LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

VOLKSWIRTSCHAFTLICHE FAKULTÄT

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Wealth Distribution and Optimal Inheritance Taxation in Life-Cycle Economies with Intergenerational Transfers

Munich Discussion Paper No. 2000-10

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Volkswirtschaftliche Fakultät
Ludwig-Maximilians-Universität München

Wealth distribution and optimal inheritance taxation in life-cycle economies with intergenerational transfers

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JEL classification: D31, D91, H21, C68, E21

Key Words: Wealth Distribution, Overlapping Generations, Bequests, Optimal Taxation

Abstract:
We introduce intergenerational transfers into a general equilibrium life-cycle model in order to explain observed levels of wealth heterogeneity. In our overlapping generations model, heterogenous agents face uncertain lifetime and leave both accidental and voluntary bequests to their children. Furthermore, agents face stochastic employment opportunities. The model is calibrated with regard to the characteristics of the US economy. Our results indicate that bequests only account for a small proportion of observed wealth heterogeneity. The introduction of an inheritance tax increases both welfare as measured by the average value of the newborn and equality of the wealth distribution.

Preliminary versions of this paper have been presented at conference on 'Intergenerational transfers, taxes and the distribution of wealth' in Uppsala 1999 and the Econometric Society European Meeting in Santiago de Compostela 1999. We would like to thank Michael Kaganovich, John Laitner, James Smith, Frank Stafford, and Carl Cristian von Weizsäcker for comments on earlier versions of the paper. All remaining errors are ours.

1 Introduction

Wealth is much more unequally distributed than earnings. In the US economy, Henle and Ryscavage (1980) estimate a Gini coefficient of earnings for men of approximately 0.42 during 1958-77, while Wolff (1987) estimates a wealth Gini coefficient equal to 0.72 based on data from the 1983 Survey of Consumer Finances (SCF).[1] There are numerous reasons why wealth is distributed much more unequally than earnings. In this paper, we will concentrate on intergenerational transfers as one possible explanation for this stylized fact. Our motivation for the study of bequests is founded on the work of Kotlikoff and Summers (1981). Kotlikoff and Summers separate total wealth in the US into a nongovernmental transfer component and a life-cycle wealth component. According to their estimates, the former contributes about 80% to total wealth.

Standard life-cycle models with a representative agent and certain lifetime fail to reproduce observed wealth heterogeneity. In these models, wealth is only dispersed between generations but not within generations. In recent years, due to the advance of computational methods in economics, models of heterogenous-agent economies have received increasing attention. In such kind of models, households may differ with regard to their earnings and their asset holdings, even within generational cohorts, and the distribution of wealth is derived endogenously. Huggett (1996) studies a life-cycle economy where agents face uncertain lifetime. In addition, labor productivity is stochastic and calibrated in order to match US earnings inequality. In the absence of annuity markets, the model is able to successfully replicate the US wealth Gini coefficient. The model only fails to produce the wealth holdings of the

[1] For a detailed description of the US distribution of earnings, income, and wealth, the reader is referred to Díaz-Giménez et al. (1997) and Davies/Shorrocks (1999).

very rich households.[2] As shown by Krussell/Smith (1998), the same result holds in the stochastic Ramsey model if one assumes preference heterogeneity. In particular, Krussell and Smith assume that the discount factor β can take three values and follows a Markov process with average duration of 50 years at the highest and lowest value of β.[3]

Both Huggett (1996) and Krussell/Smith (1998) neglect voluntary bequests.[4] Furthermore, they do not explicitly account for a parent-child link. In this paper, we consider a life-cycle economy. Contrary to Huggett (1996) and Krussell/Smith (1998), we introduce an altruistic bequest motive.[5] Every family consists of a parent and his child, and the individual child is forming his decision depending upon the expected bequest from his respective parent. Agents are neither allowed to borrow nor to leave negative bequests. With the help of this model, we are able to study the question as to whether bequests, both accidental and voluntary, help to explain observed wealth heterogeneity. As one of our main results, we find the voluntary bequest motive to be of negligible importance, while accidental bequests are able to increase wealth inequality in our model modestly.

As our second focus of analysis, we are interested in the examination of inheritance

[2]In this paper, when we talk about the rich, we refer to the wealth-rich.

[3]Quadrini/Ríos-Rull (1997) review recent studies of endogenous wealth inequality in models of heterogenous agents with uninsurable idiosyncratic exogenous shocks to earnings, including attempts to include business ownership, higher rates of return on high asset levels, and changes in health and marital status, among others.

[4]Huggett (1996) assumes accidental bequests to be redistributed in equal amounts to all living agents. He also reports results from experiments where the receipt of bequests was random, but where the distribution from which bequests were drawn was the same for all agents.

[5]Our paper is related to Flemming (1979). However, in his partial equilibrium model, Flemming assumes that agents spread consumption uniformly over their maximum expected lifespan, whereas we consider a microfounded general equilibrium model with an intertemporal optimal allocation of consumption.

taxation. Inheritance taxation is often regarded as an appropriate policy in order to redistribute wealth and to increase equality of opportunities. However, the deteriorating effect on wealth accumulation is often cited as a major argument against inheritance taxation.[6] In this paper, we introduce inheritance taxation and compute its quantitative effects on both wealth accumulation and distribution. Furthermore, we compute the optimal inheritance tax rate using the expected lifetime utility of the newborn generation as our measure of welfare. As our second main result, inheritance taxation is shown to reduce wealth inequality and increase welfare in our model. The optimal tax rate on inheritance is demonstrated to amount to approximately 95% implying a consumption equivalent welfare gain of 2.43%.

The organisation of the paper is as follows. Section 2 introduces the model. In section 3, the model is calibrated with regard to characteristics of the US economy. Furthermore, the computational procedure is described. In section 4, our numerical results are presented. Section 5 concludes.

2 A Model of Bequests

Our model is an extension of İmrohoroğlu et al. (1995). In our economy, three sectors are depicted: the household sector, the production sector, and the government. Households live a maximum of 60 years and maximize discounted life-time utility. They inherit wealth from their parents and leave bequests to their children. Agents supply labor inelastically and differ with regard to their individual productivity and

[6] Depending on the specific marginal utility function from bequests, the capital stock need not necessarily decline for higher inheritance tax rates (see Atkinson, 1971a). Furthermore, even if the capital stock declines for higher inheritance tax rates, the distribution of earnings and wealth need not become more equal if, for example, unskilled labor has a higher degree of complementarity with capital than does skilled labor (the argument is taken from Bevan/Stiglitz, 1979).

employment opportunity. In old age, they receive public pensions. Firms maximize profits. Output is produced with the help of labor and capital. The government provides unemployment insurance and social security which are financed by a tax on income and inheritance.

