Intended and Accidental Bequests in a Life-cycle Economy*

Lutz Hendricks
Arizona State University
Department of Economics
February 6, 2002

Abstract

This paper studies quantitative importance of accidental versus intended bequests. Bequests are decomposed into accidental and intended components by comparing the implications of a standard life-cycle model under alternative assumptions about bequest motives. The main finding is that accidental bequests account for at least half, and perhaps for all of observed bequests. The paper then examines how assumptions about bequest motives affect the effects of income tax changes. In contrast to previous research, I find that bequest motives are not important for the analysis of capital income taxation. The effects of labor income taxes are reduced by altruistic bequests, but the role played by bequests is much weaker than suggested by previous models.

1 Introduction

This paper studies the quantitative importance of accidental versus intended bequests. Given that bequests account for a large fraction of household wealth, it is important to understand the motives that lead parents to transfer wealth to their children (Gale and Scholz 1994). Several competing theories of bequest behavior have been proposed, such as parental altruism or joy-of-giving motives where parents derive utility from the act of giving (Abel 1987). However, the fact that only a small share of household wealth is annuitized, suggests that some bequests arise accidentally as parents die while holding non-annuitized wealth (Abel 1985). The purpose of this paper is to measure the magnitude of such accidental bequests.

Understanding whether bequests are mostly intended or accidental has important implications for policy analysis. The most obvious example is the evaluation of estate tax reforms. If bequests are accidental, then taxing estates does not distort saving behavior. However, if bequests are altruistically motivated, then taxing estates could entail large welfare costs (Laitner 2001). Bequest motives also determine whether Ricardian Equivalence holds for tax changes that shift revenues across generations. Finally, Engen et al. (1997) and Hendricks (2000) show that the effects of income tax changes depend in important ways on whether parents are altruistically linked with their children.

This paper measures the quantitative importance of accidental versus intended bequests by comparing the implications of an otherwise standard life-cycle model under alternative assumptions about bequest behavior. The model features random mortality as a source of accidental bequests. Since there

*Financial support from the College of Business at Arizona State University is gratefully acknowledged. For helpful comments I am grateful to Jose-Victor Rios-Rull and to seminar participants at Arizona State University and the University of Pennsylvania.

is no consensus about the motives underlying bequest behavior,[1] the model accommodates two popular bequest motives: altruism and joy-of-giving.[2]

The main finding is that accidental bequests account for at least half of observed bequests. Empirical estimates of aggregate inheritances in the U.S. cluster around 2% of output (see Hendricks 2001 for a review of the evidence). A life-cycle model with selfish households implies an inheritance-output ratio of 1.5%, which coincides with data from the 1989 Survey of Consumer Finances (SCF). This figure is robust against changes in risk aversion and annuity income, but alternative assumptions about mortality rates imply larger accidental bequests of up to 2.5% of output. Hence, accidental bequests can fully account for bequests at least as large as those observed in the SCF.

However, accidental bequests *cannot* fully account for some of the larger empirical estimates of aggregate inheritances, which range up to 2.65% of output (Gale and Scholz 1994). Accounting for these estimates requires that bequests are partly intended. I therefore measure the fraction of accidental bequests in a model of altruistic parents, where the strength of the bequest motive is chosen to match an inheritance-output ratio of 2.65%. Accidental bequests are defined as the difference between the bequests of altruistic and selfish households. I find that 47% of bequests are accidental, while 53% are intended. With weaker bequest motives, the fraction of accidental bequests is obviously larger. I conclude that at least half of bequests, and perhaps all bequests, are accidental.

The paper then examines other observations that have been interpreted as evidence in favor of accidental or intended bequests. The fact that retired households hold only a small share of wealth in the form of private annuities is at times interpreted as evidence in favor of intended bequests (see Hurd 1990 for a discussion). However, I find that even selfish households in the baseline model choose not to annuitize, given realistic rate of return differentials between annuitized and non-annuitized assets. De Nardi (2000) argues that intended bequests are necessary to account for the emergence of large estates. Her model features joy-of-giving preferences that are parameterized to approximate altruism. By contrast, I find that altruistically motivated bequests do not increase the concentration of bequests. Regardless of the bequest motive, the model fails to account for the observation that the largest 2% of estates account for nearly 70% of aggregate bequests.

Finally, retired households decumulate assets only slowly, if at all. This is at times interpreted as evidence in favor of intended bequests (see Hurd 1990). On the other hand, Hurd (1987) shows that parents dissave at similar rates as non-parents, which appears inconsistent with altruism. I find that bequest motives have only a weak effect on dissaving in retirement. Regardless of the bequest motive, model households dissave at rates that are consistent with data. As a result, the differences between altruistic and selfish households may be small and hard to detect in the data. I conclude that neither of these observations offers strong evidence in favor of accidental or intended bequests.

The last part of the paper studies whether the outcomes of tax experiments depend on the nature or the strength of the bequest motive, given that models match key features of size distribution of inheritances. Engen et al. (1997) and Hendricks (2000) show that altruistic bequests substantially alter the steady state effects of tax policies in models with certain lifetimes. The intuition is that altruism effectively extends the planning horizon of the household and thus increases the long-run interest elasticity of saving. In contrast to these previous results, I find that the effects of capital income taxes are nearly invariant to assumptions about bequest motives as well as to reasonable variations in the size of bequest flows. Altruistic bequests modify the effects of labor income taxation, but by less than previous work suggests. The discrepancy is due to the fact that in the models of Engen et al. (1997) and of Hendricks (2000) all households have operative bequest motives and all bequests are

[1] After reviewing the literature, Gale and Perozek (2000, p. 7) conclude that "each motive that has been tested has also been rejected."

[2] Additional theories have been proposed in the literature, but are difficult to implement in a quantitative model. Important examples include strategic bequests (Bernheim et al. 1985) and exchange motives (Cox and Rank 1992).

intended. By contrast, in the model studied here as well as in the data, only one-third of households leave positive bequests.

Previous literature A related paper is Gokhale et al. (2001) which studies the implications of accidental bequests for retirement wealth inequality. Their model implies accidental bequests of only around 1% of output. While the model accommodates a number of interesting extensions, such as marital sorting and progressive income taxation, it maintains three potentially important assumptions which are relaxed here: households are infinitely risk averse, selfish, and live at most to age 88.

The paper is organized as follows. The model is described in section 2. Results from the numerical experiments are presented in section 3. The final section concludes.

2 The Model

The economic environment is a version of the stochastic incomplete markets life-cycle model commonly used to study the wealth distribution (e.g., Huggett 1996; Castaneda et al. 2000).[3] The economy is inhabited by a continuum of ex ante identical households, by a single representative firm, and by a government. All markets are competitive and the economy is in steady state.

2.1 Households

Each household consists of overlapping generations of parents and children. Each parent has one child which is born T_G periods before the parent dies. At the beginning of time, a unit mass of agents is alive. Households age stochastically as in Castaneda et al. (2000). Each household lives through $a = 1, ..., A$ "ages", each of which lasts a random number of periods. A household solves the following problem:

$$\max\, E \sum_{t=1}^{T} \beta^t\, u(c_t) + \beta^T\, \psi\, \widehat{V}(k_{T+1}, e_{T+1}, \psi', q')$$

subject to the budget constraint

$$k_{t+1} = (1+r)\, k_t + w\, h_{a_t}\, e_t\, q - c_t + \tau_{a_t}$$

and the borrowing constraint $k_{t+1} \geq 0$. Here, t indexes the date, T is the household's stochastic lifetime, r is the (constant) rate of return to capital, w is the after-tax wage rate, τ_a is a lump-sum transfer, and $h_a\, e_t\, q$ is the household's labor endowment. The latter is the product of a permanent endowment (q), a transitory endowment (e_t), and a deterministic age-efficiency profile h_a which depends on the age state a described more fully below. k denotes the household's capital stock. The evolution of the random variables e and a is governed by exogenous Markov processes described in more detail below. The household values own consumption (c) and, in case of death, the bequest left to his child according to the value function $\widehat{V}$. The parameter ψ determines the intensity of the parent's bequest motive. The arguments ψ' and q' in the value function $\hat{V}$ denote the child's random draws of ψ and q.

