Modeling the Macroeconomic Implications of Social Security Reform

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This paper studies the long–run implications for national wealth accumulation of potential changes in the U.S. social security system or in the size of the U.S. national debt. Privatization of a portion of the existing (unfunded) U.S. social security system would, if the national debt were held constant, tend to increase the U.S. economy's supply of financing at the existing interest rate.[1] In a world with unimpeded international capital flows, that would tend to reduce U.S. dependence on foreign financing of its national debt and physical capital stock. In a closed economy — the subject of this paper — an increase in the domestic supply of credit might, at least in the long run, lower interest rates, increase the capital intensivity of production, raise output per worker, and raise wages (e.g., Feldstein [1998]). However, the latter results depend upon the response of private (domestic) wealth accumulation to changes in factor prices.

Economists have two basic frameworks for analyzing private saving behavior. In one, the "life cycle" or "overlapping generations model" (e.g., Diamond [1985] and Modigliani [1986]), a policy change toward funding part of the social security system or reducing the national debt is indeed likely to increase the long–run capital intensivity of the economy and reduce interest rates. This is the most widely employed model in existing studies of social security reform (e.g., Auerbach and Kotlikoff [1987] and Kotlikoff [1998]). According to the other most prominent framework of analysis, the "dynastic" or "representative agent model" (e.g., Barro [1974]), modifications of social security or changes in the national debt cause few if any effects on aggregate capital accumulation or interest rates. It seems fair to say that the representative agent model is currently the most widely used framework in macroeconomic theory generally.

The present paper proposes to study social security policy changes with a model combining the two basic frameworks. Just as the basic frameworks have quite different predictions about the effects of policy, a variety of results are possible from the hybrid model. To identify which results are the most realistic, this paper attempts to calibrate parameter values carefully. Because the hybrid nests the other two frameworks, it can be used to assess their relative quantitative importance. The calibration uses data on the aggregate U.S. stock of wealth but also data from the Federal Reserve's *Survey of Consumer Finances* on the distribution of wealth among households. In practice, households are not homogeneous, and the discussion below suggests that the behavior of the richest decile of

[1] Privatization of a part of social security might in practice be accompanied by an increase in national debt, the latter being used to finance benefits of the currently elderly during the transition to a funded system. Such a transition would, in a sense, merely convert implicit government liabilities for social security benefits under the present system into explicit government debt. This paper assumes that privatization would not work that way — that temporary taxes would provide the means of compensating elderly beneficiaries during the transition to a funded system. This seems to be the conventional interpretation of "privatizing social security" (e.g., Feldstein [1998]).

families requires careful consideration. At this point, this paper's analysis suggests distinct outcomes: with calibrated parameter values, the closed–economy steady–state equilibrium predicted effects of reducing the size of the unfunded social security system or of the national debt are modest — with the equilibrium stock of physical capital changing only a small amount.

The organization of this paper is as follows. Section 1 reviews the basic frameworks and hybrid model graphically. Section 2 briefly considers existing empirical evidence. Section 3 examines the U.S. distribution of wealth. Section 4 turns to the distribution of earnings. Section 5 considers how to model the U.S. Federal estate tax — a crucial issue in our calibration. Section 6 presents the equations of this paper's model. Section 7 returns to estate taxation. Section 8 calibrates the hybrid model's parameters. Section 9 presents policy simulation results. Section 10 concludes.

1. A Graphical Overview

This section characterizes the two basic existing frameworks of the introduction in terms of a common diagram. Then it shows the graph which this paper's new model produces.

The overlapping–generations model emphasizes the utility–maximizing behavior of finite–lived individual households. Since a typical cycle of life ends with a period of retirement, the model suggests that a household will save in youth and middle age, and dissave in old age. The framework can also encompass saving to meet lifetime contingencies, such as spells of unemployment. And, if annuities markets are incomplete, there can be unintentional bequests.

Figure 1 illustrates a derivation of the model's long–run equilibrium. For simplicity, omit, for this section, growth and depreciation of capital. Let K be the economy's steady–state stock of physical capital and L the labor supply. Let the latter be inelastic. Suppose there is a Cobb–Douglas aggregate production function, so that long–run GDP is $K^{\alpha} \cdot L^{1-\alpha}$, with $\alpha \in (0,1)$. Then with competitive behavior in the production sector, the ratio of factor shares is constant. Specifically, if w is the steady–state wage and r the steady–state interest rate, $r \cdot K/[w \cdot L] =$ a constant. Moving r to the right–hand side of the equation, one then has a hyperbolic relation between $K/[w \cdot L]$ and r. That is Figure 1's "demand for capital" curve. At each r one can sum the net worth, in wage units, of households of every age. When preference orderings are homothetic, this is a particularly simple exercise. This fixes Figure 1's "supply of financing" curve. The supply curve may be rising or falling because increases in the interest rate lead to complex combinations of income and substitution effects. In the very simple case of logarithmic preferences, two–period lives, and inelastic labor supply of one unit in youth and 0 in old age, for example, the curve will be vertical. Assuming no national debt, an intersection of the demand and supply curves determines a steady–state equilibrium.[2] At an intersection, the amount of wealth households are willing to hold in their portfolios is just sufficient to finance the economy's stock of physical capital.

[2] See Tobin [1967] for an early use of this diagram.

See figures at end of manuscript

Figure 1: The demand for capital and supply of credit in an OLG model

Figure 2 illustrates possible consequences of policy reform in the context of the overlapping generations model. If one introduces a national debt D, household net worth must finance it as well as K. The steady–state equilibrium from Figure 1 moves from E to E'. In the illustration, taxes necessary to cover interest on the debt reduce household saving (and consumption), shifting the aggregate supply curve to the left. In the end, the interest rate rises, implying the capital–to–labor ratio falls. Results depend, of course, on the exact shape of the supply curve (and the nature of the tax system). An unfunded social security system tends to shift the supply curve to the left as well: taxes in working years tend to reduce households' capacity to save; anticipated retirement benefits reduce each household's need to save. Again, the effect tends to be a rise in the long–run equilibrium interest rate and a corresponding reduction in the steady–state capital–to–labor ratio.