2.1 Households

Households are of measure one and each newborn generation is of equal measure. Hence, we neglect population growth and aging of the society. Agents have an uncertain lifetime and live a maximum of $T + T^R = 40 + 20$ periods. Time periods correspond to years. We use a subscript s to denote calendar time and an argument t in parentheses to denote age. The first $t \leq T$ periods of their life, agents are workers. Retirement after T years is mandatory. A household born in period s maximizes his intertemporal utility:[7]

$$\max_{c(t)} E_s \sum_{t=1}^{T+T^R} \beta^{t-1} \left(\left[\prod_{j=1}^{t} \psi_j \right] u(c_{s+t}(t)) + \varsigma_0 \left[\prod_{j=1}^{t-1} \psi_j \right] (1-\psi_t) v(b_{s+t}(t)) \right), \quad (1)$$

where $c_{s+t}(t)$, $b_{s+t}(t)$, and β denote the consumption of the t-year old in period $s+t$, his bequests, and the discount factor, respectively. ψ_j is the conditional probability of survival from age $j-1$ to age j. Expectations E_s are taken conditional on information in period s. Instantaneous utility from consumption is specified as a CES function:

$$u(c(t)) = \frac{c(t)^{1-\sigma} - 1}{1-\sigma}, \quad (2)$$

where σ denotes the coefficient of relative risk aversion. If the agent dies at age t, he leaves bequests $b(t) = (1-\tau_k)k(t)$ to his offspring providing him with utility $\varsigma_0 v(b)$. Bequests are subject to an inheritance tax τ_k. $k(t)$ are the asset holdings of the t-year

[7]The additive separability of utility from consumption and bequests is adapted from Atkinson (1971a).

old agent. As capital is the only kind of asset in the economy, we will refer to k as assets, the capital stock, and the wealth interchangeably. ς_0 is a measure of parental altruism. The utility from bequest is also specified as a CES function:

$$v(b(t)) = \begin{cases} \frac{b(t)^{1-\varsigma}-1}{1-\varsigma} & k(t) \geq \tilde{K}(t) \\ 0 & else \end{cases} \quad (3)$$

Following Blinder (1975), we set $\varsigma = \sigma$.[8] In our analysis, we distinguish three different cases: (i) in our benchmark case, all agents do have a bequest motive, $\tilde{K}(t) = 0$ for ages $t = 31, \ldots, 60$, (ii) only the most affluent agents do have a bequest motive, $\tilde{K}(t) > 0$, and (iii) no bequest motive, $\varsigma_0 = 0$. Our motivation to include the specification $\tilde{K} > 0$ is based upon the empirical work of Menchik/David (1983) who regress bequests on lifetime earnings for actual data on both bequests and earnings. They find that for low income levels, the marginal propensity to bequeath out of earnings is not significantly different from zero. Hurd and Shoven (1979) even find that, in 1979, households in the upper 10% wealth held about 46% (55% excluding houses) of bequeathable wealth. In the third case, there is no altruistic bequest motive. All bequests are accidental. The third case serves as a comparison case in order to evaluate the contribution of the bequest motive for the explanation of observed wealth heterogeneity.

In addition, we impose a simple generational structure in our model similar to Laitner

[8] As pointed out by Blinder (1975), this argument is implied by results of Yaari (1965). Shorrocks (1979) investigates the circumstances under which the isoelastic form of utility from bequests follows from an extended life-cycle model, where individuals are concerned with the consumption standards of their descendants.

(1992,1993).[9] In particular, families only consist of one parent and his child.[10] Following Kotlikoff/Summers (1981), we assume that the age gap between those leaving bequests and those receiving them equals $T^* = 30$ years. As a consequence, we can divide the households in two subsets: the parents who are of age $t > T^*$ and who leave bequests on the one hand and the children who are of age $t \leq T^*$ on the other hand. The child is aware of his parent's wealth and he maximizes his lifetime utility (1) considering the probability and the amount of future bequests. Furthermore, we assume that $\psi_t = 1$ for $t \leq T^*$. This assumption is rather harmless considering that the empirical survival probabilities of the young agents are close to one. As an implication, every deceased household has a living heir.

During working time, $t \leq T$, agents supply one unit of labor inelastically. Working agents face a stochastic employment opportunity. Let $\rho_s(t) \in \{e, u\}$ denote the employment status in period s at age $t \leq T$ which is assumed to follow a first-order Markov process with invariant transition matrix $\Pi[\rho(t+1), \rho(t)] = \pi_{ij}$, $i, j = e, u$, where $\pi_{ij} = \text{Prob}\{\rho(t+1) = i | \rho(t) = j\}$. If $\rho = e$ ($\rho = u$), the agent is employed (unemployed).

The employed agent ($\rho = e$) earns labor income $(1 - \tau_w)\bar{h}\epsilon(t)w_s(t)$, where w is the aggregate wage per efficiency unit, τ_w is the tax rate on wage income, $\epsilon(t)$ denotes the efficiency index of the t-year old generation, and $\bar{h}$ are the (indivisible) hours worked. If unemployed ($\rho = u$), the agent receives unemployment compensation $\zeta(1 - \tau_w)\bar{h}\epsilon(t)w_s$, where ζ is the replacement ratio. After retirement, the agent receives pensions $p_s = \theta(1 - \tau_w)\bar{h}\bar{\epsilon}w_s$, with a replacement ratio θ relative to average

[9] Contrary to the model of Laitner (1992,1993), lifetime is assumed to be uncertain in our model. Hence, in the absence of annuity markets, we have both accidental and altruistic bequests. Furthermore, we assume the child and the parent to decide independently. Laitner assumes the child and the parent to form a decision entity resulting in a gain of analytical tractability.

[10] Furthermore, we neglect any problems concerning mating patterns or concomitant issues.

net labor earnings of the employed agents.

The state vector $x_s(t)$ of the parent, $t > T^*$, is given by his own capital $k_s(t)$ (which simply takes the value of zero after his decease) and his employment status $\rho_s(t)$ (which takes the value $\rho = r$ during retirement, $t > T$, and $\rho = d$ for the deceased parent). The child's state vector $x_s(t)$ comprises his own capital stock $k_s(t)$, his employment status $\rho_s(t)$ as well as his parental wealth $k_s^p(t+T^*)$ and employment status $\rho_s^p(t+T^*)$, $x_s(t) = (k_s(t), \rho_s(t), k_s^p(t+T^*), \rho_s^p(t+T^*))$ for $t \leq T^*$. Furthermore, let $g_s(x(t))$ denote the density of $x(t)$ at time s, with initial distribution $g_0(.)$ given.

The working agent faces the budget constraint in period s:

$$\begin{aligned} k_{s+1}(t+1) + c_s(t) &= (1 + r_s(1-\tau_r))\, k_s(t) + 1_{\rho_s=e}\,(1-\tau_w)\,\epsilon(t)\bar{h}w_s + \\ &\quad +1_{\rho_s=u}\zeta(1-\tau_w)\epsilon(t)\bar{h}w_s + \vartheta_s(t), \end{aligned} \tag{4}$$

where τ_r and r_s denote the tax rate on interest income and the interest rate, respectively, and $1_{\rho=e}$ ($1_{\rho=u}$) is an index function taking the value one if the agent is employed (unemployed). Upon death of his parent, the child inherits $\vartheta_s(t) = (1-\tau_k)k_s^p(t+T^*)$. Otherwise, $\vartheta_s(t) = 0$. We assume that death takes place at the beginning of period s and bequests are distributed to the heirs prior to the consumption allocation of period s.