The household problem may be represented as a stationary dynamic program:

$$\begin{aligned} V(a,k,e,\psi,q) = \max\, & u(c) + (1-\phi_a)\,\beta \sum\nolimits_{e'} V(a,k',e',\psi,q)\,\Omega_a(e,e') \\ & +\phi_a\,\beta\,(1-\mu_a) \sum\nolimits_{e'} V(a+1,k',e',\psi,q)\,\Omega_{a+1}(e,e') \\ & +\psi\phi_a\,\beta\,\mu_a \sum\nolimits_{q'} \Lambda(q,q') \sum\nolimits_{e'} \Omega_0(e,e') \sum\nolimits_{\psi'} \Psi(\psi')\,\hat{V}(k',e',\psi',q') \end{aligned}$$

[3] Hendricks (2002) uses a similar model to study the implications of bequest motives for wealth accumulation and intergenerational persistence.

subject to the budget constraint

$$k' = (1+r)\,k + w\,h_a\,e\,q - c(s) + \tau(s) \tag{1}$$

At the beginning of the period, the household is endowed with a state vector $s = (a, k, e, \psi, q)$. The timing of events within each period is as follows. First, the household chooses current consumption $c(s)$ and savings $k' = \kappa(s)$ subject to the budget constraint. At the end of the period, the household's next period age state is drawn. With probability $1 - \phi_a$ the household remains in age state a in the next period. Then a new transitory labor endowment e' is chosen from the set $\{\omega_1, ..., \omega_{n_w}\}$ according to the Markov transition matrix $\Pr(e' = \omega_j | \, e = \omega_i; \, a) = \Omega_a(\omega_i, \omega_j)$ and the next period state vector is $s' = (a, k', e', \psi, q)$. With probability $\phi_a\,(1 - \mu_a)$ the household advances to the next age state, but does not die. The household problem then continues with a new labor endowment drawn according to Ω_{a+1} and a state vector of $s' = (a + 1, k', e', \psi, q)$. During retirement ($a > a_R$), the transitory labor endowment is equal to zero.

With probability $\phi_a\,\mu_a$ the household dies at the end of the period. For the last phase death is certain: $\mu_A = 1$. In the case of death, the household's place is taken by a new agent (the household's child), who starts life with $a = 1$, with a transitory endowment drawn according to Ω_0, and with a permanent labor endowment drawn from the set $\{q_1, ..., q_{n_q}\}$ according to the Markov transition matrix $\Pr(q' = q_j | \, q = q_i) = \Lambda(q_i, q_j)$, and an altruism parameter ψ' which is drawn independently for each household from the density Ψ. Below, I will consider the case where some fraction of households is altruistic and shares the same $\psi > 0$, while the remaining households are not altruistic and have $\psi = 0$. The purpose of this distinction is to compare the savings behavior of parents with that of childless households.

The inheritance is determined as follows. In each period, a parent chooses the amount of capital to take into the next period, $k' = \kappa(s)$. If the parent survives, $\kappa(s)$ will be his capital endowment tomorrow. However, if the parent dies, the child receives an amount $\hat{b}(\kappa)$ at age T_G, where the function $\hat{b}(\kappa)$ is given to the parent. For example, if inheritances are taxed at rate τ_b then each child inherits $\hat{b}(\kappa) = (1 - \tau_b)\,\kappa$.

It is important to capture the fact that parents and children overlap, so that inheritances are received when the children are middle aged. However, keeping the model computationally tractable when parents are altruistic requires to model parents and children as if they did not overlap. Otherwise the state space for the parent's problem would include the child's state variables and vice versa. These two requirements are reconciled by imposing two informational assumptions. First, the parent does not know anything about the child's life history, even though the child has lived for a number of periods before the parent dies. The second assumption is that the child learns at the beginning of life how much it will inherit from the parent. In other words, the child must know the realization of the parent's random lifetime events (such as earnings). Furthermore, the child can borrow the present value of its future inheritance. This allows me to solve the household problem as if the child were born after the parent's death. Instead of inheriting a random amount $\widehat{b}(\kappa)$ at age T_G, the child may be thought of as receiving a capital endowment of $b(\kappa) = \widehat{b}(\kappa)\,(1 + r)^{-T_G}$ at birth. Similarly, the parent values an inheritance as augmenting the child's age 1 capital endowment by $b(\kappa)$. This setup also affects the interpretation of the household's borrowing constraint. The household can borrow up to the present value of his future inheritance without violating the constraint $k_{t+1} \geq 0$.

The value function for bequests depends on the nature of parental altruism. I consider three versions of altruism. If the household is selfish, then no utility is derived from leaving a bequest: $\widehat{V} = 0$. If the household has joy-of-giving altruism (Abel 1987), then utility is derived from the size of the inheritance:

$$\widehat{V}(k', .) = b(k')^{1-\sigma^*}/(1-\sigma^*). \tag{2}$$

The value function in (2) implies that the parent cares not about the amount given, but about the amount received by the children. The functional form together with the restriction $\sigma = \sigma^*$ ensures that the ratio of bequests to consumption does not diverge in a growing economy. Finally, in the case of Becker-Barro altruism, the value of the inheritance to the parent equals the child's value function at age 1:

$$\widehat{V}(k', e', \psi', q') = V(1, b(k'), e', \psi', q')$$

The first-order conditions for this problems are given by

$$\begin{aligned} u'(c(s)) &= \beta\,(1-\phi_a\,\mu_a)\,E\,V_k(s') + \beta\,\phi_a\,\mu_a\,\psi E\,\widehat{V}_k(s') \\ V_k(s) &= (1+r)\,u'(c(s)) \end{aligned}$$

The Euler equation for this problem is

$$\begin{aligned} u'(c(a,k,e,\psi,q)) = {} & (1-\phi_a)\,\beta\,(1+r')\,\sum\nolimits_{e'} u'(c(a,k',e',\psi,q))\,\Omega_a(e,e') \\ & +\phi_a\,(1-\mu_a)\,\beta\,(1+r')\sum\nolimits_{e'} u'(c(a+1,k',e',\psi,q))\,\Omega_{a+1}(e,e') \\ & +\psi\phi_a\,\mu_a\,\beta\,\sum\nolimits_{q'}\Lambda(q,q')\,\sum\nolimits_{e'}\Omega_1(e,e')\sum\nolimits_{\psi'}\Psi(\psi')\,\widehat{V}_k(k',e',\psi',q') \end{aligned} \tag{3}$$

With Becker-Barro altruism the marginal utility of leaving a bequest is given by

$$\widehat{V}_k(k', e', \psi', q') = (1+r')\,u'\left(c(1, b(k'), e', \psi', q')\right)\,b'(k').$$

With joy-of-giving altruism this becomes

$$\hat{V}_k\,(k', .) = b'(k')\,b(k')^{-\sigma^*}.$$

While complicated in appearance, the interpretation of the Euler equation is entirely conventional. Giving up one unit of consumption incurs the marginal utility cost $u'(c(s))$, which is the left-hand-side of the Euler equation. If the household survives, consuming next period yields marginal utility $\beta\,u'(c(s'))\,(1+r')$; this occurs with probability $(1-\phi_a\,\mu_a)$ and is represented by the first two lines on the right-hand-side of (3). The only non-standard feature is that next period's age state can either be a or $a+1$.

2.2 Firms

A single representative firm solves a standard static profit maximization problem. It rents capital K and labor L from households so as to maximize $F(K,L) - r^G\,K - w^G\,L$, where F is a constant returns to scale production function. Profit maximization requires that factor prices equal marginal products: $r^G = F_K(K,L)$ and $w^G = F_L(K,L)$.

