separable from all other types of consumption in the utility function. We set d_1 and τ (transportation costs) so that H^{21} is around 8 percent (see above). Market inputs used to produce q^1 are calibrated to be about 3% of the income of the young. These market inputs to child care (i.e. z^1) are assumed to include all goods and services relating to child care as well as education expenses,[29] but exclude food and housing expenses induced by children on the household budget. The parameters p_1 and p_2 are set so that for the chosen value of $\gamma = 1$, the level of transfers as well as other choice variables match the basic stylized facts. Finally, for old age care, the parameters ϕ_2, p_3 and p_4 are varied to yield H^{22} in the neighborhood of .15 and z^2 around 5 percent of the income of the old.

For the production of the market good, we assume as in most of the real business cycle literature that $\alpha = .7$. Capital is assumed to depreciate at an annual rate of one percent. In the base case and unless otherwise indicated, all tax rates and transfers are set to zero.

The base line parameter values used in the calibration are summarized in Table 3. We performed extensive analyses on the sensitivity of the results to the parameters of the model. To conserve space, the additional results are not reported in detail but are available on request.

5 Results

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 .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.

5.1 How Important are Time and Money Transfers?

To assess the role of time and monetary transfers on work effort, capital accumulation and welfare, we simulate the model numerically and consider four steady-state scenarios: one where agents can make both monetary and time transfers (base case), one where it is optimal for agents to make zero time transfers, one where households make no monetary transfer, and one where neither type of transfer is operative. The results are reported in columns 1 through 4 of Table 4. Time transfers are made not operational by setting $\tau = .2$ (compared to the base case of .005). In this case

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

transportation costs are so high that it is optimal not to make time transfer.[30] Note that in this case when only time transfers are available, the steady state real interest rate is determined by equation (15) rather than (14).[31] Monetary transfers are made inoperative by excluding b^{21} as a choice variable. The fourth scenario is obtained by excluding monetary and time transfers from the household's choice problem simultaneously. Without intergenerational transfers in either time or money, households behave as though they are life-cycle savers.

The results reported in Table 4 show that both monetary and time transfers contribute importantly to capital accumulation. Compared to the case when neither type of transfer is operational (column 4), capital is 30% higher (recalling that one period is 30 years) when either monetary transfers or time transfers are available (columns 2 and 3 respectively). Introducing a second transfer (column 1) generates only a small increase to capital accumulation when either time or money 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.

Although monetary and time transfers have similar quantitative effects on the economy, they affect capital accumulation and labor supply in different ways. Monetary transfers increase capital accumulation by making households save more (compare columns 2 and 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 labor supply encourages saving and enhances capital accumulation. As can be seen from our simulations, time transfers indeed have a much stronger

[30] 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.

effect on labor supply (H^w increases from .3468 to .3715) than monetary transfers (H^w increases from .3468 to .3494). While it is tempting to conjecture that time transfers are substitutes for monetary transfers, this is clearly not the case here. The reason is that time transfers are not tradable and therefore do not affect the intertemporal budget constraint in the same way monetary transfers do.

Time transfers also have implications for the volume of monetary transfers. Specifically, time transfers decrease the amount of monetary transfers from the old to the young. This is because the higher labor income reduces the amount of monetary transfers required to equate the marginal utility of consumption across generations. 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 increase the production of the home good for the young and reduce that of the old. This is because when time transfers are operative, the time of the old is also used as an input in producing child care, q^1. With the base case parameters, the utility loss from less leisure outweighs the utility gain from higher second period consumption. Thus, in the simulations, time transfers raise the utility of the young but reduce the utility of the old. However, from the point of view of lifetime utility, even altruistic households with monetary transfers only (see the last two rows of columns 2 and 4) are better off than life-cycle households. Allowing for time transfers increase lifetime utility further (see the last two rows of columns 1 and 3).