The old agent faces the budget constraint:

$$k_{s+1}(t+1) + c_s(t) = (1 + r_s(1-\tau_r))\, k_s(t) + p_s(t). \tag{5}$$

As the retired agent does not have any living parent, he does not receive any bequests. In addition, agents are not allowed to borrow at any time and we impose the liquidity constraint $k \geq 0$.

The first-order condition of the t-year-old household alive at time s is given by:

$$\begin{aligned} \frac{u'(c_s(t))}{\beta} &= \psi_{t+1}E_s\left\{u'(c_{s+1}(t+1))\left[1 + r_{s+1}(1-\tau_r)\right]\right\} \\ &\quad +(1-\psi_{t+1})E_s\left\{\varsigma_0(1-\tau_k)v'\left(b_{s+1}(t+1)\right)\right\}. \end{aligned} \tag{6}$$

Notice that the second additive term on the right-hand side of equation (6) is zero for the child aged $t < T^*$.

2.2 Firms

Firms are of measure one and produce output with effective labor N_s and capital K_s. Labor N_s is paid the wage w_s. Capital K_s is hired at rate r_s and depreciates at rate δ. Production is characterized by constant returns to scale and assumed to be Cobb-Douglas:

$$F(K_s, N_s) = A_0 K_s^{\alpha} N_s^{1-\alpha}. \tag{7}$$

In a factor market equilibrium, factors are rewarded with their marginal product:

$$w_s = A_0(1-\alpha)\left(\frac{K_s}{N_s}\right)^{\alpha}, \tag{8}$$

$$r_s = A_0\alpha\left(\frac{N_s}{K_s}\right)^{1-\alpha} - \delta. \tag{9}$$

2.3 The Government

The government provides public pensions and unemployment compensation which are financed by means of taxation. The government budget balances each period:

$$\begin{aligned}
&\tau_w w_s N_s + \tau_r r_s K_s + \tau_k B_s = \\
&\sum_{t=1}^{T^*} \sum_{\rho_s(t)=u} \sum_{\rho_s^p(t+T^*)} \int\int \zeta(1-\tau_w)\epsilon(t)\bar{h} w_s g(x_s(t)) dk_s(t) dk_s^p(t+T^*) + \\
&\sum_{t=T^*+1}^{T} \sum_{\rho_s(t)=u} \int \zeta(1-\tau_w)\epsilon(t)\bar{h} w_s g(x_s(t)) dk_s(t) + \\
&\sum_{t=T+1}^{T+T^R} \sum_{\rho_s(t)=r} \int p_s g(x_s(t)) dk_s(t),
\end{aligned} \tag{10}$$

where B_s denotes aggregate bequests.

The government policy is characterized by the vector $\Omega = \{\theta, \zeta, \tau_r, \tau_k\}$, while the labor income tax rate τ_w adjusts in order to keep the government budget balanced.

2.4 Stationary Equilibrium

The concept of equilibrium used in this paper uses a recursive representation of the consumer's problem following Stokey et al. (1989). Let $V_s(x_s(t), t)$ be the value of the objective function of a t-year old agent in period s characterized by a state vector $x_s(t)$. $V_s(x_s(t), t)$ is defined as the solution to the dynamic program:

$$\begin{aligned} V_s(x_s(t), t) &= \max_{c,k'} \left[u(c) + \beta \psi_{t+1} E_s \left\{ V_{s+1}(x_{s+1}(t+1), t+1) \right\} \right. \\ &\quad \left. + \beta(1-\psi_{t+1}) \varsigma_0 E_s \left\{ v(b_{s+1}(t+1)) \right\} \right], \end{aligned} \tag{11}$$

subject to the budget constraint (4) and (5) for the child and the parent, respectively. k' denotes the next-period capital stock.

We will define a stationary equilibrium for given government policy Ω and stationary distribution of the state variable, $g(x(t), t)$. The time index will be omitted from stationary variables such as the wage rate w, the interest rate r, aggregate capital stock K and employment N, and the distribution of the state variable $g(x(t), t)$.

Definition

A stationary equilibrium for a given set of government policy parameters $\Omega = \{\theta, \zeta, \tau_r, \tau_k\}$ is a collection of value functions $V(x(t), t)$, individual policy rules $c(x(t), t)$ and $k'(x(t), t)$ for consumption and next-period capital, respectively, an age-dependent, time-invariant distribution of the state variable $g(x(t), t)$ for each generation $t = 1, 2, \ldots, T + T^R$, relative prices of labor and capital $\{w, r\}$, such that:

1. Relative prices $\{w, r\}$ solve the firm's optimization problem by satisfying (8) and (9).
2. Given relative prices $\{w, r\}$ and the government policy arrangement Ω, the individual policy rules $c(.)$ and $k'(.)$ solve the consumer's dynamic progam (11).

3. Individual and aggregate behavior are consistent, i.e. the aggregate capital stock K and aggregate bequests B are given by the sum of the assets and the bequests of all households, respectively, and aggregate effective employment is given by the effective labor supply of all employed workers.

4. The goods market clear:

$$A_0 K^\alpha N^{1-\alpha} = \sum_{t=1}^{T^*} \sum_{\rho(t)} \sum_{\rho^p(t+T^*)} \int\int c(x(t),t) g(x(t),t) dk(t) dk^p(t+T^*) +$$
$$\sum_{t=T^*+1}^{T+T^R} \sum_{\rho(t)} \int c(x(t),t) g(x(t),t) dk(t) + \delta K. \tag{12}$$

5. The age-dependent time-invariant distribution $g(x(t),t)$ satisfies:

(i) in period $t=1$:

$$g(k(1),\rho(1),k^p(T^*+1),\rho^p(T^*+1),1) \tag{13}$$
$$= \begin{cases} g(k(T^*+1),\rho(T^*+1),T^*+1)\cdot \pi_{\rho(1),\rho(1)} & \text{for } k(1)=0 \\ 0 & \text{else.} \end{cases} \tag{14}$$

(ii) in period $t=1,\ldots,T^*$:

$$g(x(t+1),t+1) = \tag{15}$$
$$\psi_{t+1} \sum_{\rho(t)} \sum_{\rho(t+T^*)} \sum_{\substack{k(t+1)=k'(x(t),t) \\ k(t+T^*+1)=k'(k(t+T^*),\rho(t+T^*),t+T^*)}} g(x(t),t)\pi_{\rho(t+T^*+1),\rho(t+T^*)}\pi_{\rho(t+1),\rho(t)}$$
$$+(1-\psi_{t+1}) \sum_{\rho(t)} \sum_{\rho(t+T^*)} \sum_{\substack{k(t+1)=k'(x(t),t)+(1-\tau_k)k(t+T^*+1) \\ k(t+T^*+1)=k'(k(t+T^*),\rho(t+T^*),t+T^*)}} g(x(t),t)\pi_{\rho(t+T^*+1),\rho(t+T^*)}\pi_{\rho(t+1),\rho(t)}$$