2.3 Government

The government taxes labor income at a proportional rate and provides lump-sum transfers to retired households. The wage tax rate is τ_w, so that the after-tax wage rate is given by $w = (1-\tau_w)\,w^G$. Capital income is taxed at the proportional rate τ_K. The after-tax interest rate therefore equals $r = (r^G -$

$\delta)\,(1-\tau_K)$. Aggregate wage tax revenues then equal $\tau_w\, w^G\, L$. Bequests are taxed at the proportional rate τ_b. Transfers are paid in equal amounts to all retired households. Hence, $\tau_s = 0$ if $a(s) \leq a_R$ and $\tau_s = \tau_R$ otherwise, where τ_R is a constant. Aggregate transfer payments amount to $\int \Theta(s)\, \tau_s\, ds$, where $\Theta(s)$ denotes the density of households over states. Any excess tax revenues are used for government consumption (G). The government budget constraint is therefore

$$G + \int \Theta(s)\, \tau(s)\, ds = \tau_w\, w^G\, L + \tau_K\, r^G\, K + \tau_b\, B$$

where B are aggregate bequest flows. The proportional estate tax is, of course, highly counterfactual. Its purpose is to capture the fact that a fraction of the estate is lost to death expenses and taxes. The total fraction lost to such expenses appears to be similar for rich and for poor households (see the companion paper for details). The assumption that the marginal tax is constant is more problematical, but simplifies the analysis.

2.4 Equilibrium

A stationary competitive equilibrium consists of aggregates (K, C, G), a price system (r^G, w^G), a value function (V), policy functions (c, κ), and a distribution over household types, $\Theta(s)$, such that:

- The policy functions and value function solve the household problem.
- Firms maximize profits.
- Markets clear.
- The government budget is balanced.
- The distribution of household types is stationary.
- Inheritances, expressed as additions to capital endowments at birth, relate to bequests (k^p) as $b(k^p) = (1-\tau_b)\, k^p \,/\, n_c\, (1+r)^{-T_G}$.

The capital market clearing condition is $K = \int \Theta(s)\, k(s)\, ds$. The labor market clears, if $L = \int \Theta(s)\, l(s)\, ds$, where $l(s) = 1$ for states with $a \leq a_R$ and $l(s) = 0$ otherwise. The goods market clears if $F(K, L) - \delta\, K = C + G$.

2.5 Discussion

The treatment of inheritances and borrowing constraints deserve discussion. The most natural modeling approach would assume that parents and children learn about each other's earnings and aging histories while they overlap. This would introduce strategic interaction. Unfortunately, it would also increase the size of the household's state vector by an unmanageable amount. A natural alternative would assume that children and parents cannot observe each other's histories. Children then receive a random inheritance drawn from the equilibrium distribution of bequests. Apart from complicating the household problem, it is not clear how to model borrowing constraints in this case. The common assumption that households cannot die in debt would rule out (almost) all borrowing. It would also be counterfactual. The approach pursued here permits household borrowing while keeping the state vector tractably short. Its main drawback is that the borrowing constraints facing young households are relaxed when bequests are larger. As a result, the model exaggerates the effect of bequests on the wealth distribution. Larger bequests increase the amounts borrowed by young households and thus increase wealth inequality.

A number of model extensions would be of interest, but are left for future research. For the majority of households, it is likely that investments in child human capital and, to a lesser extent, inter-vivos transfers constitute a large part of intergenerational transfers. Abstracting from these types of transfers is, however, not likely to affect the conclusions drawn about wealth-rich households, who account for the bulk of bequests. Evidence from estate tax records suggests that inter-vivos transfers are far smaller than bequests for rich parents (Joulfaian 1994).

2.6 Model Parameters

This section describes the choice of model parameters, which are summarized in table 1.

[INSERT TABLE 1 HERE]

Demographics New households enter the model at physical age 20 (model age 1). In the data, inheritances are typically received around age 50. I therefore set the generation gap to $T_G = 30$ years. Households live through $A = 12$ phases. The first 3 phases represent the household's working life ($a_R = 3$). The transition probabilities ϕ_a are chosen such that these phases last on average 15 years each, corresponding to physical ages 20 to 64. The remaining 9 phases represent retirement and last on average 3 years each.

Mortality rates are taken from the Period Life Table, 1997, of the Social Security Administration. The first model deaths occur at the end of phase a_R, i.e. at the transition to retirement. The mortality rate μ_3 is chosen to minimize the deviations from the fraction of households surviving from age 20 to age 65. In the last phase, the mortality rate equals $\mu_A = 1$ by definition. In the intervening retirement years, the mortality rate is independent of age ($\mu_{a_R+1} = ... = \mu_{A-1}$) and chosen to match the observed fraction of households that survive from age 65 to ages 70, 75, ..., 90. Figure 1 shows the fractions of households surviving by age implied by the model and the data.

These choices reflect a trade-off between computational simplicity and realistic mortality rates. Given this paper's focus on saving and bequests at advanced ages, matching life-expectancy during retirement appears crucial. Hence, retirement is divided into many short phases. Matching the duration of work life, on the other hand, appears less important and computationally more costly because the household's state space is larger during work periods.[4]

Preferences The period utility function is of the CRRA type: $u(c) = c^{1-\sigma}/(1-\sigma)$. The curvature parameter σ is set to a conventional value of 2. The discount factor β is chosen to match a capital-output ratio of 2.9, which is the ratio of household wealth to income in the 1989 SCF. In the joy-of-giving model, I set the curvature of the bequest utility function equal to that of the period utility function ($\sigma^* = \sigma$). This ensures that the model is consistent with balanced growth.[5] The altruism parameter ψ takes on the values of zero or $\hat{\psi}$. The fraction of non-altruistic agents, $\Psi(0)$, matches the fraction of childless households at retirement age in the 1990 census of 0.19. The strength of the bequest motive, $\hat{\psi}$, is chosen to match an estimate of the inheritance-output ratio.

Aggregate inheritance flows Since the size of aggregate inheritances is important for most of this paper's findings, I review the evidence in some detail. The object of interest is the ratio of aggregate inheritances received from a previous generation to output. One approach measures inheritances reported by the children of deceased parents. Based on 1983-86 SCF data, Gale and Scholz (1994) estimate aggregate inheritance flows of 2.65% of GNP. Based on the 1989 SCF, Hendricks (2001) finds annual inheritances ranging from 1.1% to 1.9% of GNP for the years 1978 to 1987.

An alternative approach estimates bequests as the product of wealth and mortality rates. Using this approach, Auerbach et al. (1999) arrive at a bequest-output ratio of 3.6% for 1990. Since their estimate includes death expenses, charitable donations and bequests to surviving spouses, who typically

[4] Resolving a small number of the steady state experiments with deterministic aging during retirement yields results that are similar to the ones reported below.

[5] As written, the model abstracts from steady state growth, but may be interpreted as a scaled version of a growing economy.

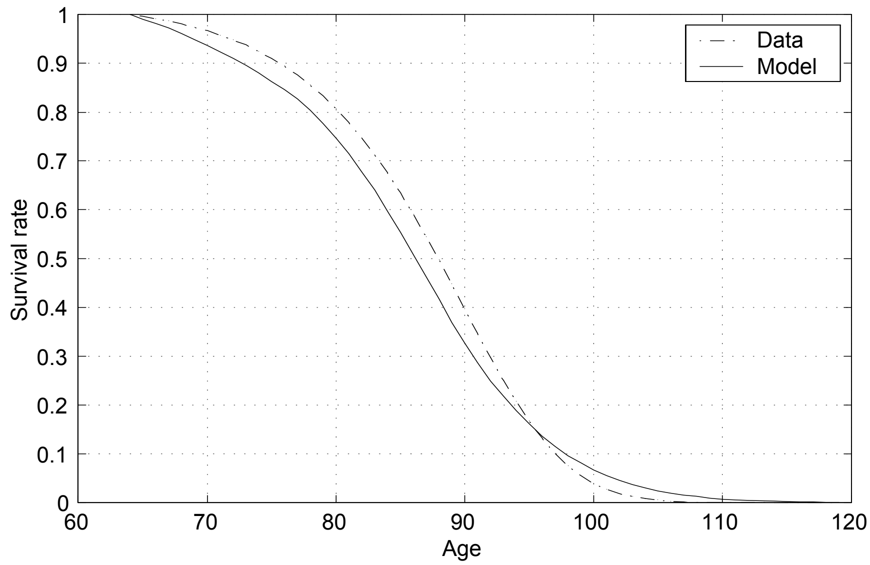

Figure 1: Survivial rates

receive a large fraction of the estate value (Joulfaian 1994), inheritances of children and other relatives will be substantially smaller. Similar calculations that distinguish between singles and couples in the 1989 SCF imply inheritance flows between 2% and 2.7% of GNP, depending on assumptions about the fraction bequeathed when a surviving spouse is present (see Hendricks 2001 for details). The fact that inheritance data yield smaller figures than wealth and mortality data may reflect underreporting of inheritances.