See figures at end of manuscript

Figure 2: Equilibrium with national debt and an unfunded social security system

In the second basic framework, the representative agent model, the unit of private decision making is an infinite–lived dynasty. In the simplest setup, all dynasties are identical and lack life cycles. Given a steady–state equilibrium for the economy as a whole, without cycles of life the behavior of individual dynasties is stationary. Dynasties smooth their consumption across time periods — motivated by the concavity of their utility function. For an aggregative steady state, the equilibrium interest rate must be such that each dynasty desires at each date to consume its labor earnings plus the interest on its assets. Then the principal of each dynasty's wealth remains intact, allowing equal consumption in the future.

Point E in Figure 3 identifies the steady–state equilibrium of a representative agent model. The "demand curve" is exactly as in Figure 1. The "supply of financing curve" is now horizontal because, as outlined above, in a steady state each dynasty acts to preserve its net worth, regardless of the latter's magnitude. Another way of understanding this is to note that if c_t is a dynasty's time–t consumption, r is the steady–state interest rate, β is the dynasty's subject discount factor, and $u(c_t)$ is its flow of utility, first–order conditions for dynastic utility maximization imply

$$u'(c_t) = (1+r) \cdot \beta \cdot u'(c_{t+1}). \tag{1}$$

In a stationary steady state, $c_{t+1} = c_t$; hence, the steady–state interest rate depends only on preference parameters — i.e.,

$$(1+r) \cdot \beta = 1 \tag{2}$$

determines r.

See figures at end of manuscript

Figure 3: The demand for capital and supply of financing with dynastic family lines

Turning to policy, government debt does not influence the steady–state interest rate if lump–sum taxes finance debt service — because (2) is unaffected. Hence, government debt does not affect the steady–state capital stock. As in Figure 2, the equilibrium supply of financing must exceed the demand for K by D; however, the horizontal supply curve now means the economy attains an equilibrium with $D > 0$ at E', with exactly the same r as in Figure 3. Similarly, an unfunded social security system does not affect r or K. The advent of such a system increases the present value of each dynasty's benefits and taxes equally, leaving its consumption choices, and willingness to hold wealth, the same. In the end, changes in social security do not shift either the demand or supply curve.

See figures at end of manuscript

Figure 4: Changes in social security and national debt in the case of dynastic families

The present paper constructs a model with both life–cycle saving and dynastic elements: each household has a finite life span and a life–cycle of earnings, and each household cares about the lifetime utility of its descendants as well as itself and may wish to leave an estate (or make *inter vivos* gifts). To make the model more realistic, and more comparable to data, this paper assumes an exogenous distribution of earning abilities within each birth cohort. It also assumes that intergenerational transfers must be nonnegative.[3] Then in a steady–state equilibrium, households with high earnings (and/or high inheritances) choose to share with their descendants through gifts and bequests, whereas households with limited resources compared to the likely outcome for their descendants move to zero–transfer "corner solutions." The latter households behave as in a purely life–cycle framework.

Figure 5 presents a picture. The "demand curve" is as in Figure 1. The "supply of financing curve" of Figure 1's purely life–cycle model is the dotted graph. In the hybrid model, very prosperous households also have estate–motivated wealth accumulation, so the new supply curve is the solid graph shifted to the right from the dotted one. At higher and higher (long–run) values of r, intergenerational transfers become more and more attractive. Eventually they are so prevalent that dynasties essentially become infinite lived — the number of generations before a zero transfer in the dynasty of a currently prosperous household becomes very large, and such households behave much like the representative agents of Barro. That generates Figure 5's horizontal asymptote.[4]

See figures at end of manuscript

Figure 5: The demand and supply of financing in the hybrid model

[3] For a discussion of two–sided altruism, see, for example, Laitner [1997].
[4] See the more mathematical discussion below.

As Figure 5 suggests, the hybrid model can generate, if the equilibrium is at F, policy results resembling the overlapping generations model. In contrast, if the equilibrium is at E, long–run results resembling the representative agent framework will emerge. This paper seeks to calibrate the hybrid model to see which region along Figure 5's supply curve is the most relevant from an empirical standpoint.

2. Background

Empirical evidence to date has not been especially kind to either basic model. This section briefly reviews several strands of that literature (see also Laitner [1997]).

Existing work calls into question whether life–cycle saving alone can explain all of U.S. aggregate net worth. Kotlikoff and Summers [1981] (see also Kotlikoff [1988] and Modigliani [1988]) suggest bequest–motivated saving accounts for 80 percent or more of the aggregate total. Modigliani [1986], in contrast, suggests that bequests account for 20–30 percent of overall net worth, with life–cycle saving explaining the preponderance. See also Carroll and Summers [1991]. Calibrated simulations based exclusively on life–cycle saving frequently seem to have difficulty matching aggregate U.S. wealth as well (e.g., Auerbach and Kotlikoff [1987] and Mariger [1986]). A condition of the present paper's calibrations is that they match the 1995 empirical aggregate ratio $(K_t + D_t)/(w_t \cdot L_t)$.

Explaining the shape of the empirical wealth distribution is another issue. The U.S. distribution of wealth is extremely concentrated (e.g., Wolff [1996a]), with the top 5 percent of wealth holders having at least one–half of all net worth. Many analyses suggest that life–cycle saving alone cannot explain the high share held by a small fraction of households (e.g., Huggett [1996]).[5] Although other work questions whether models with bequests can go much further in this regard (e.g., Blinder [1974], Davies [1982], Laitner [2000b]), the present paper suggests that with very careful calibration, our hybrid model can do much better.

If the life–cycle model by itself does not seem entirely consistent with empirical evidence, the same can certainly be said of the representative agent model. Hurd [1987] posits that if bequest behavior is important, it should be most strongly evident among households with children. However, his data from the *Longitudinal Retirement History Survey* fails to show any difference between childless and other households. Laitner and Juster [1996] examine the net worth of elderly couples in the TIAA–CREF pension system. A model of intentional bequests implies that parent net worth should vary positively with parent lifetime earnings, but negatively with the earning power of the parents' children. For a subsample reporting that leaving an estate is a high priority, the sign predictions are borne out; for parents not caring about estates, the coefficient on children's earnings is not significant. Nevertheless, Laitner and Juster are unable to predict which parents will report that leaving an estate is important for them.