All the results presented in Table 4 have been the subject of extensive sensitivity analyses. We focused on the crucial elasticity parameters that are specific to our model, ϕ_1, ϕ_2, e and m_1. In all our experiments, labor supply is higher when time transfers are introduced. As well, the finding that monetary transfers have only a small effect on labor supply is robust. Additional simulations were also conducted to assess the sensitivity of the results to the benchmark value of time transfers, and the result that time transfers have a positive effect on labor supply is also robust.[32] However, the relative importance of monetary and time transfer on capital accumulation is less clear cut. In some cases monetary transfers have a larger impact on capital accumulation than time transfers without significantly affecting other variables qualitatively or quantitatively (for example, with high values of ϕ_2).[33]

[32]For example, setting $\tau = .03$ gives $H^{21} = .0359$, $k = .0137$, and $H^w = .3601$, giving a benchmark for time transfers that is half of that reported in the base case in Table 4 (with $H^{21} = .0864$, $k = .0141$, and $H^w = .3707$). Allowing for only money transfers increases H^w to .3494, and allow for only time transfers increases labor supply to .3615. When neither type of transfer is operative, H^w is .3468. Thus, the primary result that time transfers increase labor supply continues to hold. The only notable difference resulting from a lower benchmark for time transfers is that the capital stock increases by less (12% instead of 30%.)

[33]For example, with $\phi_2 = .9$ (high substitutability between time and market good in the old-age-care production function) the life-cycle capital stock is .0079. Time transfers increase it to .0107 and monetary transfers to .0128. Thus, time transfers increase the capital stock by about 35% and monetary transfers, by about 60%. Correspondingly,

5.2 The Cohabitation of Life Cycle and Altruistic Consumers

One interesting result that comes out of Table 4 is that monetary and time transfer have different implications for labor supply. To examine this issue further, we consider an economy populated by two types of households: one altruistic and the other life-cycle.[34] We assume that 40% of households are life-cycle consumers. This is based on the fact that in the HRS sample, 41.6% gives neither time nor money transfer (see Table 2). Recall that as long as altruistic households make monetary transfers (even if it was just for one household), the market interest rate will always be determined by (14). Thus, holding the parameters underlying (14) constant, the cohabitation of life cycle and altruistic consumers will give steady state equilibria with the same interest rate. This setup allows us to examine the labor supply effect of both types of transfers holding the real interest rate fixed (and therefore suppressing the intertemporal substitution effect).

We again consider three cases: one in which altruistic households make both monetary and time transfers, one in which they only make monetary transfers, and one in which they only make time transfers. The results of these simulations are reported in Table 5. When both time and money transfers are available, the labor supply of the altruistic households is higher than life cycle households as well as altruistic households with only monetary transfers (column 1, $H^w = .3667$). The addition of time transfers to monetary transfers increases the labor supply of the altruistic young. With monetary transfers alone (i.e. time transfers are inoperative), the altruistic young actually spend less time on market work (column 3, $H^w = .3458$) than life-cycle households (column 4, $H^w = .3548$). This is in contrast to the result reported in Table 4 that the labor supply effect of monetary transfers is positive. This discrepancy arises because in the present experiment, the life cycle consumers face the same interest rate as consumers making intergenerational transfers. This highlights the fact that monetary transfers have a direct effect on labor supply that is negative. A positive general equilibrium labor supply effect from monetary transfers can arise only if the intertemporal substitution effect is sufficiently strong to offset the negative income effect. Extensive sensitivity analyses by varying b, ϕ_1, ϕ_2, e and m_1 show that the negative effect of monetary transfers on labor supply is robust. Adding time transfers always increases labor supply relative to those who make monetary transfers only, though the magnitude of the difference is experiment specific.

For completeness, the last two columns of Table 5 report results pertaining to an economy in which life cycle consumers coexist with altruistic consumers but that monetary transfers are inoperative. The result that time transfers have positive effects for labor supply continue to hold.

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the life-cycle labor supply is .3336. Time transfers increase it to .3579 and monetary transfers (without time transfers) bring it to .3379. Thus, even though in this case monetary transfers have a larger contribution to capital accumulation than time transfers, the results for labor supply are qualitatively similar to the ones obtained in Table 4 with $\phi_2 = .5$.

[34] Michel and Pestieau (1998) showed that the steady state equilibrium is determined by the degree of altruism irrespective of the number of altruistic households.

Several additional features of the results in Table 5 are worth reinforcing. First, operative time transfers further increase the lifetime utility of the altruistic households. Second, as in Table 4, the altruistic households enjoy higher levels of consumption and lifetime utility than the life-cycle households (column 2 or 4), but this involves a trade-off between higher utility when young and lower utility when old. This is because time and money transfers relax the time constraint and expand consumption possibilities of the altruistic young, but these same households become donors of time and money when old, at which point they enjoy fewer discretionary resources than those who are not altruistic. Third, the consumption of life-cycle households as well as those with only monetary transfers (see columns 3 and 4, respectively) are higher when young than when old. But when time transfers are allowed (see column 1), the consumption of the old is closer to the consumption of the young. The old can afford more market goods because they save more when young and substitute some monetary transfers with time transfers when old. Thus, time transfers also have the effect of flattening the consumption profile.