(iii) in period $t=T^*+1,\ldots,T$ for $\rho(t+1)\in\{e,u,r\}$:

$$g(k(t+1),\rho(t+1),t+1) = \psi_{t+1} \sum_{\rho(t)\in\{e,u\}} \sum_{k(t+1)=k'(x(t),t)} g(x(t),t)\pi_{\rho(t+1),\rho(t)}, \tag{16}$$

and for the measure of deceased agents:

$$g(0,d,t+1) = g(0,d,t) + (1-\psi_{t+1}) \sum_{\rho(t)\in\{e,u\}} \int g(x(t),t) dk(t). \tag{17}$$

(iv) in period $t=T+1,\ldots,T+T^R-1$ for $\rho(t+1)=r$:

$$g(k(t+1),r,t+1) = \psi_{t+1} \sum_{k(t+1)=k'(k(t),t)} g(k(t),r,t) \tag{18}$$

and for the measure of deceased agents:

$$g(0,d,t+1) = g(0,d,t) + (1-\psi_{t+1}) \int g(k(t),r,t)dk(t). \qquad (19)$$

6. The government budget (10) is balanced.

3 Computation

3.1 Calibration

The model can only be solved numerically. For this reason, the model is calibrated in order to match the characteristics of the US economy. Parameter values are chosen from existing studies.[11]

Agents are born at a real-life age of 20 (model period 1) and live up to a maximum of 79 years (model period 60). Each year, a cohort of equal size is born. The sequence of conditional survival probabilities $\{\psi_j\}_{j=31}^{59}$ is set equal to the Social Security Administration's survival probabilities for men aged 50-78 for the year 1994.[12] ψ_{60} is set equal to zero, and ψ_j, $j = 1,\ldots,30$ is set equal to one. The efficiency index $e(t)$ of the t-year old worker is taken from Hansen (1993), and interpolated to in-between years. As a consequence, the model is able to replicate the cross-section age distribution of earnings of the US economy. Following İmrohoroğlu et al. (1995), we normalize the average efficiency index $\bar{e}$ to one and set the shift length equal to $\bar{h} = 0.45$.

Empirical estimates of the intertemporal elasticity of substitution $1/\sigma$ vary considerably. Real business cycle models like Kydland/Prescott (1982) and Hansen (1985) apply a value of σ at the height of 1.5 and 1.0, respectively, while Jones et al. (1993)

[11] If not mentioned otherwise, the parameter values are taken from İmrohoroğlu et al. (1995).

[12] We thank Mark Huggett and Gustavo Ventura for providing us with the data.

use values in the range of 1.0 and 2.5. In our computation, σ is set equal to 2. ς is set equal to σ as argued by Blinder (1975). We choose a value $\beta = 0.975$ for the discount rate implying a capital-output ratio of 3.0 as found by Auerbach/Kotlikoff (1995).[13] Utility from bequests relative to utility from consumption is given the weight $\varsigma_0 = 1$ in our benchmark specification (case i) which implies an annual flow of aggregate bequests B relative to aggregate wealth K equal to 1.37%. In case iii without a bequest motive, $\varsigma_0 = 0$, bequests are only accidental and drop to 1.06% of aggregate wealth. Both numbers are in good accordance with empirical studies reviewed by Modigliani (1988).

In our benchmark calibration, every agent has a bequest motive, $\tilde{K} = 0$. In our second specification, only the wealthy parents have an operative bequest motive. Empirical results of Menchik/David (1983) suggest that only the top 20th percentile of the distribution of earnings (including inherited wealth) have an operative bequest motive. For this reason, we will also analyse the case where only agents in the top quintile of wealth distribution in each generation $t = 31, \ldots, 60$ leave voluntary bequests.[14] In order to obtain a ratio of bequest relative to wealth equal to $B/K =$ 1.37% as in case i, ς_0 is set equal to 2.5.

Following Prescott (1986), capital's share in output is set equal to $\alpha = 0.36$. The annual rate of depreciation is set equal to $\delta = 0.08$. The technology level A_0 is

[13] The capital-output ratio is somewhat smaller if capital is defined to exclude land, consumer durables, and residental structures owned by the government (see Stokey/Rebelo, 1995). A sensitivity analysis of β is performed in section 4.3.

[14] Notice that, in our model, there is no wealth mobility between the retired agents within each generation. As a consequence, agents do not change their type and either leave voluntary bequests or not in old age. We would like to thank James Smith for bringing this to our attention.

normalized to one. Employment follows the first-order Markov process:

$$\Pi[\rho(t+1), \rho(t)] = \begin{bmatrix} 0.94 & 0.06 \\ 0.94 & 0.06 \end{bmatrix}. \tag{20}$$

By this choice, the probability of employment is equal to 0.94, independent of the employment status in the previous period.

The unemployment insurance replacement ratio, $\zeta = 0.4$, is taken from İmrohoroğlu et al. (1995). The replacement ratio of social security benefits, $\theta = 0.5$, is taken from İmrohoroğlu et al. (1998). Lucas (1990) provides an estimate of the capital income tax rate $\tau_r = 0.36$. The inheritance tax rate τ_k is set equal to zero in our benchmark case following Grüner/Heer (2000). The labor income tax rate τ_w adjusts in order to keep the government budget balanced. In our benchmark case, $\tau_w = 13.1\%$. Our parameterization is summarized in table 1.

3.2 The Solution Algorithm

The model has no analytical solution. Algorithms to solve heterogenous-agent models with an endogenous distribution have only recently been introduced into the economic literature. Notable studies in this area are Aiyagari (1994,1995), den Haan (1996), Huggett (1993,1996), İmrohoroğlu et al. (1995), Ríos-Rull (1995), and Krussell/Smith (1998). Like most of these studies, we will only focus on the steady state of the model.[15] Our algorithm is similar to the one used by İmrohoroğlu et al. (1995) who

[15]den Haan (1996) and Krusell/Smith (1998) also compute the transition function of the capital stock distribution. For this reason, den Haan uses a specific class of function for the cross-sectional distribution of assets. Choosing the exponential family, he is able to characterize the distribution by a discrete number of parameters. This procedure allows him to model the transition function of the distribution with a dynamic equation in a few parameters. Similarly, Krussell/Smith (1998) characterize the distribution by a discrete number of moments. In the present analysis, however, the distribution is calculated without any assumptions on its functional form.

Table 1: Calibration of parameter values

Description	Function	Parameter
utility from consumption	$u(c) = \frac{c^{1-\sigma}-1}{1-\sigma}$	$\sigma = 2$
utility from bequests	$\varsigma_0 v(b) = \varsigma_0 \frac{b^{1-\varsigma}-1}{1-\varsigma},\ k \geq \tilde{K}$	
case i		$\varsigma_0 = 1.0,\ \varsigma = 2,\ \tilde{K} = 0$
case ii		$\varsigma_0 = 2.5,\ \varsigma = 2,\ \tilde{K} > 0$
case iii		$\varsigma_0 = 0$
discount factor	β	$\beta = 0.975$
production function	$y = A_0 k^{\alpha} n^{1-\alpha}$	$\alpha = 0.36,\ A_0 = 1$
depreciation	δ	$\delta = 0.08$
shift length	$\bar{h}$	$\bar{h} = 0.45$
government policy		
tax rates		
capital income	τ_r	$\tau_r = 36\%$
inheritance	τ_k	$\tau_k = 0\%$
replacement ratios		
unemployment compensation	ζ	$\zeta = 0.4$
public pensions	θ	$\theta = 0.5$

also perform a numerical analysis of a life-cycle model. The solution algorithm is described by the following steps:

1. Choose the policy $\Omega = \{\theta, \zeta, \tau_r, \tau_k\}$.
2. Make initial guesses of K, B, r, w, and τ_w.
3. Compute the household's decision function by backward induction.
4. Compute the steady-state distribution of assets and bequests in each cohort.
5. Compute the aggregate asset holdings K and bequests B of households as well as government expenditures on unemployment compensation and pensions.
6. Compute the values r, w, and τ_w which solve the firm's Euler equations and the government budget.
7. Update K, B, r, w, and τ_w and return to step 3 until convergence.