Altonji *et al.* [1997] use *Panel Study on Income Dynamics* data on *inter vivos* gifts to look for the same relation between gift amount and parent earnings, and gift amount and recipient earnings. The sign pattern is again evident. However, the authors show that according to representative agent theory, their regression coefficient on parent resources

[5] For another perspective, however, see Gokhale *et al.* [1999].

minus the coefficient of recipient resources should, in fact, be 1. The latter is not borne out: the estimated difference in the coefficients is an order of magnitude less than 1. Laitner and Ohlsson [2001] examine inheritances in the same data set. Although they employ a somewhat different regression specification, their outcomes are the same: estimated coefficients have the sign pattern which the representative agent model predicts, but the magnitudes of the estimated coefficients are much too small.

In the end, empirical evidence provides at most mixed support for either basic framework. A combined model should, of course, do better. It is also apparent from distributional data that the accumulation behavior of the richest 1–5 percent of U.S. households is enormously important in explaining aggregative national wealth.

3. Net Worth Data

This paper uses data on household net worth from the 1995 *Survey of Consumer Finances* to assess our calibrations (see Section 9).[6] This section briefly discusses the data and then proposes a sequence of modifications to it. The first steps attempt to enhance the interpretability of the data; the second set of steps derives a subset which is convenient for this paper's analysis.

The 1995 SCF has 4988 variables for 4299 households (see Kennickell et al. [1997]). The 4299 households include a random "area probability" sample of 2781 and a so–called "list" sample of 1518. The "list sample" comes from a tax file of wealthy households. Kennickell [1998, table 1] details household response rates, which vary from about 70 percent for the area probability sample, to 30–45 percent for the lowest 5 of 7 stratums of the list sample, 24 percent for the sixth stratum of the list sample, and 13 percent for the seventh stratum. Item nonresponse is another concern, and the SCF makes elaborate efforts to obtain ranges from reluctant respondents and to impute missing values.[7] The SCF weights mimic the U.S. population as a whole. According to the survey, 1995 aggregate household net worth is $21.04 trillion. For comparison, net worth in our calibrations below — the total of the 1995 U.S. physical capital stock, business inventories, and national debt — is $18.4 trillion. Notice that except for vehicles, the SCF does not measure consumer durables.

Column 1 of Table 1 presents summary statistics for the unadjusted data. Average net worth per household is $212,000; median net worth is $57,000. The high concentration of the distribution's upper tail is apparent: the top 1% of wealth holders have 35% of the household sector's net worth.

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[6] The internet site is www.federalreserve.gov/pubs/oss/oss2/95/scf95home.html for the data and codebook. Our net worth variable follows from the SAS algorithm in the codebook.

[7] Kennickell [1997, table 1] shows the response rate (of those reporting "any" for a given category) varies, for example, from 94% on credit card balances, to 62% on value of own business, to 64% on value of stock, to 80% on checking account balance, etc. In the data set, each household has 5 rows, with one column for every variable. The rows present varying imputations. Our analysis uses the weights X42001, as described in the codebook, divided by 5 to correct for multiple imputations.

Column 2, Table 1, presents our first adjustment. Asset amounts measure current market values. The latter include capital gains. Because the IRS taxes capital gains only upon realization, survey amounts overstate households' wealth to the extent that as yet unrealized gains carry an implicit tax liability. We make a correction based on Poterba and Weisbenner [2000, table 4]. The latter allows us to compute a percentage of net worth in other real estate, business, other business, and directly held stock for households in six net–worth categories (i.e., 0–250K, 250–500K, 500–1000K, 1–5M, 5–10M, 10M+) and then to estimate the share of unrealized capital gains per cell. (We omit capital gains on own residence, since most of these are tax exempt.) We impute a 20% tax on unrealized gains. Column 2 displays net–of–accrued–capital–gains–tax wealth.[8] The share of the top 1 percent of wealth holders falls by 1.4% from column 1 to 2.

Other corrections in the same vein, slated for future drafts, involve pensions. The SCF net worth data include defined contribution pension accounts but omit the capitalized value of defined benefit pension rights and the capitalized value of all post–retirement pension flows. (The IRS taxes pension (and most individual retirement account) payouts as ordinary income, so pension wealth also needs a tax liability adjustment.) As stated, it is also the case that the *Survey of Consumer Finances* omits most consumer durables. It seems likely that a careful treatment of pensions and a correction for missing consumer durables will further reduce the concentration of net worth.[9]

Our second category of adjustments anticipate simplifications in our theoretical model. First, the model assumes that bankruptcy laws prevent households from borrowing themselves into a state of negative net worth. About 7 percent of column–1 households have negative net worth. Column 3, Table 1, raises negative amounts to zero. This step turns out to make little difference, especially to the shares of the top 1–10 percent. Second, in the model couples head all households, whereas in the data some heads are singles, widows, etc. For all households which are not couples or partners, column 4 doubles net worth and halves the sample weight. (In effect, column 4 marries singles to others in exactly the same economic circumstance as themselves, simultaneously reducing the number of households to match the implied consolidation.) The concentration of wealth drops because singles often have fewer resources; the share of the top 1 percent falls 1.1%. Third, since our theoretical model determines the distribution of net worth for households with heads age 22–73, column 5 of Table 1 selects the same age range from the data.

The changes in mean wealth from column 1 to 5 primarily reflect differences in the definition of a household. Accordingly, this paper's concern focuses on the ability of the model of Section 6 (i) to explain aggregate wealth accumulation and (ii) to reproduce the shape of the wealth distribution in column 5.

[8] Unrealized capital gains in estates receive special tax treatment, and Section 3 returns to this issue.

[9] In terms of the significance of pension wealth, Gustman et al. [1999], where table 3 shows pension wealth is 32% of non–social security private net worth for households in the Health and Retirement Survey, and table 20 implies that defined benefit pension wealth is about twice as large as defined contribution pension wealth.