5.3 Does a Child Tax Credit Crowd Out Private Transfers?

In our model with homogeneous agents and operative monetary transfers, a lump-sum redistribution of taxes over time has no effects on the economy (unless we are at a corner solution) because a redistribution of taxes is exactly compensated by a redistribution of parental monetary transfers with no effect on time transfers. In other words, Ricardian equivalence holds. To see the impact of distortionary taxes on the economy, we introduce a child care tax credit paid by the old (via lump-sum taxes).[35] The results (not reported) show that if the government subsidizes 20% of child care costs, income would increase (by about 2%), and child care would increase by about 3%. While monetary and time transfers would decrease by 15% and 2% respectively, the subsidy does not completely eliminate parental transfers. Note, however, the child care subsidy is a (involuntary) transfer of resources from the old to the young. Viewed in this light, the government can engineer a transfer from the old to the young without fully crowding out voluntary parental support, and total parental support (voluntary plus child care subsidy) could in fact be higher.

To examine who benefit from child-care subsidies, we allow agents to differ in terms of their efficiency in market work. For the low-income households (type A), H^w units of market work translate into $\mu^A H^{wA}$ man hours, for the high-income households (type B), H^w units of market work translate into $\mu^B H^{wB}$ units of time for market work, with $\mu^B > \mu^A$. We assume half the population is of type A and half is of type B. Because earnings is the only source of income in the model, the type A will be poorer than the type B both when young and old. Thus, there is no

[35]Although it is not realistic to assume that taxes discriminate between age groups, we do this to understand more clearly how taxing the old affects their support to the young. The results described in this section would not change qualitatively if we were to tax (lump-sum) both the old and the young.

intergenerational income mobility in the model.[36]

In columns 1 and 2 of Table 6 we report the results for the base case of this model. Not surprisingly, the type A households who are less efficient earn and consume less than the type B households. The type A also make less monetary and time transfers than the type B. The positive relationship between income and money transfers is self-explanatory and is consistent with the data. The positive relationship between time transfers and income arises because, by assumption, both types A and B are equally efficient in home production. Given the efficiency advantage of type B in market work, type A has a comparative advantage in home production and hence has a smaller need for time transfers. In the HRS, the mean time transfer per-grandchild increases with income, as in our model economy.[37]

We then assess the desirability of a means-tested subsidy and that of a universal subsidy in this economy with households that differ by earnings ability. Under a means tested program, the eligibility to the child tax subsidy depends on income. We assume that the government knows agents by type (since income is observed) and only the low income group (type A) can claim the mean-tested subsidy. Under a universal program, all households receive the subsidy. In both cases, a 20% subsidy is considered. This is paid for by lump-sum taxation on the old of both types. The results of the means-tested program are reported in columns 3 and 4 of Table 6. The child tax credit makes low income households use more market inputs (such as day care, nannies) in child care and increases the labor supply of the young. Overall child care increases (from .1699 to .1723). Monetary transfers are not affected and time transfers decrease only slightly. As labor supply increases, the young earn more labor income. For the high income group who pays for the subsidy without receiving any benefit, there are no important changes in parental support. In terms of utility, the low income households are better off and high income households are worse off.

The results for the universal child care subsidy are reported in columns 5 and 6 of Table 6. Because the total value of the subsidy is proportional to the level of spending on child care, the rich benefit more because their absolute spending on child care is higher. As well, each additional unit of time spent on market work generates more labor income for the more efficient group (high income) than the less efficient group (low income). The universal subsidy program thus has the undesirable effect of increasing the lifetime utility of the rich at the expense of the poor.

[36]The aggregate production function is now a function of effective hours worked. That is,

$$y_t = k_t^{(1-\alpha)}(Type^A \mu^A H^{wA} + Type^B \mu^B H^{wB})^\alpha \equiv k_t^{1-\alpha} H_t^{w\alpha},$$

with $Type^A = Type^B = .5$, where $Type^A$ is the proportion of households who are less efficient (or the poor). When $\mu^A = \mu^B = 1$ the base case solution of the previous section obtains.