An indirect estimate of aggregate inheritance flows may be obtained from Joulfaian's (1994) sample of estate tax records. Aggregate net worth of the top 2.5% of estates in 1982 is $45.9 billion. Of this amount, 58.4% are distributed to surviving spouses, charity and death expenses, leaving $19 billion (0.57% of GNP) to be distributed to children and other persons. Data on the size distribution of inheritances summarized below indicate that the top 2% of estates account for at least 60% of aggregate inheritances. Aggregate inheritance flows, excluding surviving spouses, then amount to at most 1.2% of GNP. Based on this evidence, I consider inheritance-output ratios of 1.5% (based on the 1989 SCF) and 2.65% (based on Gale and Scholz 1994).[6]

Labor Endowments Parameterizing the stochastic process for labor endowments is made difficult by the scarcity of panel data on household earnings. Some datasets, such as the PSID, provide longitudinal information, but the earnings data are top-coded. The SCF avoids top-coding, but contains only cross-section information. A number of previous studies imposed earnings processes estimated from top-coded data and found that the models could not generate the large wealth holdings found among the richest households in the data. An alternative, proposed by Castaneda et al. (2000) is to choose parameters of the labor endowment process to match points on the cross-sectional income and wealth distributions together with information on earnings mobility. The resulting endowment process has two components. If n_w denotes the number of endowment states, then the lower $n_w - 1$ states resemble an endowment

[6] A number of studies convert intergenerational transfer flows into a stock and report the fraction of wealth due to intergenerational transfers (e.g., Gale and Scholz 1994). Such measures are highly sensitive to assumptions about discount rates and generation gaps.

process that is estimated from top-coded panel data. In addition, there is a very large and highly transitory earnings state, which helps the model replicate the large fractions of income and wealth of the richest 1% of households.

The approach pursued here combines elements of both methods. The transitory labor endowment takes on one of $n_w = 6$ values. The lower 5 values together with the transition probabilities among them approximate the AR(1) process estimated by Storesletten et al. (2000; their process "D" without the iid shock). The permanent labor endowment takes on one of $n_h = 3$ values. The middle level is normalized to one. The other two levels together with the transition probabilities are chosen to approximate an AR(1) with a Gini coefficient of annual earnings among working households of 0.48 (based on SCF data) and an intergenerational lifetime earnings persistence of 0.35. Intergenerational earnings persistence is lower than some estimates in the literature (see Mulligan 1997). The reason is that empirical estimates refer to individual earnings persistence, which should be higher than the persistence of household earnings if marital sorting is imperfect.

As in Castaneda et al. (2000), an additional high endowment state is added to the transitory endowment process in order to generate sufficient wealth concentration. This state is reached from any endowment state with an arbitrary probability of 0.4%. Its level is chosen such that in equilibrium the top 5% of households own 58.2% of aggregate wealth. The labor income distribution implied by the model is quite close to SCF data (table 2). The Gini coefficient for both model and data is 0.63. The model process captures both the fraction of total labor income received by each percentile class as well as the maximum income level in each class fairly closely. The main exception is that the model misses the skewness *within* the top 1% of the empirical labor income distribution. One benefit of this approach is to preserve much of the information about shock variance and persistence estimated from top-coded panel data. Another benefit is that the computational burden of calibrating the model is much lighter than in Castaneda et al.'s approach.

[INSERT TABLE 2 HERE]

Firms The production function is Cobb-Douglas: $F(K, L) = \Xi K^{\alpha} L^{1-\alpha}$ with a capital share parameter of $\alpha = 0.3$. The depreciation rate of capital is set to yield a rate of return of $r = 0.04$ for a capital-output ratio of 2.9. The productivity parameter Ξ is normalized to yield a wage rate of $w^G = 1$.

Government Policies The wage tax rate is set to $\tau_w = 0.4$ following Trostel (1993). Retirement transfers amount to 40% of mean household earnings (Castaneda et al. 2000). A similar ratio is obtained by computing the ratio of annuitized income to mean household earnings in the SCF. Annuitized income for the retired consists mostly of pensions, social security benefits and other retirement income (SCF variable 5722). The estate tax rate is set to $\tau_b = 0.25$. For poor households, this captures death expenses of roughly 20% documented in Hurd and Smith (1999). For richer households, this represents in addition estate taxation.

3 Findings

This section studies the implications of the model economy for accidental and intended bequests. I consider three model versions. The *accidental bequest* model features selfish households. The *altruism* and the *joy-of-giving* models feature accidental and intended bequests. The bequest intensity (ψ) matches an inheritance-output ratio of 2.65% of output. This is the largest of the empirical estimates reviewed in Hendricks (2001). Models with intended bequests that are parameterized to match an inheritance-output ratio of 1.5%, based on the 1989 SCF, generate results that are essentially identical to the accidental bequest model and are therefore not reported.

In addition, I consider two common benchmark models. In the *no bequest* model, bequests are fully taxed ($\tau_b = 1$) and redistributed in equal lump sums among all living households. Models of this type are commonly used in the literature due to their simplicity (e.g., Huggett 1996). Finally, the *strong* *altruism* model features altruistic parents who place as much weight on their children's welfare as on their own ($\psi = 1$).[7]

Wealth Distribution For the purpose of studying bequest behavior, it is important that the models replicate the concentration of wealth observed in the data. The first row of table 3 shows the size distribution of net worth (including real estate, but excluding pension wealth) in the 1989 Survey of Consumer Finances (SCF; see Hendricks 2001 for details). Wealth holdings are highly concentrated among a small fraction of households. The top 1% of households own 36% of total wealth in the SCF, while the bottom 11.4% own negative or no wealth.

The bottom part of table 3 shows the Lorenz curves for wealth implied by the model economies. Adjusting the highest labor endowment to match the fraction of wealth held by the richest 5% of households ensures that all models replicate the observed concentration of wealth.[8]

The accidental bequest model comes closest to matching the SCF wealth distribution. It roughly replicates the mean wealth levels in each percentile class, although households in the 60th through 80th percentiles hold too little wealth (table 4). The fractions of households holding zero or negative wealth are similar to the data. The main discrepancy between model and data is the lack of skewness *within* the top 5% of the wealth distribution. The likely reason is that the labor endowment process fails to generate the very highest incomes observed in the data.

The no bequest model differs from the accidental bequest case mainly in that fewer households hold zero or negative wealth. The reason is, of course, that households cannot borrow against future inheritances. Conversely, in the joy-of-giving model all households expect positive inheritances and the fraction of negative wealth holders is much larger than in the data. Otherwise, the wealth distribution is similar to the accidental bequest case. The wealth distribution changes more dramatically when parents are altruistic. Even when the highest labor endowment is eliminated, the model overstates the share of wealth held by the richest 5% of households.[9] As a result, the share of wealth held by the richest 20% is always too large. However, table 4 reveals that the mean wealth holdings in most percentiles are close to the accidental bequest model. The exceptions are larger wealth holdings of the top 5% of households and more extensive borrowing of the young. I conjecture that not allowing young households to borrow against future inheritances would result in a wealth distribution that is more similar to the no bequest case.

[INSERT TABLES 3 AND 4 HERE]

3.1 Are all Bequests Accidental?

In this section I study whether accidental bequests can account for the magnitude of bequest flows observed in U.S. data. Two previous studies have addressed this question based on stochastic life-cycle models. Based on a simulated life-cycle model, Gokhale et al. (2001) find that accidental bequests amount to at most 1.2% of output, which is smaller than most empirical estimates. Their model maintains two potentially important assumptions that are relaxed here: households are infinitely risk averse and live at most to age 88. Hurd (1989) estimates a partial equilibrium model of retirement saving with a constant marginal utility of bequests. Preference parameters are chosen to match the rate at which retired individuals dissave in the RHS. Hurd finds no evidence of a bequest motive. One

[7] Strictly speaking, ψ should be less than 1 because in growing economies children are richer than their parents. However, interpreting the model as the stationary transformation of a growing economy reduces ψ only trivially from 1 to $\gamma^{1-\sigma}$, where γ is the growth factor of output per worker.