4. The Distribution of Earnings

The 1995 SCF collects data on household earnings for 1994.[10] The survey measures wages and salaries, variable X5702, and business income, variable X5704. Since our theoretical model assumes a constant returns to scale aggregate production function with capital's share $\alpha = .3251$, we define a "household's earnings" as $X5702 + (1 - \alpha) \cdot X5704$. Column 1 of Table 2 summarizes the constructed variable. This section processes it further, and then uses it to develop a parametric description of the distribution of earnings.

Column 2, Table 2, adjusts for marital status. As in the case of wealth, we double the earnings of singles, and halve their weight — in effect marrying singles to spouses with identical earning ability.

Our theoretical model assumes that each working–age household inelastically supplies labor and earns at time t

$$W_t \cdot e_s \cdot z_j \cdot \epsilon_{jt}, \tag{1}$$

where W_t is the wage; e_s is age–s human capital from experience; and, z_j is household j's life–long earning ability (which differs among households). The empirical model of this section adds an *iid*, family specific, yearly shock ϵ_{jt}, so that earnings are

$$W_t \cdot e_s \cdot z_j \cdot \epsilon_{jt} \ . \tag{1$'$}$$

Turning to the data, we calculate mean earnings for 5–year age groups (i.e., 20–24, 25–29, etc.); impute the mean to the median age for the group; and, from the means, linearly interpolate $W_t \cdot e_s$ all ages s. Dividing each household's earnings by the interpolated value $W_t \cdot e_s$ yields our observations of $z_j \cdot \epsilon_{jt}$. Section 6's model requires an earnings distribution with a compact support; hence, we drop households with $z_j \cdot \epsilon_{jt}$ below .2 or above 10,000. For consistency with the model, we also drop observations having $s < 22$ or $s > 65$. Column 3, Table 2, summarizes remaining observations.

Existing empirical work often treats $\ln(z_j)$ and $\ln(\epsilon_{jt})$ as independent normal random variables. Estimates from panel data then imply roughly equal variances (see, for example, King and Dicks–Mireaux [1982]). As the variance of the log of $z_j \cdot \epsilon_{jt}$ for column 2's data is .4187, this paper assumes

$$\ln(\epsilon_{jt}) \sim \text{normal}(0, \sigma_\epsilon^2) \quad \text{with} \quad \sigma_\epsilon^2 = .2094. \tag{2}$$

Solon [1992] estimates an intergenerational model

$$\ln(z_j') = \zeta \cdot \ln(z_j) + \mu + \eta_j \tag{3}$$

where z_j' is the lifetime earning ability of the son of a household with ability z_j, ζ and μ are parameters, and $\eta_j \sim \text{normal}(0, \sigma_\eta^2)$. This paper adopts Solon's estimate $\zeta = .45$. To allow thicker tails for the earnings distribution, this paper assumes a t distribution for η,

[10] Although the SCF asks about current pay rates, hours, etc., as well, the latter data does not include weeks worked during the year; hence, this paper employs only the 1994 information.

the latter being a normal$(0, \sigma_\eta^2)$ random variable divided by an independent χ^2 variable with n degrees of freedom. For $n \to \infty$, of course, η is lognormal. For finite n, its density is

$$f_\eta(\eta; \sigma_\eta, n) = \frac{\Gamma(\frac{n+1}{2})}{\sigma_\eta \cdot \Gamma(\frac{n}{2}) \cdot \sqrt{\pi \cdot n}} \cdot [\frac{1}{(1 + (\frac{\eta}{\sigma_\eta})^2/n)}]^{(n+1)/2}. \tag{4}$$

We proceed as follows. Fix an n. This paper truncates the support of η to

$$[(1-\zeta) \cdot (\ln(.2) - \mu),\ (1-\zeta) \cdot (\ln(10000) - \mu)].$$

We set up a 100–element grid, say, Z_1,...,Z_{100}, linear in logs, over the support of the random variable $\tilde{z}$; set up a 100×100 matrix M with

$$M_{ij} = f_\eta(e^{\ln(Z_i) - \zeta \cdot \ln(Z_j) - \mu}; \sigma_\eta, n);$$

and, assuming trapezoidal integration, determine the vector $\vec{N} \equiv (N_1, ..., N_{100})$ such that

$$N_i = \sum_{j=1}^{100} M_{ij} \cdot N_j \cdot \bar{Z}_j, \quad \text{all} \quad i = 1, ..., 100, \quad \text{and} \quad \sum_{j=1}^{100} N_j \cdot \bar{Z}_j = 1,$$

where

$$\bar{Z}_j = \begin{cases} .5 \cdot (Z_2 - Z_1), & \text{if } j = 1, \\ .5 \cdot (Z_{100} - Z_{99}), & \text{if } j = 100, \\ .5 \cdot (Z_{j+1} - Z_{j-1}), & \text{otherwise.} \end{cases}$$

Thus, $\vec{N}$ numerically approximates the stationary density function for $\tilde{z}$. For our given n, we choose (μ, σ_η) so that the mean of the latter density is 1 and the variance of $\ln(z)$ is one–half the variance of the log of the observations from column 3. Finally, we derive summary statistics for the product of our $\tilde{z}$ and the independent lognormal $\tilde{\epsilon}$ specified in (2).

Column 4, Table 2, presents summary statistics for $n = 100$, when $\tilde{z}$ is virtually lognormal. The concentration at the upper end of the distribution is far lower than column 3's data.

Calculations show that $n = 3$ goes too far in the other direction, whereas $n = 4$ still leaves the upper tail's concentration too low. Column 5 presents results for $n = 3.8192$, this paper's choice, the n which minimizes the χ^2 test statistic derived from the frequencies implicit in column 2 and the new summary.[11] For this n, the calculations above imply $\mu = -.1024$ and $\sigma_\eta = .3032$.

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[11] The actual chi square statistic is 11.7 with, since n is estimated, 9 degrees of freedom. See Hogg and Craig [1978, p.274]. The p–value is .23. Note, however, that strictly speaking the test requires a random sample, rather than a nonrandom and weighted sample.