[37]Another possible explanation for why time transfers are higher for the low income groups is that the lower income households might choose to live closer or even coreside with their parents to take further advantage of joint home production. In such a case, τ^A should be lower than τ^B, rather than equal .

6 Conclusion

This paper differs from other studies on family decisions and intergenerational transfers in that it focuses on time transfers. This type of transfer has received little or no attention in the economics literature. Data from the HRS suggest that intergenerational time transfers in the form of grandparenting are important. The HRS survey also indicates that an important fraction of the households who make time transfers do not make monetary transfers, a phenomenon prevalent for the lower income groups.

Using an overlapping generations model that is calibrated to match some important stylized facts of the US economy, it is shown that time transfers 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.

Both time and monetary transfers are found to be not very sensitive to the introduction of a child care subsidy. In a model where households are heterogeneous in terms of their earning abilities, a means tested program is found to improve the welfare of the poor while a universal child care tax credit benefits the higher income households and decrease the welfare of the lower income households. Consideration of transitional dynamics are required to thoroughly assess the desirability of child-care tax policies. As well, other forms of tax financing (i.e. other than lump-sum taxation) should be considered.

The general conclusion of this paper is that family decisions can have non-trivial macroeconomic consequences. This result is important because time transfers can play an important and 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.

An aspect that we have not examined in this paper is how and whether the economy benefit from parents and/or grandparents spending more time with children. A widely appreciated fact is that the knowledge and skills achieved by children are acquired at home from parents or adults, rather than in schools from teachers, see Juster (1985c). It is also a widely held belief that children who receive more care when they were young are more likely to succeed. Becker (1991) writes that "Children from successful families are more likely to be successful themselves by virtue of the additional time spent on them" (p.179). Others have also found a positive relation between cognitive skills formed in childhood and economic success at older ages.[38] Becker and Tomes (1976) suggest such a relationship at the microeconomic level. In future work, we will attempt to make the explicit connection between the quality of child care and future human capital and analyze the consequences from a macroeconomic perspective.[39]

[38]Hill and O'Neill (1995) and the references therein.

[39]Lord and Rangazas (1991) emphasize the link from outlays on children to labor supply by allowing bequests to be made in terms of investment in human capital, but it is not clear if parental time per se contributes to the formation of human capital.

References

Altig, D. and 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. and Kotlikoff, L. (1996), The Effects of Income and Wealth on Time and Money Transfers Between Parents and Children. NBER Working Paper 5522.

Angrist, J. D. and Evans, W. N. (1996), Children and their Parents' Labor Supply: Evidence from Exogenous Variation in Family Size, NBER Working Paper 5778.

Auerbach, A. and Kotlikoff, L. (1987), *Dynamic Fiscal Policy*, Cambridge University Press, Cambridge.

Barro, R. J. (1974), Are Government Bonds Net Wealth, *Journal of Political Economy* **82:6**, 1095–1117.

Becker, G. S. (1988), Family Economics and Macro Behavior, *American Economic Review* pp. 1–11.

Becker, G. S. (1991), *A Treatise on the Family*, Harvard University Press.

Becker, G. S. and Tomes, N. (1976), Child Endowments and the Quantity and Quality of Children, *Journal of Political Economy* **84:4**, S143–S162.

Becker, Gary, S. (1965), A Theory of the Allocation of Time, *Economic Journal* **75**, 493–517.

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. and 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* **XXX**, 1434–1475.

Cox, D. (1987), Motives for Private Income Transfers, *Journal of Political Economy* **95:3**, 508–546.

Cox, D. and Raines, F. (1985), Interfamily Transfers and Income Redistribution, *in* M. David and T. Smeeding (eds), *Horizontal Euity, Uncertainty, and Economic Well-Being*, NBER and University of Chicago Press, Chicago.

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

Gale, W. G. and Scholz, J. K. (1994), Intergenerational Transfers and the Accumulation of Wealth, *Journal of Economic Perspectives* **fall**, 145–160.

Greenwood, J. and 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. A. and O'Neill, J. (1995), Family Endowments and the Achievement of Young Children with Special Reference to the Underclass, *Journal of Human Resources* **XXIX:4**, 1065–1099.