[8] The findings are similar, if the top labor endowment is chosen to match the fraction of wealth held by the richest 1% of households.

[9] This finding may appear to contradict previous research which showed that life-cycle models are unable to replicate the largest wealth holdings observed in the data. However, these results were obtained from models that were calibrated based on top-coded earnings data.

potential problem is that the RHS does not oversample high-wealth households. Since the top 2% of households account for 70% of total bequests, this could bias his findings in favor of accidental bequests.

Comparing the implications of the accidental bequest model with data on inheritance flows permits to measure accidental bequests in the context of a general equilibrium model with standard household risk aversion. With baseline parameters, the model implies an inheritance-output ratio of 1.5%, which matches aggregate inheritances in the 1989 SCF. The mean lifetime inheritance of 1.5 times average household earnings is slightly larger than in the SCF (1.3).[10] However, accidental bequests account for only 57% of Gale and Scholz's (1994) estimate of the inheritance-output ratio of 2.65%.

Sensitivity analysis Next, I study whether the size of accidental bequests is sensitive to variations in model parameters. Among the parameters that should affect the size of accidental bequests are risk aversion, transfer levels, and mortality rates. Higher transfers should lead to smaller accidental bequests as annuitized wealth substitutes for financial wealth. However, the effect of reasonable variations in ratio of retirement transfers to mean earnings are small. Varying this ratio between 30% and 50% changes the bequest to output ratio less than 0.1%. The intuition is that the bulk of bequests is left by the richest 10% of households. For them, transfer wealth is only a small fraction of total wealth. Relaxing the assumption that all households receive the same transfer incomes would likely not change the findings very much because transfer income in the SCF is far less unequally distributed than total family income.

Higher risk aversion should raise precautionary saving at old age and increase accidental bequests. Varying the curvature parameter of the utility function between $\sigma = 1$ (log utility) and $\sigma = 4$ increases the inheritance-output ratio from 1.45% to 1.72%, compared with a baseline value of 1.5%. I conclude that reasonable variations of σ do not move accidental bequests outside of the range of empirical estimates of bequest flows in U.S. data.

The parameter that most strongly affects accidental bequests is mortality during retirement. Higher mortality rates yield larger accidental bequests. The mortality rates of the baseline models are those for married couples starting at age 40. If the model is calibrated instead to match mortality rates of female *individuals* after age 65, then the inheritance-output ratio increases to 2.54%. Lower mortality rates than those of the baseline model are difficult to justify.[11] The sensitivity of accidental bequests to variations in mortality rates may cast doubt on the assumption of stochastic aging. Resolving the accidental bequest model with deterministic aging up to a maximum lifetime of 110 years yields an inheritance-output ratio of 1.86%. The fact that bequests are larger than in the stochastic aging case supports the conclusion that accidental bequests account for at least half of all observed bequests.

Why are accidental bequests so large? The finding that accidental bequest are large plays an important role for the properties of models with intended bequests examined below: it places upper bounds on the strength of altruistic and joy-of-giving motives. It is therefore natural to ask why large accidental bequest are a robust feature of the model. To gain intuition, it is instructive to calculate what fraction of retirement wealth households sacrifice as accidental bequests to insure against longevity risk. To calculate this fraction, I sort agents into decile classes based on the amount of wealth held at the end of work life. I then calculate the average bequest for each wealth decile, discounted to the last date of work. The ratio of bequests to retirement wealth is less than 12% for all wealth deciles, except for the highest which bequeaths 17% of retirement wealth. Essentially, wealthy agents expend 12-17% of their retirement wealth in order to insure against low consumption in case of late deaths.

The reason why agents are willing to sacrifice a sizeable fraction of retirement wealth is the large

[10] An alternative measure of bequest flows is the share of transfer wealth, which is the ratio of inherited wealth to total wealth (see Gale and Scholz 1994). However, this ratio is very sensitive to variations in discount rates and demographic structure.

[11] Private information about mortality rates could be important. If individuals learn about their impending deaths, they may deplete their assets faster, even though average mortality in their age group is low.

loss of utility suffered by households who fall into low wealth classes at old age. Households in the top retirement wealth decile consume more than 20 times mean household earnings. By contrast, households without assets consume the transfer level (40% of mean earnings). As a result, the mean marginal utility, $c^{-\sigma}$, of an agent in the bottom retirement wealth quintile is more than 2000 times larger than that of an agent without wealth. A rich household will therefore accept a substantial risk of losing wealth to accidental bequests to avoid running out of assets at old age. I show below that rich households would be roughly indifferent between losing some wealth to accidental bequests and annuitizing their assets at conditions offered in U.S. markets for private annuities.

3.2 Measuring Accidental Bequests

Since accidental bequests cannot fully account for some of the larger empirical estimates of bequest flows, it is instructive to ask what fraction of bequests is accidental in models with intended bequests. To address this issue, I study versions of the model where a fraction of households is altruistic towards their children ($\psi = \hat{\psi}$), while the other households are selfish ($\psi = 0$). At the beginning of life each household independently draws the realization of ψ. I set the share of selfish households to 0.19, which is the fraction of retired households without children in the SCF. The strength of the bequest motive for altruists ($\hat{\psi} = 0.33$) is chosen to match an inheritance-output ratio of 2.65%. I measure the fraction of accidental bequests as the ratio of bequests of non-altruistic households to those of altruistic households and find that 47% of bequests are accidental while 53% are intended.

The fraction of accidental bequests is robust against variation in the elasticity of intertemporal substitution. Varying σ between 1 and 4 implies that accidental bequests account for 46% to 55% of total bequests. Imposing mortality rates for female individuals instead of couples increases the fraction of accidental bequests to 76%. As in the accidental bequest model, varying the size of annuitized retirement income has little impact. Naturally, setting bequest intensity, ψ, to match smaller inheritance-output ratios increases the share of accidental bequests. I conclude that accidental bequests account for at least one-half and perhaps all of observed bequest flows.

In principle, the model could be used to measure the strength of the bequest motive. However, the value of ψ that matches aggregate inheritance flows is highly sensitive to household risk aversion. Varying σ between 1 and 4 yields values of ψ that cover almost the entire range between 0 and 1. Given that empirical estimates of σ cover a broad range, the model yields little insight into the strength of the bequest motive.[12]

3.3 Other Evidence

In this section, I examine other evidence that has been used to discriminate between accidental and intended bequests

3.3.1 Annuities

One observation that is at times interpreted as evidence in favor of intended bequests is the small share of retirement wealth held in annuities (see Hurd 1990 for a discussion). By purchasing annuities, households can insure against longevity risk. However, one likely reason why households fail to annuitize wealth is that annuities are not actuarially fair because of adverse selection problems. Mitchell et al. (1999) calculate that a dollar invested in private annuities offered in the U.S. in 1995 yields an expected present value of benefit payments of 85 cents.