5. Federal Gift and Estate Taxes

Federal gift and estate tax revenues play a major role in the calibrations below. In general, the small aggregate collections from the existing tax are rather puzzling given the high nominal statutory rates and the concentration of wealth evident in Section 3. This section examines in detail how one might specify the estate tax for simulations.

Column 1 of Table 3 lists 1995 federal estate tax rates.[12] The federal gift tax uses the same schedule; however, the gift tax applies only to net of tax transfer amounts — i.e., for a flat tax t and gross transfer x, the estate tax liability would be $t \cdot x$, but the gift tax liability would be $t \cdot x/(1+t)$. In 1995, each taxpayer had a lifetime credit of \$192,800 for combined gift and estate taxes; there were unlimited marital and charitable deductions; and, each year a taxpayer could exclude any number of gifts of \$10,000 or less to separate individuals. Two important points are (i) despite the high rates in Table 3, 1995 aggregate gift and estate tax collections were only \$17.8 billion (a figure which sums \$14.8 billion of federal revenues — see the *Economic Report of the President* [1999] — with \$3.0 billion credited for state death duties — see Eller [1997]), and (ii) although gift tax rates are noticeably more attractive for donors, gift tax collections are typically an order of magnitude less than revenues from estates. Section 7 returns to the second point. Here we examine the first, attempting to derive for our numerical analysis a specification of the federal estate tax system which is consistent with Table 1's distribution of wealth.

The upper section of Table 4 presents 1995 tax data on large estates (gross estate less debts), marital deductions, and charitable deductions. The figures come from Eller [1997]. We construct the second section from the SCF data of column 1, Table 1, according to the steps below. Our goal is to determine what degree of tax avoidance makes the SCF and tax data consistent with one another.

To measure tax avoidance, captured by parameter θ^f below, we need to estimate marital and charitable deductions. First, consider single households in the SCF. If NW_j is SCF net worth for household j, if ω_j the household's SCF sample weight, and if p_j is the probability of death this year for the household head's age and sex from a standard mortality table, one can construct analogues of the variables of columns 1, 2, 4, and 6 from the top of table 4 from $p_j \cdot \omega_j$ times, respectively,

$$1, \quad NW_j \cdot [\theta^c + \theta^f \cdot (1-\theta^c)], \quad 0, \quad NW_j \cdot \theta^c, \tag{5}$$

where θ^c is the fraction of the estate going to charity and θ^f is the fraction of taxable wealth actually reported on a decedent's estate tax form. "Estate planning" presumably renders $\theta^f < 1$. Looking at Eller's data, we assume

$$\theta^c = \begin{cases} \theta^{c,low}, & \text{for } NW_j < 10,000,000, \\ \theta^{c,high}, & \text{otherwise,} \end{cases}$$

and we expect $\theta^{c,high} > \theta^{c,low}$. We treat "partners" as two singles, each having half a household's net worth. Married couples are more complicated. If θ^m is the fraction of

[12] In practice, there was a bracket above \$10 million with a marginal rate .60, and a higher bracket returning to marginal rate .55 — these arising from the phase–out of lower infra–marginal rates. This paper ignores the .60 bracket.

the first decedent's estate transferred (tax free) to the surviving spouse, and if $\bar{p}_j$ is the mortality rate for the head's spouse, the four figures corresponding to (5) are $(p_j + \bar{p}_j + p_j \cdot \bar{p}_j) \cdot \omega_j$ times

$$1, \quad \frac{NW_j}{2} \cdot [\theta^m + \theta^c + \theta^f \cdot (1 - \theta^m - \theta^c)], \quad \frac{NW_t}{2} \cdot \theta^m, \quad \frac{NW_t}{2} \cdot \theta^c \tag{6}$$

for a first decedent's estate. To cover the chance that both spouses die the same year, one must add $p_j \cdot \bar{p}_j \cdot \omega_j$ times

$$1, \quad \frac{NW_j}{2} \cdot (1 + \theta^m) \cdot [\theta^c + \theta^f \cdot (1 - \theta^c)], \quad 0, \quad \frac{NW_j}{2} \cdot (1 + \theta^m) \cdot \theta^c \ . \tag{7}$$

to pick up the second spouse's estate. We choose the θ's to minimize the sum of squared deviations between columns 1, 2, 4, and 6, for rows 1–6, of the upper and lower segments of table 4.[13] The minimizing values are $\theta^{c,low} = .04$, $\theta^{c,high} = .22$, $\theta^m = .40$, and $\theta^f = .58$. The first three are a means to an end, but the last is important for our analysis.

The estimated value of θ^f implies that estate planning reduces a taxable estate by about 40%. This seems credible in light of the many strategies available for avoiding estate taxes (e.g., Schmalbeck [2000]). Applying Table 3's rates to the implied taxable estates from the SCF, aggregate revenues are \$18.7 billion. (In contrast, imposing $\theta^f = 1$, and repeating the steps above, federal estate tax collections are \$42.9 billion — a figure in line, for instance, with Wolff's [1996b] calculations from the 1992 SCF — but clearly contrary to empirical evidence.)

Charitable foundations constitute one more piece of this section's analysis. Wealthy households consume, in part, through charitable gifts. A parent can transfer power over donations to his children by creating a private foundation (which his descendants presumably can control). Contributions to such foundations are tax free. Eller's [1996] data (from 1992) show that donations to private foundations constitute 28.8% of charitable contributions in estates.

This paper computes "effective" estate tax rates as follows. Our model's estates do not include general charitable contributions or transfers to spouses, but we assume they do include donations to private foundations. For estate x, assume the reported taxable estate is $x \cdot (1 - .288 \cdot \theta^c) \cdot \theta^f$. Column 1 of table 3 and the uniform credit generate a tax assessment on the latter amount. For the median amount in each of Table 3's brackets, compute the marginal tax rate using our definition of taxable estate. Column 2, Table 3, presents the rates. Column 3 presents the rates our simulations below actually employ. The minimum gross estate for any tax due is \$1,038,000; the minimum in the simulations is \$1,000,000.