In step 3, a simple finite-time dynamic programming problem is solved by iterating the policy functions $c(., t)$ and $k'(., t)$ of a household of generation t backward starting in period $T + T^R$. The dynamic program has one to four state variables depending on the age of the agent:

1. Agents of age t, $t = 1 \ldots, 10$, choose consumption $c = c(k, \rho, k^p, \rho^p, t)$ and next-period capital stock $k' = k'(k, \rho, k^p, \rho^p, t)$ depending on their own capital k, their own employment status ρ, their parental wealth k^p, and their parent employment status ρ^p. The measure of these agents are denoted by $g(k, \rho, k^p, \rho^p, t)$ for $k, k^p \geq 0$.
2. At age $t = 11, \ldots, 30$, children have retired parents. The state variable reduces to (k, ρ, k^p).

3. The working parent's decision functions $c(k, \rho, t)$ and $k'(k, \rho, t)$ depend on his own wealth k and employment status ρ, $t = 31, \ldots, 40$.

4. Finally, the retired agent's decision is based upon his wealth k only.

The policy functions are computed from the Euler equation (6) for each type of agent (employed/unemployed/retired with/without living employed/unemployed/retired parent) over a discrete grid $D = \{d_1, d_2, \ldots, d_m\}$ with $m = 50$ for the capital stock k and k^p, respectively. The lower bound is set equal to $d_1 = 0$, the upper bound $d_m = 20$ is found to be never binding in our simulations. Given the optimal controls in grid points in period $t+1$, we can determine the optimal decision rules in period t. Following Huggett/Ventura (1998), we use linear (and bilinear) interpolation in order to get decision rules off these gridpoints. We find that, for given accuracy,[16] interpolation allows for much faster computation at a lower number of gridpoints than restricting the control space to the set of gridpoints D only.

At step 4, the time-invariant distribution of the state variable is calculated. For this reason, the distribution of the 31-year old agent has to be initialized. As an initial guess, we use a uniform distribution:

$$g(k, \rho, 31) = \begin{cases} \frac{1}{k_{max}/2 - k_{min}} \Pi[\rho, \rho] & k_{min} \leq k \leq k_{max}/2 \\ 0 & \text{else.} \end{cases} \tag{21}$$

The age-dependent distribution is computed from (13)-(19)[17] and $g(k, \rho, 31)$ is updated until convergence.

[16] Accuracy is measured by the residual function for the first-order condition (6) (see e.g. Judd, 1998).

[17] In order to ensure that next-period distribution $g(x(t+1), t+1)$ lies on an asset grid point, $k, k^p \in D$, we make a small adjustment. Suppose that for $t \geq 30$, $k'(x(t), t)$ is bounded by k^1 and k^2 from below and from above, respectively. In this case, we assign the value $(k^2 - k')/(k^2 - k^1) \cdot g(x(t+1), t+1)$ to the point k^1 and $(k' - k^1)/(k^2 - k^1) \cdot g(x(t+1), t+1)$ to the point k^2. For $t < 30$, similarly, we use bilinear assignment rules.

3.3 Measures of Distribution and Welfare

In the next section, we compare alternative government policies Ω quantifying the effects on distribution and welfare. The equality of wealth distribution is measured by the Gini coefficient. The welfare associated with a government policy $\Omega = \{\theta, \zeta, \tau_r, \tau_k\}$ is measured by the expected discounted utility of a newborn:

$$W(\Omega) = \sum_{\rho \in \{e,u\}} \sum_{\rho^p \in \{e,u\}} \int V(0, \rho, k^p, \rho^p, 1) g(0, \rho, k^p, \rho^p, 1) dk^p. \tag{22}$$

The welfare effect of a change in government policy from Ω to Ω' is measured by the consumption equivalent increase Δ_c as suggested by McGrattan (1994):

$$W(\Omega') = \sum_{t=1}^{T+T^R} \int \beta^{t-1} \left(\left[\prod_{j=1}^{t} \psi_j \right] u((1+\Delta_C)\tilde{c}(\tilde{x}(t), t)) + \varsigma_0 \left[\prod_{j=1}^{t-1} \psi_j \right] (1-\psi_t) v(\tilde{b}(\tilde{x}(t), t)) \right) \tilde{g}(\tilde{x}(t), t) d\tilde{x}(t), \tag{23}$$

where $\tilde{x}(t)$, $\tilde{c}(., t)$, $\tilde{b}(., t)$, and $\tilde{g}(., t)$ denote the state vector, the consumption function, the bequest function, and the distribution of the state vector in period t under government policy Ω. As our reference economy with government policy Ω and $\Delta_c = 0$, we take our benchmark economy with $\tilde{K} = 0$ and $\varsigma_0 = 1$ (case i).

4 Results

Our results are described for alternative formulations of the bequest motive. For the three cases considered, equilibrium properties are derived and the effect of the bequest motive on wealth heterogeneity is examined. In the second part of this chapter, we study optimal inheritance taxation. A sensitivity analysis of our results with regard to the preference parameters concludes the chapter.

Figure 1: Consumption policy of a 25-year old worker

4.1 Equilibrium Properties

In our benchmark case i, all agents have an operative bequest motive. The child's decision functions depend on his own wealth k, his employment status ρ, parental wealth k^p, and parental employment status ρ^p. For the 25-year-old unemployed child with employed parent (corresponding to the model period $t = 6$), the consumption function is illustrated in figure 1 as a function of his own and his parent's wealth. Consumption is an increasing function of both child wealth and parental wealth. Furthermore, consumption is also higher if the child (parent) is employed.[18]

In our economy, bequests influence wealth heterogeneity. Rich parents will have rich children. However, as is obvious from inspection of figure 1, this effect is reduced by the forward-looking behavior of the children. Children of rich parents also consume more than children of poor parents because they expect higher bequests in the future.

[18] We refrained from displaying the consumption function of the employed child since it is qualitatively the same as the one in figure 1.

Figure 2: Wealth-age profile

The average wealth-age profiles of case i (solid line), case ii (broken line), and case iii (dotted line) are illustrated in figure 2. The hump-shape of the profile is typical for the life-cycle model. Agents build up savings during working life, and assets starts to fall after retirement. Notice that, in the benchmark case, there is a jump in wealth between age 49 and age 50 resulting from our assumption that all agents die at age 80 and leave bequests to their 50-year old children. Compared to case iii without bequest motive, agents build up a higher stock of capital and dissave less in old age.