To investigate whether lack of annuitization should be interpreted as evidence in favor of intended bequests, I calculate whether households in the accidental bequest model would purchase annuities with realistic rates of return. I calculate the household's value function with and without access to fair

[12] Nishiyama (2001) reports a similar finding.

annuities.[13] For each level of retirement wealth for an agent without annuities, I compute the retirement wealth that yields the same indirect utility for an agent with annuities. I find that wealthy households would be roughly indifferent between purchasing such annuities and investing their wealth in one period bonds, while less wealthy households would prefer not to annuitize. The wealthiest households would sacrifice 14-15% of retirement wealth in order to gain access to annuities, whereas for less wealthy households the fraction is below 10%. I conclude that the fact that households annuitize only a small part of their wealth is not inconsistent with the hypothesis that households are selfish and that all bequests are accidental.[14]

3.3.2 Size Distribution of Inheritances

One challenge for life-cycle models with selfish households is to generate large estates. Tables 5 and 6 report the size distribution of lifetime inheritances in the 1989 SCF (see Hendricks 2001 for details). Inheritances are scaled by mean household earnings. The lifetime inheritance is calculated as the discounted present value at age 50 of all inheritances ever received by the household. The samples are restricted to households with at most one surviving parent (of head and spouse jointly, if a spouse is present). Similar results are obtained if only households with no surviving parents are included, but the sample sizes are then smaller. The distribution of inheritances is highly skewed. The top 2% of households inherit 44 times mean household earnings and account for almost 70% of all inheritances. By contrast, the bottom two-thirds receive small or no inheritances. Inheritances are similarly concentrated in a sample of households taken from the Panel Study of Income Dynamics (PSID). However, aggregate inheritances in the PSID amount to less than half of the SCF, possibly due to the fact that the PSID does not over-sample rich households.

While the accidental bequest model is consistent with the small inheritances received in the lower part of the distribution, it fails to account for the largest inheritances observed in the data. In the model, the top 2% of households receive only 49% of aggregate inheritances, compared with almost 70% in the data. For the 90th to 95th percentiles, the model over predicts inheritances by at least one-half (table 6).

Neither altruistic nor joy-of-giving motives help account for the concentration of inheritance flows. The implications of altruistic bequests are very similar to those of accidental bequests. With joy-of-giving, the size distribution of inheritances is even less concentrated. The bottom 70% of households receive 26.5% of aggregate inheritances, compared with 0% in the data. Failing to account for the fact that most households receive no inheritances is a robust anomaly of the joy-of-giving specification with CRRA preferences. The intuition is obvious: the marginal utility of leaving a bequest is unbounded at zero.

One might conjecture that the models fail to generate the largest estates because they do not capture the largest wealth holdings. While the wealth distribution implied by the model matches the fraction of wealth held by the top 5% of households, it does not account for the skewness of labor income and wealth holdings *within* the top 5% (see table 3 and the discussion above). However, how (retirement) wealth is distributed among the wealth-richest 5% of households does not strongly affect the aggregate bequest left by those households. The reason is that the household problem at high wealth levels is nearly scale invariant. Doubling retirement wealth would lead a wealth-rich household to approximately double his saving and consumption in each age state. The reasons why consumption is not exactly proportional to wealth are the presence of annuity income and the possibility of running out of assets at old age.

[13] An annuity is a one-period bond that yields $(1+r)/(1-\phi_a\,\mu_a)$ for a household in phase a. For households in phase a_D the rate of return is capped at the level of phase $a_D - 1$. Otherwise, the rate of return to annuities in phase a_D would exceed 50% per year due to the high mortality in that phase.

[14] Another possible source of insurance against longevity risk are financial transfers from children to elderly parents. However, Gale and Scholz (1994) report that such transfers are quite rare.

Since both play only a small role in rich households' savings decisions, redistributing wealth among the top 5% of retired households would leave the total bequest left by those households roughly unchanged. This reasoning is confirmed by numerical experiments that vary the skewness within the top 5% of the labor income distribution.

It is not likely that accounting for inter-vivos transfers in the data would substantially change these results. For wealth-rich households, inter-vivos transfers are much smaller than bequests. Even the richest 2% of households rarely transfer even the maximum untaxed amount of $10,000 per year to their children (McGarry 2001). I conclude that the size distribution of inheritances is equally consistent with accidental and with altruistic bequests, although not with joy-of-giving. However, none of the bequest motives studied here account for the observed concentration of inheritance flows. Future research should investigate how to account for the large estates observed in the data.

[INSERT TABLES 5 and 6 HERE]

3.3.3 Dissaving in Retirement

An additional observation commonly viewed as inconsistent with intended bequests is household dissaving in retirement. The balance of the empirical evidence suggests that households accumulate wealth until fairly advanced ages, although some studies find moderate rates of dissaving (see Carroll 1998; Dynan et al. 2000). For example, Hurd (1987) finds that households decumulate 14% of their wealth during the first decade of retirement.

Table 7 shows the average rate of asset decumulation during the first two decades of retirement implied by the model economies. The rate of dissaving is defined as proportional change of total wealth held by surviving households. Since the model abstracts from growth of household income, it is necessary to adjust the rates of dissaving. I interpret the model as the stationary transformation of an economy with a balanced growth rate of output per worker of $\gamma = 0.02$. To reverse the stationary transformation, I multiply wealth held t years into retirement by $(1+\gamma)^t$ when computing the rate of dissaving.

The rate of dissaving in the no bequest model is consistent with Hurd's (1987) data. Households deplete on average 15.1% of their wealth during the first decade of retirement. An additional 36.9% of wealth is depleted during the second decade. As expected, the figures for the accidental bequest model are similar. Altruistic and joy-of-giving bequests reduce rates of dissaving during the first decade to 7.9% and 4.8%, respectively. All of these figures are well within the range of empirical estimates.[15]

However, intended bequests imply a gap between the dissaving rates of parents and non-parents, whereas Hurd (1987) finds that both groups of households dissave at the same rates. In the altruism model, selfish households dissave 17.0% of their wealth during the first decade of retirement, compared with 5.8% for altruists. These findings support Hurd's (1989) conclusion that the data point towards a weaker bequest motive. It is worth keeping in mind, however, that matching the largest empirical estimate of aggregate inheritances may overstate the difference between altruistic and selfish parents.

[INSERT TABLE 7 HERE]

3.3.4 Summary

To summarize, a model with only accidental bequests accounts for aggregate inheritance flows on the order of 1.5% of output, which is consistent with empirical estimates from the SCF. Accounting for larger inheritances requires that bequests are partly intended. If bequest motives are parameterized to match Gale and Scholz's (1994) estimate of aggregate inheritances (2.65% of output), then 47% of bequests are accidental. Since empirical estimates of aggregate inheritances are typically smaller than Gale and Scholz's figure, I conclude that at least half of bequests are accidental.

[15] One might expect the rates of dissaving to be sensitive to variations in household risk aversion or mortality rates. However, this is not the case, likely because different values of σ require adjustments of β to match the same capital-output ratio. This differs markedly from the partial equilibrium findings of Hurd (1989).

Other evidence that could in principle shed light on the importance of accidental bequests is not conclusive. Regardless of the bequest motive, the model economies are consistent with the small share of annuitized wealth held by households and with rates of dissaving in retirement. However, neither of the model economies accounts for the size distribution of inheritances and especially for the observation that 2% of households account for 70% of total inheritances.

3.4 Tax Experiments

This section addresses the question how alternative assumptions about bequest motives affect the outcomes of tax policy experiments. A number of previous studies found that altruistic bequests substantially modify the effects of income tax changes (see Engen et al. 1997 and Hendricks 2000). However, these findings are based on models in which the bequest motive is operative for all households and where all bequests are intended. Here, I reconsider the role of bequest motives in an environment with realistic lifespan uncertainty which captures the fact that most households do not leave bequests to their children. I study changes in labor income taxation, in capital income taxation, and a simple confiscatory estate tax.

Table 8 shows the changes in aggregate output and in the Gini coefficient of wealth due to a 10% capital income tax. In order to obtain results that are easily interpreted, I assume government spending is adjusted to balance the government budget in every period. In the no bequest model, higher capital income taxes crowd out saving and investment; as a result, output declines. Bequests of either type magnify the output response by 8%, but affect the wealth Gini only little. The differences between bequest motives are minimal.

The findings for a ten percentage point increase in the labor income tax rate are shown in table 9. Given that labor supply is exogenous, a wage tax has only income effects, but no distortionary effects. This experiment offers a particularly useful benchmark because a wage tax change has no effect on output in models where all households have operative altruistic bequest motives, such as Engen et al. (1997) and Hendricks (2000). Without a bequest motive, households respond to lower earnings by saving less. As a result, the capital stock decreases. With fixed labor supply, output must decrease and the interest rate rises. For the accidental and joy-of-giving motives, the changes are nearly the same as in the no-bequest case. With altruism, the output response is reduced by around 20%, but remains very different from models in which altruistic bequest motives are operative for all households.