Finally, an estate escapes income taxation on capital gains unrealized during the decedent's life: an executor raises all assets to market value before calculating the estate tax liability, but the capital gains from the first step are exempt from income taxation. As in Section 1, compute the capital gain's tax liability using Poterba and Weisbenner [2000]. Column 4, Table 3, presents marginal estate tax rates corrected both as in column 2

[13] The actual criterion scales the number differences by 1/10,000 and the dollar differences by 1/10,000,000.

and for the saving in capital gain taxes. Column 5 presents the rounded rates which the simulations use.

In our simulations, households use the "perceived marginal tax rates" of column 6 to guide their behavior. However, each simulation simultaneously computes the estate tax liability from a government revenue standpoint from the "effective marginal tax rate" of column 4. In our calibration process, we compare total government revenues based on column 4 with the 1995 U.S. aggregate collections of $17.8 billion (despite the fact that households care only about column 6).

6. Theoretical Model

This paper's theoretical model has three distinctive elements. First, households are "altruistic" in the sense of caring about the utility of their grown–up descendants. Because of this, a household may choose to make *inter vivos* gifts or bequests to its descendants. Second, within each birth cohort there is an exogenous distribution of earning abilities. Third, households cannot have negative net worth at any point in their lives (perhaps because bankruptcy laws stop financial institutions from making loans without collateral); similarly, intergenerational transfers must be nonnegative (so that parents cannot extract old age support from reluctant children through negative gifts and bequests). These elements lead to a distribution of intergenerational transfers and, ultimately, a distribution of wealth. In particular, a high–earning–ability parent with a low–earning–ability child will tend to want to make an *inter vivos* gift or bequest, but a low–earning–ability parent with a high–earning–ability child will not. Borrowing constraints may also lead to transfers: even parents who do not intend to make bequests at death may choose to make *inter vivos* gifts to their children, say, when the latter are in their twenties.

The basic framework is similar to Laitner [1992], although in contrast to the latter this paper incorporates estate taxes, assumes earning abilities are heritable within family lines, and allows limited altruism in the sense that a parent caring about his grown children may, in his calculations, weight their lifetime utility less heavily than his own. In contrast to Laitner [2000b], this paper uses the 1995 *Survey of Consumer Finances* for its calibrations and provides a more sophisticated model of estate taxes.

Other comparisons to the existing literature are as follows. In contrast to Becker and Tomes [1979], Loury [1981], and many others, the present paper omits special consideration of human capital.[14] In contrast to Davies [1981], Friedman and Warshawsky [1990], Abel [1985], Gokhale *et al.* [1999], and others, the present paper assumes that households purchase actuarially fair annuities to offset fully mortality risk; consequently, all bequests in this paper's model are intentional. In contrast to Bernheim and Bagwell [1988], this paper assumes perfectly assortative mating — adopting the interpretation of Laitner [1991], who shows that a model of one parent households, each having one child, can mimic the outcomes of a framework in which each set of parents has two children and mating is endogenous. In contrast to Auerbach and Kotlikoff [1987] and others, the present paper assumes that households supply labor inelastically; similarly, each surviving household retires at age 65. Presupposing an inelastic labor supply eliminates, of course, potentially

[14] However, Section 3's model of the intertemporal heritability of earnings might be viewed as a reduced–form description of the human capital acquisition process.

interesting implications about the work incentives of heirs (see, for example, Holtz–Eakin *et al.* [1993]).

Framework. Time is discrete. The population is stationary. Think of each household as having a single parent and single offspring (see the reference to assortative mating above). The parent is age 22 when a household begins. The parent is 26 when his child is born. When the parent is 48, the child is 22. At that point, the child leaves home to form his own household. The parent works from age 22 through 65 and then retires. No one lives beyond age 87. There is no child mortality. In fact, for simplicity there is no parent mortality until after age 48. The fraction of adults remaining alive at age s is q_s.

Labor hours are inelastic. Each adult has an earning ability z, constant throughout his life, and evident from the moment that he starts work. Letting e_s be the product of experiential human capital and labor hours, and letting g be one plus the annual rate of labor–augmenting technological progress, an adult of age s and ability z who was born at time t supplies $e_s \cdot z \cdot g^{t+s}$ "effective" labor units at age $s \geq 22$. This paper focuses on steady–state equilibria in which the wage per effective labor unit, w, the interest rate, r, the income tax rate, τ, and the social security tax rate, τ^{ss}, are constant. One plus the net–of–tax interest factor on annuities for an adult of age s is

$$R_s = \frac{1 + r \cdot (1 - \tau)}{q_{s+1}/q_s} \ . \tag{8}$$

Section 4 presented our model for the evolution and stationary distribution of $\tilde{z}$.

Utility is isoelastic. If an adult has consumption c at age s, his household derives utility flow $u(c, s)$. If his minor child has consumption c^k, an adult household derives, at age s, an additional utility flow $u^k(c^k, s)$. Our analysis sets

$$u(c, s) = \begin{cases} \frac{c^\gamma}{\gamma}, & \text{if } s \leq 65, \\ \upsilon^{1-\gamma} \cdot \frac{c^\gamma}{\gamma}, & \text{if } s > 65, \end{cases}$$

$$u^k(c, s) = \begin{cases} \omega^{1-\gamma} \cdot \frac{c^\gamma}{\gamma}, & \text{if } 26 \leq s < 48, \\ 0, & \text{if } s \geq 48, \end{cases}$$

with $\gamma < 1$. We discuss the relative weights for retirement consumption, υ, and minor children, ω, below. Isoelastic preferences are homothetic, of course, allowing a steady–state equilibrium despite technological progress.

Consider a parent aged 48. Let t be the year he was born. Let his utility from remaining lifetime consumption be $U^{old}(a_{48}, z, t)$, where his earning ability is z, and his assets for remaining lifetime consumption are a_{48}. Then

$$U^{old}(a_{48}, z, t) = \max_{c_s} \sum_{s=48}^{88} q_s \cdot \beta^{s-48} \cdot u(c_s, s), \tag{9}$$

$$\text{subject to:} \quad a_{s+1} = R_{s-1} \cdot a_s + e_s \cdot z \cdot g^{t+s} \cdot w \cdot (1 - \tau - \tau_{ss}) + ssb(s, z, t) \cdot (1 - \frac{\tau}{2}) - c_s,$$

$$a_{89} \geq 0,$$

where $u(.)$ and q_s and R_s are as above, $\beta \geq 0$ is the lifetime subjective discount factor, a_s stands for the net worth the parent carried to age s, and $ssb(s, z, t)$ specifies social security benefits at age s.