Hill, M. S. (1985), Pattern of Time Use, *in* F. T. Juster and F. P. Stafford (eds), *Time, Goods, and Well-Being*, Institute for Social Research, The University of Michigan, pp. 133–175.

Hill, R. C. and Stafford, F. P. (1974), Allocation of Time to Preschool Children and Educational Opportunity, *Journal of Human Resources* **9**, 323–341.

Hill, R. C. and Stafford, F. P. (1985), Parental Care of Children: Time Diary Estimates of Quantity, Predictability and Variety, *in* F. T. Juster and F. P. Stafford (eds), *Time, Goods, and Well-Being*, Vol. Time, Goods, and Well-Being, Institute for Social Research, The University of Michigan, pp. 415–437.

Hotz, J. V. and 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* F. T. Juster and F. P. Stafford (eds), *Time, Goods, and Well-Being*, Institute for Social Research, The University of Michigan, pp. 313–332.

Juster, F. T. (1985c), Investments of Time by Men and Women, *in* F. T. Juster and F. P. Stafford (eds), *Time, Goods, and Well-Being*, Institute for Social Research, The University of Michigan, pp. 177–203.

Kotlikoff, L. J. and Morris, J. N. (1987), How Much Care Do the Aged Receive from their Children? A Bimodal Picture of Contact and Assistance, NBER working paper 2391.

Kotlikoff, L. J. and Summers, L. H. (1981), The Role of Intergenerational Transfers in Aggregate Capital Accumulation, *Journal of Political Economy* **89**, 706–32.

Laitner, J. (1997), Intergenerational and Interhousehold Economci Links, *in* M. Rosenzweig and O. Stark (eds), *Handbook of Population and Family Economics*, Elseiver Science, pp. 189–328.

Leibowitz, A. (1974b), Education and Home Production, *American Economic Review* **64**, 243–256.

Lord, W. and 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. and 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* **XXX**, S184–S223.

McGrattan, E. R., Rogerson, R. and Wright, R. (1993), An Equilibrium Model of the Business cycle with Household production and Fiscal Policy, *International Economic Review* **38:2**, 267–290.

Michel, P. and Pestieau, P. (1998), Fiscal Policy in a Growth Model with Both Altruistic and Nonaltruistic Agents, *Southern Economic Journal* **64:3**, 682–697.

Modigliani, F. (1988), Measuring the Contribution of Intergenerational Transfers to Total Wealth: Conceptual Issues and Empirical Findings, *in* D. Kessler and André (eds), *Modeling the Accumulationa dn Distribution of Wealth*, Clarendon Press, Oxford, pp. 21–52.

Ogawa, N. and Ermisch, J. F. (1996), Family Sructure, 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. and Wright, R. (1994), Estimating Substitution Elasticities in Household Production Models, mimeo, Federal Reserve Bank of Cleveland.

Soldo, J. B. and Hill, M. S. (1995), Family Structure and Transfer Measues in the Health and Retirement Study, *Journal of Human Resources* **XXX**, S109–S137.

Table 1

Time and Money Transfers in the Health and Retirement Study (HRS-Wavel) of 1992			
Time Transfers			
% of households with at least one child and one grandchild transferring time	Mean time transfer conditional on transfer > 100 hours (2,268 households)	Mean time transfer for all households with at least one child and one grandchild (5,341 households)	Mean time transfer for total sample (7,547 households)
42.5%	1,177 hours	459 hours[1]	325 hours[2]
Money Transfers			
% of households with at least one child and one grandchild transferring money	Mean money transfer conditional on transfer > $500 (1,812 households)	Mean money transfer for all households with at least one child and one grandchild (5,341 households)	Mean money transfer for total sample (7,547 households)
33.9%	$4,443.37	$1,494.39[1]	$1,868.93[2]

[1] 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.