One major focus of this paper is the explanation of observed wealth heterogeneity. Empirically, wealth is distributed much more unequally than income. Greenwood (1983), Wolff (1987), Kessler/Wolff (1992), and Wolff (1994) estimate Gini coefficients of wealth distribution for the US economy in the range 0.72-0.81. In standard life-cycle models without bequests, the implied Gini coefficient is usually significantly lower. For example, in our model without bequest ($\varsigma_0 = 0$) and certain lifetime, ($\psi_j = 1$ for $j < 60$, $\psi_{60} = 0$), the Gini coefficient only amounts to 45.7%. Without a bequest

Figure 3: Lorenz curve

motive but with stochastic survival probability (case iii), the Gini coefficient increases to 48.8%. Hence, the contribution of accidental bequests to wealth heterogeneity is rather modest. In the presence of a voluntary bequest motive for all agents (case i), agents increase savings from $K = 1.705$ (case iii) to $K = 1.803$ (case i). However, wealth dispersion does not change significantly and, in fact, even falls, the Gini coefficient being equal to 48.5%. To some extent, the negligible impact of altruistic bequests on wealth heterogeneity is caused by our generational structure. Most altruistic bequests are inherited from the 50-year old as the parent deceases at the maximum length of life at the end of age 79. At age 50, however, life-cycle wealth is below the peak at age 60.[19]

[19]Consequently, if we would like to produce higher wealth inequality in our model, we should assume the average retirement period to be as long as the average age gap between parent and child. However, such an assumption is hard to reconcile with the finding of Kotlikoff/Summers (1981) that the average parent-child age gap is 30 years on the one hand and with our generational structure based on Laitner (1992,1993) on the other hand.

Table 2: Equilibrium properties for different bequest motives

case	ς_0	$\tilde{K}$	K	τ_w	r	$\frac{K}{Y}$	Gini	B
i	1	0	1.803	13.11%	3.62%	3.09	48.54%	0.0247
ii	2.5	> 0	1.992	12.73%	4.04%	2.99	48.56%	0.0285
iii	0	0	1.706	12.70%	4.04%	2.99	48.83%	0.0180

In case ii, only the wealthy agents have a bequest motive. Recall that the second case seems to be among the most realistic according to the study of Menchik/David (1983). Even in this case, wealth inequality does not change significantly compared to the benchmark case i, with a Gini coefficient equal to 48.56% (see table 2). The Lorenz curves for case i (solid line), case ii (broken line), and case iii (dotted line) are displayed in figure 3 and compared to the empirical distribution.[20] In our model, the poorest 20% of the agents hold approximately zero wealth, whereas the richest 5% hold about 20% of wealth. As reported by Wolff (1994), the empirical numbers amount to zero wealth and 50% of total wealth, respectively. Like in Huggett (1996) and Krussell/Smith (1998), our model performs rather well in reproducing a high proportion of agents holding zero wealth, but it performs poorly in reproducing the high concentration of wealth amoung the richest agents.

There are numerous reasons why the endogenous wealth heterogeneity of our model is smaller than observed empirically: 1) We neglect any productivity heterogeneity within generations. 2) Unemployment benefits and pensions are not related to the earnings history of the recipient. 3) We neglect any asset-based means-test of social security. Hubbard et al. (1995) show that, in the presence of social insurance programs with means tests, low-income households are likely to hold virtually no wealth

[20] The data for the empirical distribution of wealth is taken from Huggett (1996). The Lorenz curves for case i-iii are almost identical.

across life-time. 4) We only consider transfer of physical wealth, but not human wealth. Loury (1981) analyzes parental human capital investment in their offspring. The allocation of training and hence the earnings of the children depend on the distribution of earnings among the parents. Becker/Tomes (1979) present a model framework comprising both human and non-human capital transfers from parents to children. 5) Agents are not allowed to borrow against anticipated bequests implying a credit limit $k \geq 0$. For lower binding constraint, $k < 0$, wealth heterogeneity increases as demonstrated by Huggett (1996). In particular, the proportion of agents holding zero and negative assets increases. Accounting for the features (1)-(5) in our model is likely to result in an increase of wealth inequality for agents characterized by low to high asset holdings, however, we are sceptical as to whether it proves successful in reproducing the observed wealth concentration among the very rich.[21]

4.2 Inheritance Taxation

The quantitative effect of the inheritance tax rate τ_k on aggregate bequests depends on the magnitude of the elasticity $v'(k(1-\tau_k))$ with respect to bequests. For our calibration with $\varsigma = 2$, agents increase their before-tax bequests for higher τ_k (see table 3). An increase of inheritance taxation, however, allows for the reduction of the wage tax in order to keep the government budget balanced. As a consequence, net labor earnings and, consequently, pensions increase. While the former effect increases aggregate savings, the latter reduces savings. The net effect is negative for tax rates τ_k below 70%, and aggregate wealth declines following an initial rise in inheritance taxation. Furthermore, wealth heterogeneity declines for two reasons. First, after-tax inherited wealth decreases. And second, the factor income distribution changes. For our Cobb-Douglas specification of the production function, capital and labor are

[21]As the only exception to these modelling choices (known to us), Quadrini (1999) presents a promising approach in order to explain the high concentration of wealth among the very rich agents. He introduces entrepreneurship into a dynamic general equilibrium model.

Table 3: Effects of inheritance taxation

τ_k	K	W	B	τ_w	r	$\frac{K}{Y}$	Gini	Δ_c
0%	1.803	-4.819	0.0247	13.11%	3.62%	3.09	48.54%	0%
10%	1.785	-4.796	0.0251	12.48%	3.70%	3.08	47.83%	+0.147%
20%	1.767	-4.773	0.0254	11.83%	3.81%	3.05	47.14%	+0.294%
30%	1.750	-4.747	0.0259	11.16%	3.85%	3.04	46.52%	+0.461%
40%	1.735	-4.717	0.0266	10.36%	3.94%	3.02	46.16%	+0.654%
50%	1.722	-4.687	0.0272	9.74%	3.98%	3.00	45.58%	+0.848%
60%	1.713	-4.657	0.0282	8.96%	4.03%	2.99	45.29%	+1.043%
70%	1.710	-4.618	0.0296	8.09%	4.03%	2.99	45.13%	+1.297%
80%	1.720	-4.572	0.0320	7.07%	3.98%	3.00	45.10%	+1.598%
90%	1.767	-4.509	0.0369	5.62%	3.77%	3.06	45.15%	+2.010%
95%	1.849	-4.447	0.0435	4.31%	3.43%	3.15	45.21%	+2.426%

paid the shares α and $1-\alpha$ of income before taxes, respectively. As the wage tax is reduced, the after-tax labor share in net income increases. Following an increase in the inheritance tax rate to 10%, for example, the Gini coefficient falls from 48.54% to 47.49%. For $\tau_k = 50\%$, the Gini coefficient amounts to 45.6%, and is approximately as low as in the case of no bequests and certain lifetime. In this case, the inequality resulting from inherited wealth is eliminated.[22]

The optimal taxation of capital in a second-best economy has been studied by Chamley (1986) and Judd (1985). In a Ramsey model with an infinite-lived representative individual, they show that the optimal capital tax rate is zero in the long run. However, zero capital taxation need not be optimal in a life-cycle model (see e.g. Atkinson/Sandmo, 1980, Summers, 1981, and Auerbach et al., 1983) or in models with incomplete markets with borrowing constraints (see e.g. Aiyagari, 1994, 1995, and

[22]As already argued by Atkinson (1971b), considering equity we are not concerned about wealth inequality as resulting from the difference in life-cycle savings at different ages (in the absence of incomplete markets and borrowing constraints), but rather with the wealth inequality as resulting from inherited bequests.