The utility over ages 22–47 for a parent born in year t is $U^{young}(a_{22}, a_{48}, z, t)$ if he carries assets a_{22} into age 22, carries assets a_{48} out of age 47, and has earning ability z. Thus,

$$U^{young}(a_{22}, a_{48}, z, t) = \max_{c_s} \sum_{s=22}^{47} q_s \cdot \beta^{s-22} \cdot [u(c_s, s) + u^k(c_s^k, s)], \tag{10}$$

$$\text{subject to:} \quad a_{s+1} = R_{s-1} \cdot a_s + e_s \cdot z \cdot g^{t+s} \cdot w \cdot (1 - \tau - \tau_{ss}) - c_s - c_s^k,$$

$$a_s \geq 0 \quad \text{all} \quad s = 22, ..., 48.$$

As stated, the model assumes that bankruptcy laws prevent households from borrowing without collateral, giving us the last inequality constraint in (10). For the sake of simplicity, on the other hand, this paper assumes that such constraints do not bind for older households, making them superfluous in (9).

To incorporate altruism, let $V^{young}(a_{22}, z, t)$ be the total utility of a 22–year old altruistic household carrying initial assets a to age 22, having earning ability z, and having birth date t — where "total utility" combines utility from lifetime consumption with empathetic utility from the consumption of one's descendants. Let $V^{old}(a_{48}, z, z', t)$ be the total utility of a 48–year old altruistic household which has learned that its grown child has earning ability z'. Then letting $E[.]$ be the expected value operator, and letting $\xi > 0$ be the intergenerational subjective discount factor, we have a pair of Bellman equations

$$V^{young}(a_{22}, z, t) = \max_{a_{48} \geq 0} \{U^{young}(a_{22}, a_{48}, z, t) + \beta^{26} \cdot E_{z'|z}\, [V^{old}(a_{48}, z, z', t)]\},$$

$$V^{old}(a_{48}, z, z', t) = \max_{b_{48} \geq 0} \{U^{old}(a_{48} - b_{48}, z, t) + \xi \cdot V^{young}(T(b_{48}, t, z'), z', t + 26)\},$$

where b_{48} is the parent's intergenerational transfer, and $T(b_{48}, t, z')$ is the net–of–transfer–tax inheritance of the child (which Section 7 shows may depend on the child's earning ability as well as on b). As stated above, we require $b_{48} \geq 0$, so that parents cannot compel reverse transfers from their children. To preserve homotheticity, we require that estate tax brackets, deductions, and credits growth with factor g over time — in other words,

$$T(b, t, z') = g^t \cdot T(b/g^t, 0, z') \quad \text{all} \quad t. \tag{11}$$

Similarly,

$$ssb(s,z,t) = g^t \cdot ssb(s,z,0) \quad \text{all} \quad t. \tag{12}$$

Given (11)–(12) and isoelastic utility,

$$U^{young}(a_{22}, a_{48}, z, t) = g^{\gamma \cdot t} \cdot U^{young}(a_{22}/g^t, a_{48}/g^t, z, 0),$$

$$U^{old}(a_{48}, z, t) = g^{\gamma \cdot t} \cdot U^{old}(a_{48}/g^t, z, 0).$$

One can then deduce

$$V^{young}(a_{22}, z, t) = g^{\gamma \cdot t} \cdot V^{young}(a_{22}/g^t, z, 0),$$

$$V^{old}(a_{48}, z, z', t) = g^{\gamma \cdot t} \cdot V^{old}(a_{48}/g^t, z, z', 0).$$

Substituting a for a_{22}/g^t, a' for a_{48}/g^t, and b for b_{48}/g^t, the Bellman equations become

$$V^{young}(a, z, 0) = \max_{a' \geq 0} \{U^{young}(a, a', z, 0) + \beta^{26} \cdot E_{z'|z}[V^{old}(a', z, z', 0)]\}, \tag{13}$$

$$V^{old}(a, z, z', 0) = \max_{b \geq 0} \{U^{old}(a - b, z, 0) + \xi \cdot g^{\gamma \cdot 26} \cdot V^{young}(T(b/g^{26}, 0, z'), z', 0)\}. \tag{14}$$

Suppose maximization yields $\phi(a_{22}, s, t, z)$ as the net worth of a family of age $s = 22, 23, ..., 47$, ability z, birth date t, and initial net worth a_{22}; $\psi(a_{22}, t, z, z')$ as its gross of tax intergenerational transfer when its child has earning ability z'; and, $\Phi(a_{22}, s, t, z, z')$ as its net worth at age $s = 48, ..., 87$. Then homotheticity implies

$$\phi(a_{22}, s, t, z) = g^t \cdot \phi(a_{22}/g^t, s, 0, z)\,, \tag{15}$$

$$\psi(a_{22}, t, z, z') = g^t \cdot \psi(a_{22}/g^t, 0, z, z')\,, \tag{16}$$

$$\Phi(a_{22}, s, t, z, z') = g^t \cdot \Phi(a_{22}/g^t, s, 0, z, z')\,. \tag{17}$$

This paper assumes all families have identical υ, ω, β, and ξ.