When interpreting these findings it is important to keep in mind that tables 8 and 9 assume fairly strong altruistic or joy-of-giving bequest motives. If intended bequests are parameterized according to my estimates of bequest flows in the SCF, the implications of all models are nearly identical. I conclude that abstracting from accidental or joy-of-giving bequests does not alter the effects of income tax changes (at least of the simple kind studied here) in important ways. However, abstracting from altruistic bequests can modify the outcomes of labor income taxes significantly, if bequest motives are fairly strong. This contrasts with the findings of Engen et al. (1997) and Hendricks (2000) who find that the common assumption that all parents leave positive bequests to their children leads to capital income tax effects that differ substantially from those implied by a model without a bequest motive.

The intuition underlying the small impact of intended bequests on income tax effects is as follows. A key determinant of the steady state tax elasticity of the capital stock is the number of successive cohorts that are linked by positive bequests. Changes in saving accumulate over cohorts that are linked by bequests, even if these bequests are accidental. As a result, Abel's (1985) model of accidental bequests implies that the responsiveness of wealth to capital and labor income taxation increases with the number of successive cohorts that leave positive bequests.[16] This reasoning carries over to models

[16] In my model, the labor income tax elasticity of wealth is lower when intended bequests increase the number of linked cohorts. The discrepancy arises because Abel's (1985) model features an exogenous pre-tax interest rate.

with altruistic bequests. As long as a household chooses $k' > 0$, savings are interest elastic, irrespective of whether the household saves for his own future consumption or for that of a child.

The results of table 5 suggest that the number of linked cohorts is not affected much by reasonable bequest motives. The fraction of parents leaving no bequests is roughly 70%, even when parents are altruistic. However, redistributing bequests reduces the number of linked cohorts and hence leads to a smaller change in the capital stock. This reasoning also explains why previous studies found substantially larger tax effects in the presence of altruistic bequests. In the models of Engen et al. (1997) and Hendricks (2000) *all* parents leave positive bequests to their offspring, so that the long-run interest elasticity of wealth is infinite. Abstracting from the fact that only around one-third of parents leave bequests to their children appears to substantially affect the long-run tax elasticities of output and capital.

It is perhaps not surprising that bequest motives matter more for the analysis of estate taxation. Table 10 shows the changes in output and in the wealth Gini due to a confiscatory estate tax ($\tau_b = 1$). Tax revenues are redistributed in equal lump-sum transfers, $\hat{\tau}$, to all households. The level of these transfers is chosen such that aggregate transfer flows equal aggregate bequest tax revenues: $\int \Theta(s)\, \hat{\tau}\, ds = B$. Total lump-sum transfers received by a household are then given by $\tau_s = \hat{\tau}$ for working age households ($a(s) \leq a_R$) and $\tau_s = \hat{\tau} + \tau_R$ for retired households. If all bequests are accidental, taxing bequests increases the capital stock. By contrast, with intended bequests, estate taxation reduces the capital stock. The magnitude of this effect depends both on the bequest motive and on its intensity.

[INSERT TABLES 8 THROUGH 10 HERE]

4 Conclusion

This paper studies quantitative importance of accidental versus intended bequests. Bequests are decomposed into accidental and intended components by comparing the implications of a standard life-cycle model under alternative assumptions about bequest motives. The main finding is that accidental bequests account for at least half, and perhaps for all of observed bequests.

The paper then examines how assumptions about bequest motives affect the effects of income tax changes. In contrast to previous research, I find that bequest motives are not important for the analysis of capital income taxation. The effects of labor income taxes are reduced by altruistic bequests, but the role played by bequests is much weaker than suggested by previous models. My findings differ from earlier work because the model replicates the observation that nearly 70% of households leave no bequests to their children. By contrast, in the models of Engen et al. (1997) and Hendricks (2000), all households were linked by positive bequests.

Future research should consider other bequest motives as well as other kinds of intergenerational transfers. Inter vivos transfers of money and time as well as parental investments in the human capital of their children deserve particular attention.

5 Appendix: Computational Algorithm

The household problem is solved by backward induction. The policy functions $c(s)$ and $\kappa(s)$ are approximated on a 100 point grid for the capital stock via linear interpolation. The fact that households may be altruistic and that the each phase of life may last for more than one period implies that each iteration over the household problem requires guesses for the household's value functions. The equilibrium computation iterates over theses guesses until the sequence converges.

To compute the equilibrium, the algorithm simulates a single long dynasty consisting of 20,000 of households. The stationary distributions of variables are approximated by their distributions over this dynasty's history. Aggregate quantities are calculated by summing over dates. For example, aggregate consumption is computed as $C = \sum c_t$ where c_t denotes the amount consumed by an individual member of the stand-in dynasty at date t. When computing the aggregate capital stock, it is necessary to correct this expression for the fact that young agents borrow their initial capital endowments using their future inheritances as "collateral." When summing over the time path of capital holdings, $k_0 (1 + r)^i$ must be subtracted from each agent's capital stock prior to age T_G because this amount is borrowed from another agent.

References

[1] Abel, Andrew B. (1985). "Precautionary saving and accidental bequests." *American Economic Review* 75(4): 777-91.

[2] Abel, Andrew B. (1987). "Operative Gift and Bequest Motives." *American Economic Review* 77(5): 1037-47.

[3] Auerbach, Alan J.; Jagadeesh Gokhale; Laurence J. Kotlikoff; J. Sabelhaus; David Weil (1999). "The Annuitization of Americans Resources — A Cohort Analysis." Mimeo.

[4] Bernheim, B. Douglas; Andrei Shleifer; Lawrence H. Summers (1985). "The strategic bequest motive." *Journal of Political Economy.* 93(6): 1045-76.

[5] Carroll, Christopher D. (1998). "Why do the rich save so much?" NBER working paper #6549.

[6] Castaneda, Ana; Javier Diaz-Giminez; Jose-Victor Rios-Rull (2000). "Accounting for earnings and wealth inequality." Mimeo. University of Pennsylvania.

[7] Cox, Donald; Mark R. Rank (1992). "Inter-Vivos Transfers and Intergenerational Exchange." *Review of Economics and Statistics* 74(2): 305-314.

[8] De Nardi, Mariacristina (2000). "Wealth inequality and intergenerational links." Mimeo. Federal Reserve Bank of Chicago.

[9] Diaz-Giminez, Javier; Vincenzo Quadrini; Jose-Victor Rios-Rull (1997). "Dimensions of inequality: Facts on the U.S. distributions of earnings, income, and wealth." *Federal Reserve Bank of Minneapolis Quarterly Review*, Spring: 3-21.

[10] Dynan, Karen E.; Jonathan Skinner; Stephen P. Zeldes (1999). "Do the Rich Save More?" NBER working paper #7906.

[11] Engen, Eric M.; Jane Gravelle; Kent Smetters (1997). "Dynamic tax models: why they do the things they do." *National Tax Journal* 50(3): 657-82.

[12] Gale, William G.; Maria G. Perozek (2000). "Do estate taxes reduce saving?" Mimeo. Brookings Institution.

[13] Gale, William G.; John K. Scholz (1994). "Intergenerational Transfers and the Accumulation of Wealth." *Journal of Economic Perspectives* 8(4): 145-60.

[14] Gokhale, Jagadeesh; Laurence J. Kotlikoff; James Sefton; Martin Weale (2001). "Simulating the transmission of wealth inequality via bequests." *Journal of Public Economics* 79: 93-128.

[15] Hendricks, Lutz (2000). "Taxation and Human Capital Accumulation." Mimeo. Arizona State University.

[16] Hendricks, Lutz (2001). "Bequests and Retirement Wealth in the United States." Mimeo. Arizona State University.

[17] Hendricks, Lutz (2002). "Bequests and Patterns of Wealth Accumulation." Mimeo. Arizona State University.

[18] Huggett, Mark (1996). "Wealth distribution in life-cycle economies." *Journal of Monetary Economics* 38: 469-94.

[19] Hurd, Michael D. (1987). "Savings of the elderly and desired bequests." *American Economic Review* 77(3): 298-312.