[2] 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-Wavel) of 1992

Household income (in dollars)	Number of households[1]	Number of households transferring time	Mean/(Median) time transfer[2] for the transferring households (in hours)	Number of households transferring money	Mean/(Median) money transfer[2] for the transferring households (in dollars)	Number of households transferring both time and money	Number of households with no forward transfers
[-1,078, 10,000]	610 (11.65%)	213 (34.92%)	1,449.19 (700)	62 (10.16%)	$2,938.98 ($1,000.00)	33 (5.41%)	368 (60.33%)
[10,000, 20,000]	814 (15.55%)	305 (37.47%)	1,190.20 (625)	167 (20.52%)	$2,169.07 ($1,200.00)	87 (10.69%)	429 (52.70%)
[20,000, 30,000]	854 (16.32%)	362 (42.39%)	1,231.32 (600)	227 (26.58%)	$3,323.38 ($1,700.00)	117 (13.70%)	382 (44.73%)
[30,000, 40,000]	693 (13.24%)	311 (44.88%)	1,128.32 (600)	258 (37.23%)	$3,243.28 ($1,500.00)	141 (20.35%)	265 (38.24%)
[40,000, 50,000]	654 (12.50%)	310 (47.40%)	1,150.77 (500)	260 (39.76%)	$3,159.38 ($1,900.00)	148 (22.63%)	232 (35.47%)
[50,000, 60,000]	457 (8.73%)	208 (45.51%)	1,129.90 (600)	191 (41.79%)	$5,433.96 ($2,200.00)	111 (24.29%)	169 (36.98%)
[60,000, 70,000]	325 (6.21%)	149 (45.85%)	1,168.66 (600)	156 (48.00%)	$5,489.26 ($3,000.00)	84 (25.85%)	104 (32.00%)
[70,000, 80,000]	251 (4.80%)	122 (48.61%)	1,268.40 (636)	128 (51.00%)	$5,743.81 ($2,100.00)	72 (28.69%)	73 (29.08%)
[80,000, 90,000]	181 (3.46%)	83 (45.86%)	964.84 (600)	100 (55.25%)	$4,636.51 ($2,700.00)	49 (27.07%)	47 (25.97%)
[90,000, 100,000]	120 (2.29%)	48 (40.00%)	807.96 (684)	77 (64.17%)	$5,861.04 ($4,000.00)	34 (28.33%)	29 (24.17%)
[100,000, 600,000]	275 (5.25%)	113 (41.09%)	979.44 (500)	156 (56.73%)	$9,161.36 ($4,600.00)	75 (27.27%)	81 (29.45%)
Mean income: $42,553.57	Total: 5,234* households (100.00%)	Total: 2,224 households (42.49%)	1,173.91 (600)	Total:1,782 households (34.05%)	$4,459.87 ($2,000.00)	Total: 951 households (18.17%)	Total: 2,179 households (41.63%)

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

[2] 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.

Table 3

Base Case Parameter Values			
Household Preferences	Altruism	γ	1
	Annual Subjective Discount Rate	β'	01
	$U(\bar{c}, L) = \frac{(\bar{c}^b L^{1-b})^{1-v}}{1-v}$	b	.42
		v	4
	$\bar{c} = [a(c-z)^e + (1-a)q^e]^{1/e}$	a	.7
		e	.3
Child Production Function	$q^1 = [p_1(\lambda H^{1*})^{\phi_1} + p_2(z^1)^{\phi_1}]^{1/\phi_1}$	ϕ_1	.6
		p_1	1
		p_2	1
	$H^{1*} = [(H^{11})^{m_1} + (\frac{d_1 Z^1}{1+n})^{m_1}]^{1/m_1}$	d_1	.4
		m_1	.9
Old Care Production Function	$q^2 = [p_3(\lambda H^{22})^{\phi_2} + p_4(z^2)^{\phi_2}]^{1/\phi_2}$	ϕ_2	.5
		p_3	.5
		p_4	.6
	Distance	τ	.005
Technology	$y = H^{w\alpha} k^{1-\alpha}$	α	.7
	Annual Depreciation rate	δ'	.01
	Annual Growth rate	g'	.015
	Annual Population Growth	n'	.01

Table 4

Steady State Values				
	Base Case			
	$b^{21} \geq 0$ $H^{21} \geq 0$	$b^{21} \geq 0$ $H^{21} = 0$	$b^{21} = 0$ $H^{21} \geq 0$	$b^{21} = 0$ $H^{21} = 0$
		$\tau = .2$		$\tau = .2$
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