İmrohoroğlu, 1998). There are numerous opposing effects of inheritance taxation on welfare in our model. First, the capital stock decreases away from the golden-rule steady-state capital stock for $\tau_k < 70\%$.[23] Second, the tax burden is shifted from the young agents (who are, if unemployed, credit-constrained during the first periods of life) to the old agents as we increase inheritance taxation and decrease labor income taxation. Third, the increase in wealth equality results in an increase of our welfare measure (22) as the value function $V(.)$ is a concave function of the capital stock. And fourth, utility from bequests declines with increasing inheritance taxation. The net effect on welfare of a marginal increase of τ_k is positive in our benchmark economy. Of course, complete inheritance taxation is not optimal as utility from bequest goes to minus infinity as τ_k approaches 100%. However, the optimal inheritance tax rate is found to even exceed 90%. For $\tau_k = 95\%$, the long-run change in welfare is equivalent to a consumption rise of 2.43%.[24]

4.3 Sensitivity Analysis

In this section, we examine the sensitivity of our results with regard to the two preference parameters, the intertemporal elasticity of substitution in consumption, $1/\sigma$, and the discount rate β. Varying these two parameters, all other parameters are kept constant. In particular, we do not adjust the parameters of the utility function from bequests, ς_0 and ς. Our results are summarized in table 4. In the first row, the benchmark case with $\sigma = 2$ and $\beta = 0.975$ is reported for ease of comparison. In

[23] In our benchmark case, the capital stock differs from the golden-rule capital stock because of incomplete markets, borrowing constraints, capital income taxation, and the provision of social security.

[24] The welfare gain is in good accordance with other quantitative studies of optimal capital taxation such as Lucas (1990) and Laitner (1995) who compute steady-state welfare gains from the abolition of capital income taxes of approximately 5-6% (of total consumption). Notice that we only consider one possible tax policy, i.e. we keep the set $\{\theta, \zeta, \tau_r\}$ of government policy parameters constant. Second-best optimal taxation certainly results in even higher welfare gains.

Table 4: Sensitivity analysis

(σ, β)	K	B	τ_w	r	$\frac{K}{Y}$	Gini
$(2, 0.975)$	1.803	0.0247	13.11%	3.62%	3.09	48.54%
$(1.5, 0.975)$	1.799	0.0259	13.09%	3.64%	3.09	48.88%
$(4, 0.975)$	1.813	0.0218	13.14%	3.59%	3.11	47.59%
$(2, 0.99)$	2.257	0.0292	14.86%	2.07%	3.58	46.69%

the second and third row, results are reported for a change in the coefficient of risk aversion taking the values $\sigma = 1.5$ and $\sigma = 4$, respectively. In the last row of table 4, the discount factor is set equal to $\beta = 0.99$.

The effect of an increase in σ, for constant ς, on altruistic bequests is obvious from inspection of the household's first-order condition (6). For a higher coefficient of risk aversion σ, aggregate bequests B decrease. There are opposing effects of a higher σ on savings K. On the one hand, agents are more risk averse and increase precautionary savings. On the other hand, the interest rate is greater than the time discount rate in our model and, consequently, average consumption grows over time. For a smaller elasticity of intertemporal substitution $1/\sigma$, agents are lessing willing to substitute consumption intertemporally and decrease savings. Furthermore, altruistic bequests decrease. For our calibration, the first effect dominates but the net effect on savings and the interest rate is rather small.[25] Following an increase in the coefficient of risk aversion, the inequality of wealth distribution declines because the poorer agents increase savings in a higher proportion than richer agents.[26] For $\sigma = 4$, for example,

[25]Contrary to Huggett (1996), we find that the bequest-wealth ratio B/K decreases, whereas aggregate savings K increase with the coefficient of risk aversion σ (in all cases i-iii considered). As one possible explanation, income uncertainty during working life in the model of Huggett (1996) is different from the one in our model (see Blundell/Stoker, 1999, for an analysis of the effects of income risk and timing on precautionary savings).

[26]With preference displaying constant relative risk aversion, precautionary savings vary inversely

the Gini coefficient of wealth distribution amounts to 47.6% compared to a Gini coefficient of 48.5% in the benchmark case with $\sigma = 2$.

For a higher discount rate $\beta = 0.99$, savings increase and the capital-output ratio rises to 3.57. Furthermore, bequests B increase because agents discount anticipated utility from bequests at a lower rate. We find that our qualitative results are robust with regard to a change in both the intertemporal elasticity of substitution $1/\sigma$ and the discount factor β. In particular, i) the effect of the bequest motive on wealth inequality is rather modest and ii) the optimal inheritance taxation exceeds 90%.

5 Conclusion

The effects of bequests and inheritance taxation on wealth accumulation, wealth distribution, and welfare are examined in a general equilibrium life-cycle model with intergenerational transfers, incomplete markets, and borrowing constraints. The model is calibrated with regard to the characteristics of the US economy. Our results can be summarized as follows. First, wealth inequality increases after accounting for inherited bequests, with the Gini coefficient of wealth distribution rising from 45.7% to 48.5%. We find that the altruistic bequest motive only accounts for a small proportion of actual wealth inequality and that inherited wealth is not a primary source of wealth inequality. Second, inheritance taxes increase both wealth equality and welfare. If we demand i) the government budget to be balanced and ii) any increase of the inheritance tax rate to be offset by a reduction of the wage tax, the optimal tax rate on inheritance is found to amount to approximately 95%.

with the level of wealth (see, e.g., Skinner, 1988).

References

Aiyagari, S.R., 1994, Uninsured Idiosyncratic Risk and Aggregate Saving, Quarterly Journal of Economics 109, 659-84.

Aiyagari, S.R., 1995, Optimal Capital Income Taxation with Incomplete Markets, Borrowing Constraints and Constant Discounting, Journal of Political Economy 103, 1158-75.

Atkinson, A.B., 1971a, Capital Taxes, the Redistribution of Wealth and Individual Savings, Review of Economic Studies 38, 209-27.

Atkinson, A.B., 1971b, The distribution of wealth and the individual life cycle, Oxford Economic Papers 23, 239-54.

Atkinson, A.B. and A. Sandmo, 1980, Welfare Implications of the Taxation of Savings, Economic Journal 90, 529-49.

Auerbach, A. and L. Kotlikoff, 1995, Macroeconomics: An integrated approach (South-Western College Publishing, Cincinnati, OH).

Auerbach, A.J., L.J. Kotlikoff, and J. Skinner, 1983, The Efficiency Gains from Dynamic Tax Reform, International Economic Review 24, 81-100.

Becker, G.S. and N. Tomes, 1979, An Equilibrium Theory of the Distribution of Income and Intergenerational Mobility, Journal of Political Economy 87, 1153-89.