[20] Hurd, Michael D. (1989). "Mortality Risk and Bequests." *Econometrica* 57(4): 779-813.

[21] Hurd, Michael D. (1990). "Research on the elderly: Economic status, retirement, and consumption and saving." *Journal of Economic Literature* 73: 565-637.

[22] Hurd, Michael; James P. Smith (1999). "Anticipated and Actual Bequests." Mimeo. Rand.

[23] Joulfaian, David (1994). "The distribution and division of bequests: Evidence from the collation study." Mimeo. Office of Tax Analysis.

[24] Laitner, John (2001). "Inequality and Wealth Accumulation: Eliminating the Federal Gift and Estate Tax." In: William G. Gale, James R. Hines, Jr., and Joel Slemrod (eds.), *Rethinking Estate*

and Gift Taxation. Washington, DC: Brookings Institution.

[25] McGarry, Kathleen (2001). "The cost of equality: unequal bequests and tax avoidance." *Journal of Public Economics* 79: 179-204.

[26] Mitchell, Olivia S.; James M. Poterba; Mark J. Warshawsky (1999). "New Evidence on the Money's Worth of Individual Annuities." *American Economic Review* 89(5), December, 1299-1318.

[27] Mulligan, Casey B. (1997). *Parental priorities*. Chicago: University of Chicago Press.

[28] Nishiyama, Shinichi (2001). "Bequests, inter vivos transfers, and wealth distribution." Mimeo. Congressional Budget Office.

[29] Storesletten, Kjetil; Chris Telmer; Amir Yaron (2000). "Consumption and risk sharing over the life cycle." Mimeo. Stockholm University.

[30] Trostel, Philip A. (1993). "The effect of taxation on human capital." *Journal of Political Economy* 101(2): 327-50.

Tables

Table 1. Model parameters

Households	
$\beta = 0.9614$	Matches $K/Y = 2.9$
$\sigma = 2$	
Demographics	
$A = 12$	Number of life-cycle phases
$a_R = 3$	Three work phases, corresponding to ages 20-65
μ_a	Matches mortality rates of couples. Social Security Administration, Period Life Tables 1997
ϕ_a	Matches mean phase length of 15 years for work life and 3 years for retirement
$T_G = 30$	Children are born 30 years before parents die
Firms	
$\alpha = 0.3$	Capital income share in NIPA
$\delta_k = 0.063$	Matches after-tax interest rate of 4%
Ξ	Normalized such that $w^G = 1$
Government	
$\tau_w = 0.4$	Trostel (1993)
$\tau_k = 0$	
$\tau_b = 0.25$	See text
τ_R	Set to 40% of mean household earnings

Table 2. Distribution of household labor income

Percentile class	20	40	60	80	90	95	99	100
SCF								
Cumulative fraction	-0.4	3.1	16.5	40.1	57.8	69.7	85.8	100.0
Class mean	0.0	0.2	0.7	1.2	1.8	2.4	4.0	34.1
Model								
Cumulative fraction	0.0	1.4	14.0	35.1	53.3	67.2	87.2	100.0
Class mean	0.0	0.1	0.8	1.4	2.4	3.6	6.5	16.5

Notes: The table shows the cumulative fraction of household labor income received by each percentile class and the mean in each class. Labor income in the SCF consists of wages, salaries, and 86.5% of business and professional income (based on Diaz-Giminez et al. 1997).

Table 3. Wealth distribution. Cumulative fractions.

Percentile class	20	40	60	80	90	95	99	100	< 0	= 0	Gini
SCF	-4.2	-2.9	2.7	16.2	29.8	41.8	64.1	100	7.3	4.1	0.86
No bequests	0.0	0.4	2.7	10.7	25.7	41.8	71.5	100	0.0	5.1	0.85
Accidental bequests	-3.1	-2.6	0.0	9.0	24.8	41.8	72.9	100	6.0	3.1	0.89
Joy-of-giving	-4.9	-4.3	0.1	9.8	25.4	41.8	71.6	100	24.0	1.4	0.90
Altruism	-6.7	-6.4	-4.3	3.6	19.2	36.5	70.0	100	10.7	2.9	0.98
Altruism. $\psi = 1$	-13.8	-13.8	-12.6	-6.0	9.3	27.1	63.9	100	14.4	2.9	1.13

Notes: The table shows the cumulative fraction of aggregate wealth held by each percentile class.

Table 4. Wealth distribution. Class means.

Percentile class	20	40	60	80	90	95	99	100
SCF	-1.1	0.3	1.4	3.5	7.0	12.4	28.8	186.3
No bequests	0.0	0.1	0.5	1.6	6.0	12.9	29.9	118.7
Accidental bequests	-0.6	0.1	0.5	1.9	6.6	14.1	32.2	112.4
Joy-of-giving	-1.0	0.1	0.9	2.0	6.5	13.6	30.9	117.7
Altruism	-1.4	0.1	0.4	1.6	6.4	14.3	34.7	124.3
Altruism. $\psi = 1$	-2.9	0.0	0.2	1.4	6.3	14.7	38.1	149.6

Notes: The table shows the mean wealth held in each percentile class relative to mean household earnings.

Table 5. Size distribution of inheritances. Cumulative fractions.

Percentile class	70	80	90	95	98	100	Mean	*I/Y* [%]
SCF	0.0	1.8	9.4	18.9	30.8	100.0	1.3	1.5
PSID	0.0	0.2	5.6	15.4	33.2	100.0	0.5	
Accidental bequests	0.5	3.2	13.6	29.5	50.8	100.0	1.5	1.5
Joy-of-giving	26.5	32.8	44.4	56.2	70.0	100.0	2.7	2.6
Altruism	1.5	5.3	15.5	30.3	51.7	100.0	2.7	2.7
Altruism. $\psi = 1$	1.7	7.4	19.8	34.2	54.5	100.0	4.6	4.6

Notes: Inheritances are expressed as multiples of mean earnings per household. The table shows the cumulative fraction of total inheritances received by each percentage class. *I/Y* denotes the inheritance-output ratio.

Table 6. Size distribution of inheritances. Class means.

Percentile class	70	80	90	95	98	100
SCF	0.0	0.2	1.0	2.4	5.0	44.2
PSID	0.0	0.0	0.2	0.8	2.4	13.4
Accidental bequests	0.0	0.4	1.6	4.9	10.9	37.6
Joy-of-giving	1.0	1.7	3.1	6.3	12.2	39.9
Altruism	0.1	1.0	2.7	7.9	19.0	64.6
Altruism. $\psi = 1$	0.1	2.6	5.7	13.3	31.0	104.7

Notes: Inheritances are expressed as multiples of mean earnings per household. The table shows the mean inheritance received in each percentage class.

Table 7. Dissaving in retirement

No bequest	-15.1	-36.9
Accidental bequests	-14.6	-37.0
Joy-of-giving	-4.8	-16.9
Altruism	-7.9	-21.7
Altruism. $\psi = 1$	2.5	1.2

Notes: The table shows the percentage changes in wealth during the first and second decade of retirement

Table 8. Effects of a 10% capital income tax

Model	Output	Wealth Gini
No bequest	-1.31	0.00
Accidental bequests	-1.37	0.01
Joy-of-giving	-1.35	0.01
Altruism	-1.36	0.00
Altruism. $\psi = 1$	-1.43	0.00

Notes: The tables shows the percentage change in Y and the change in the Gini of household wealth.

Table 9. Effects of a 10% wage tax

Model	Output	Wealth Gini
No bequest	-3.26	-0.01
Accidental bequests	-3.27	-0.01
Joy-of-giving	-3.18	-0.01
Altruism	-2.78	0.02
Altruism. $\psi = 1$	-2.43	0.06

Notes: The tables shows the percentage change in Y and the change in the Gini of household wealth.

Table 10. Effects of a confiscatory estate tax

Model	Output	Wealth Gini
Accidental bequests	0.16	-0.05
Joy-of-giving	-1.22	-0.05
Altruism	-1.73	-0.14
Altruism. $\psi = 1$	-4.56	-0.29

Notes: The tables shows the percentage change in Y and the change in the Gini of household wealth.