Table 5 : Altruistic and Non-Altruistic Agents

	Steady State Values					
	Altruistic	**Life-cycle**	**Altruistic**	**Life-cycle**	**Altruistic**	**Life-cycle**
	60%	**40%**	**60%**	**40%**	**60%**	**40%**
	Base Case Parameters		$\tau^a = \tau^b = .2$			
	$H^{21} \geq 0$	$H^{21} = 0$	$H^{21} = 0$	$H^{21} \geq 0$	$H^{21} \geq 0$	$H^{21} = 0$
	$b^{21} \geq 0$	$b^{21} = 0$	$b^{21} \geq 0$	$b^{21} = 0$	$b^{21} = 0$	$b^{21} = 0$
k	0.0138		0.0133		0.0119	
y	0.1357		0.1310		0.1302	
$Saving/y$	0.1386		0.1386		0.1253	
c^1	0.0700	0.0688	0.0698	0.0688	0.0662	0.0656
c^2	0.0675	0.0575	0.0593	0.0575	0.0683	0.0579
q^1	0.1553	0.1468	0.1488	0.1468	0.1564	0.1481
q^2	0.0495	0.0543	0.0542	0.0543	0.0488	0.0542
z^1	0.0042	0.0042	0.0043	0.0042	0.0038	0.0038
z^2	0.0046	0.0036	0.0037	0.0036	0.0047	0.0036
H^{11}	0.0947	0.1189	0.1206	0.1189	0.0928	0.1215
H^{22}	0.1323	0.1555	0.1541	0.1555	0.1293	0.1551
H^{21}	0.0840	0.0000	0.0000	0.0000	0.0379	0.0000
H^w	0.3667	0.3548	0.3458	0.3548	0.3703	0.3506
L^1	0.5386	0.5263	0.5336	0.5263	0.5369	0.5279
L^2	0.7837	0.8445	0.8459	0.8445	0.7733	0.8449
b^{21}	0.0059	0.0000	0.0094	0.0000	0.0000	0.0000
r	2.6986		2.6986		3.0126	
$w \cdot H^w$	0.0962	0.0931	0.0908	0.0931	0.0931	0.0881
$(r+\delta) \cdot k$	0.0451	0.0341	0.0427	0.0341	0.0417	0.0351
k/y	0.1014		0.1014		0.0917	
U_1	-20.8077	-22.5896	-21.6577	-22.5896	-21.7785	-23.2900
$\beta^* \cdot U_2$	-7.5360	-7.3274	-7.1175	-7.3274	-7.6805	-7.2762

Table 6: Heterogenous Agents

Steady State Values						
			Child care subsidy to *type A* paid by the old*		Universal child care subsidy paid by the old*	
	Low income *type A*	High income *type B*	Low income *type A*	High income *type B*	Low income *type A*	High income *type B*
	Base Case Parameters		$\theta^A = .2$		$\theta^A = \theta^B = .2$	
k	0.0102		0.0102		0.0104	
y	0.1008		0.1011		0.1023	
$Saving/y$	0.1386		0.1386		0.1386	
c^1	0.0303	0.0696	0.0309	0.0696	0.0308	0.0719
c^2	0.0316	0.0668	0.0316	0.0668	0.0314	0.0668
q^1	0.1699	0.1545	0.1723	0.1545	0.1717	0.1601
q^2	0.0527	0.0493	0.0528	0.0493	0.0527	0.0494
z^1	0.0009	0.0041	0.0016	0.0041	0.0016	0.0069
z^2	0.0016	0.0045	0.0016	0.0045	0.0016	0.0045
H^{11}	0.1349	0.0932	0.1327	0.0931	0.1316	0.0893
H^{22}	0.1694	0.1321	0.1695	0.1321	0.1694	0.1325
H^{21}	0.0553	0.0869	0.0546	0.0870	0.0562	0.0849
H^w	0.3321	0.3715	0.3348	0.3718	0.3380	0.3767
L^1	0.5330	0.5353	0.5324	0.5351	0.5304	0.5340
L^2	0.7754	0.7810	0.7759	0.7808	0.7744	0.7826
b^{21}	0.0005	0.0013	0.0005	0.0013	0.0000	0.0015
r	2.6986		2.6986		2.6986	
$w \cdot H^w$	0.0436	0.0975	0.0439	0.0976	0.0444	0.0989
$(r+\delta) \cdot k$	0.0194	0.0411	0.0195	0.0411	0.0196	0.0418
k/y	0.1014		0.1014		0.1014	
U_1	-38.0684	-21.1918	-37.9535	-21.2152	-38.3950	-21.0601
$\beta^* \cdot U_2$	-14.3599	-7.6557	-14.3357	-7.6629	-14.4723	-7.6257

* Via lump sum taxes.