Bevan, D.L. and J.E. Stiglitz, 1979, Intergenerational transfers and inequality, Greek Economic Review 1, 8-26.

Blinder, A.S., 1975, Distribution Effects and the Aggregate Consumption Function, Journal of Political Economy 83, 447-75.

Blundell, R. and R.M. Stoker, 1999, Consumption and the timing of income risk, European Economic Review 43, 475-507.

Chamley, C.P., 1986, Optimal taxation of capital income in general equilibrium with infinite lives, Econometrica 54, 607-22.

den Haan, W.J., 1996, Understanding equilibrium models with a small and a large number of agents, NBER working paper 5792.

Davies, J.B. and A.F. Shorrocks, 1999, The Distribution of Wealth, paper presented at the conference on 'Intergenerational transfers, taxes and the distribution of wealth' in Uppsala, 1999.

Díaz-Giménez, J., V. Quadrini, and J.V. Ríos-Rull, 1997, Dimensions of Inequality: Facts on the U.S. Distributions of Earnings, Income, and Wealth, Federal Reserve Bank of Minneapolis Quarterly Review 21, 3-21.

Flemming, J.S., 1979, The Effects of Earnings Inequality, Imperfect Capital Markets, and Dynastic Altruism on the Distribution of Wealth in a Life Cycle Model, Economica 46, 363-80.

Greenwood, D., 1983, An Estimation of US Family Wealth and Its Distribution from Microdata, 1973, Review of Income and Wealth 24, 23-44.

Grüner, H.P. and B. Heer, 2000, Optimal flat-rate taxes on capital — a reexamination of Lucas' supply model, Oxford Economic Papers 52, 289-305.

Hansen, G.D., 1985, Indivisible Labor and the Business Cycle, Journal of Monetary Economics 16, 309-27.

Hansen, G., 1993, The cyclical and secular behavior of the labor input: comparing efficiency units and hours worked, Journal of Applied Econometrics 8, 71-80.

Henle, P. and P. Ryscavage, 1980, The distribution of earned income among men and women, 1958-77, Monthly Labor Review, April, 3-10.

Hubbard, R.G., J. Skinner, and S.P. Zeldes, 1995, Precautionary Saving and Social Insurance, Journal of Political Economy 103, 360-99.

Huggett, M., 1993, The risk-free rate in heterogenous-agent incomplete-insurance economies, Journal of Economic Dynamics and Control 17, 953-69.

Huggett, M., 1996, Wealth Distribution in Life-Cycle Economies, Journal of Monetary Economics 38, 469-94.

Huggett, M. and G. Ventura, 1998, On the Distributional Effects of Social Security Reform, ITAM discussion paper 9801.

Hurd, M. and J. Shoven, 1985, Inflation Vulnerability, Income, and Wealth of Elderly, 1969–79, in: M. David and T. Smeeding, eds., Horizontal Equity, Uncertainty, and Economic Well-Being (University of Chicago Press, Chicago).

İmrohoroğlu, A., S. İmrohoroğlu, and D.H. Joines, 1995, A life cycle analysis of social security, Economic Theory 6, 83-114.

İmrohoroğlu, A., S. İmrohoroğlu, and D.H. Joines, 1998, The Effect of Tax-Favored Retirement Acccounts on Capital Accumulation, American Economic Review 88, 749-68.

İmrohoroğlu, S., 1998, A Quantitative Analysis of Capital Income Taxation, International Economic Review 39, 307-28.

Jones, L.E., R.E. Manuelli, and P.E. Rossi, 1997, On the Optimal Taxation of Capital Income, Journal of Economic Theory 73, 93-117.

Judd, K.L., 1985, Redistributive Taxation in a Simple Perfect Foresight Model, Journal of Public Economics 28, 59-83.

Judd, K.L. 1998, Numerical Methods in Economics (MIT Press, Cambridge, MA).

Kessler, D. and E.N. Wolff, 1992, A Comparative Analysis of Household Wealth Patterns in France and the United States, Review of Income and Wealth 37, 249-66.

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

Krussell, P. and A.A. Smith, 1998, Income and Wealth Heterogeneity in the Macroeconomy, Journal of Political Economy 106, 867-96.

Kydland, F. and E.C. Prescott, 1982, Time to build aggregate fluctuations, Econometrica 50, 1345-70.

Laitner, J., 1992, Random Earnings Differences, Lifetime Liquidity Constraints, and Altruistic Intergenerational Transfers, Journal of Economic Theory 58, 135-70.

Laitner, J., 1993, Long-run equilibria with borrowing constraints and altruism, Journal of Economic Dynamics and Control 17, 65-96.

Laitner, J., 1995, Quantitative Evaluations of Efficient Tax Policies for Lucas' Supply Side Models, Oxford Economic Papers 47, 471-92.

Loury, G.C., 1981, Intergenerational transfers and the distribution of earnings, Econometrica 49, 843-67.

Lucas, R.E., 1990, Supply-Side Economics: An Analytical Review, Oxford Economic Papers 42, 3-42.

McGrattan, E., 1994, The macroeconomic effects of distortionary taxation, Journal of Monetary Economics 55, 491-514.

Menchik, P.L. and M. David, 1983, Income Distribution, Lifetime Savings, and Bequests, American Economic Review 73, 672-90.

Modigliani, F., 1988, The Role of Intergenerational Transfers and Life Cycle Saving in the Accumulation of Wealth, Journal of Economic Perspectives 2, 15-40.

Prescott, E., 1986, Theory ahead of Business Cycle Measurement, Federal Reserve Bank of Minneapolis Quarterly Review 10, 9-22.

Quadrini, V., 1999, Entrepreneurship, Saving and Social Mobility, Pompeu Fabra University, mimeo.

Quadrini, V. and J.V. Ríos-Rull, 1997, Understanding the U.S. Distribution of Wealth, Federal Reserve Bank of Minneapolis Quarterly Review 21, 22-36.

Ríos-Rull, J.V., 1995, Models with heterogenous agents, in: T.F. Cooley, ed., Frontiers of business cycle research (Princeton University Press, Princeton, NJ).

Shorrocks, A.F., 1979, On the Structure of Inter-generational Transfers Between Families, Economica 46, 415-25.

Skinner, J., 1988, Risky income, life cycle consumption, and precautionary savings, Journal of Monetary Economics 22, 237-55.

Stokey, N., J.R. Lucas, and E.C. Prescott, 1989, Recursive methods in economic dynamics (Harvard University Press, Cambridge, MA).

Stokey, N. and S. Rebelo, 1995, Growth effects of flat-rate taxes, Journal of Political Economy 103, 519-50.

Summers, L.H., 1981, Capital Taxation and Accumulation in a Life Cycle Growth Model, American Economic Review 71, 533-44.

Wolff, E.N., 1987, Estimates of household wealth in the US, 1962-83, Review of Income and Wealth 33, 231-57.

Wolff, E.N., 1994, Trends in Household Wealth in the United States, 1962-83 and 1983-89, Review of Income and Wealth 40, 143-74.

Yaari, M., 1965, Uncertain Lifetime, Life Insurance and the Theory of the Consumer, Review of Economic Studies 32, 137-50.