There is an aggregate production function

$$Q_t = [K_t]^\alpha \cdot [E_t]^{1-\alpha}, \quad \alpha \in (0,1), \tag{18}$$

where Q_t is GDP, K_t is the aggregate stock of physical capital, and E_t is the effective labor force. The model omits government capital and consumer durables. K_t depreciates at rate $\delta \in (0,1)$. Normalizing the size of the time–0 birth cohort to 1 (so that every birth cohort has size 1), and employing the law of large numbers,

$$E_t = \sum_{s=22}^{65} g^t \cdot q_s \cdot e_s. \tag{19}$$

The price of output is always 1. Perfect competition implies

$$w_t = (1-\alpha) \cdot \frac{Q_t}{E_t} \quad \text{and} \quad r_t = \alpha \cdot \frac{Q_t}{K_t} - \delta. \tag{20}$$

The government issues D_t one–period bonds with price 1 at time t. Assume

$$D_t / Q_t = \text{constant}. \tag{21}$$

Let SSB_t be aggregate social security benefits. Assume the social security system is unfunded; so,

$$SSB_t = \tau^{ss} \cdot w_t \cdot E_t. \tag{22}$$

If G_t is government spending on goods and services, assume

$$G_t / Q_t = \text{constant}. \tag{23}$$

Leaving out the social security system, in which benefits and taxes contemporaneously balance, the government budget constraint is

$$G_t + r_t \cdot D_t = \tau \cdot [w_t \cdot E_t + r_t \cdot K_t + r_t \cdot D_t] + D_{t+1} - D_t + \int_0^\infty \int_0^\infty [b - T(b,t,z')] \cdot F^t(db, dz')\,, \tag{24}$$

where $F^t(b, z')$ is the joint distribution function for parental transfers b to households of age 22 at time t and earning ability z' — so that the last term is estate–tax revenues (recall the normalization on cohort populations). This paper assumes public–good consumption does not affect marginal rates of substitution for private consumption.

Households finance all of the physical capital stock and government debt. Let $H(z' \mid z)$ be the distribution function for child earning ability z' conditional on parent ability z (recall Section 4). Then when NW_t is the aggregate net worth held which the household sector carries from time t to $t+1$, the economy's supply and demand for financing balance, using the law of large numbers, if and only if

$$\frac{K_{t+1} + D_{t+1}}{E_t} = \frac{NW_t}{E_t} \equiv \frac{\sum_{s=22}^{47} q_s \cdot \int_0^\infty \int_0^\infty \phi(T(b, t-s, z), s, t-s, z)] \cdot F^{t-s}(db, dz)}{E_t}$$
$$+ \frac{\sum_{s=48}^{87} q_s \cdot \int_0^\infty \int_0^\infty \int_0^\infty \Phi(T(b, t-s), s, t-s, z, z') \cdot H(dz' \mid z) \cdot F^{t-s}(db, dz)}{E_t} \tag{25}$$

In "equilibrium" all households maximize their utility and (8)–(25) hold. A "steady–state equilibrium" (SSE) is an equilibrium in which r_t and w_t are constant all t; in which

Q, K, and E grow geometrically with factor g; and, in which the time–t distribution of pairs $(b/g^t, z)$ is stationary. The last implies

$$F^t(b, z) = F^0(b/g^t, z) \equiv F(b/g^t, z) \quad \text{all} \quad b, z, t\,. \tag{26}$$

This paper focuses exclusively on steady–state equilibria.

Existence and Computation of Equilibrium. We can amend Propositions 1–3 of Laitner [1992] in a straightforward manner to establish the existence of a steady–state equilibrium.

The propositions imply that we can compute a steady–state equilibrium as follows. Perfectly competitive behavior on the part of firms and our aggregate production function yield

$$\frac{(r+\delta)\cdot K_t}{w \cdot E_t} = \frac{\alpha}{1-\alpha}\ ,$$

where K_t/E_t is stationary in a steady state. Household wealth finances the physical capital stock and the government debt. Combining the two uses of credit,

$$\frac{K_{t+1} + D_{t+1}}{w \cdot E_t} = g \cdot [\frac{\alpha}{1-\alpha} \cdot \frac{1}{r+\delta} + \frac{D_t}{w \cdot E_t}] = g \cdot [\frac{\alpha}{1-\alpha} \cdot \frac{1}{r+\delta} + \frac{1}{1-\alpha} \cdot \frac{D_t}{Q_t}]\ . \tag{27}$$

Line (21) shows D_t/Q_t is a parameter; thus, (27) yields the "demand" for financing curve in Figure 6.[15]

See figures at end of manuscript

Figure 6: The steady–state equilibrium demand and supply of financing

Define $\bar{r}$ from

$$(1+\bar{r})^{26} \cdot (1-\tau^{beq}) \cdot \xi \cdot \beta^{26} \cdot g^{(\gamma-1)\cdot 26} = 1, \tag{28}$$

where τ^{beq} is the maximal marginal tax rate on bequests. Fix any r with $r \cdot (1-\tau) < \bar{r}$, and fix $w = 1$. We can solve our Bellman equations using successive approximations: set $V^{old,1}(.) = 0$; substitute this for $V^{old}(.)$ on the right–hand side of (13), and solve for $V^{young,1}(.)$; substitute the latter on the right–hand side of (14), and solve for $V^{old,2}(.)$; etc. This yields convergence at a geometric rate: as $j \to \infty$,

$$V^{young,j}(.) \to V^{young}(.) \quad \text{and} \quad V^{old,j}(.) \to V^{old}(.)\ .$$

This paper's grid size for numerical calculations is 250 for net worth and 25 for earnings. The grids are evenly spaced in logarithms — except for even division in natural numbers for the lowest wealth values.

[15] Note that Figure 6 is only slightly different from Figure 5.

Turning to the distribution of inheritances and wealth, for a dynastic parent household born at t, policy function (16) yields

$$a'_{22}/g^{t+26} = T(\psi(a_{22}/g^t, 0, z, z')/g^{26}, 0, z') \,, \tag{29}$$

where a'_{22} is initial net worth in the dynasty's next generation. Lines (3)–(4) imply

$$z' = [z]^{\zeta} \cdot e^{\mu} \cdot e^{\eta}, \tag{30}$$

where η has a known distribution. Together (29)–(30) determine a Markov process from points $(a_{22}/g^t, z)$ to Borel sets of points $(a'_{22}/g^{t+26}, z')$ one generation later. In practice, we adjust μ so that the stationary distribution of z has mean 1, and we truncate the distribution of η so that $z \in [.2, 10,000]$. Then as in Laitner [1992], there are bounded intervals $\mathcal{A}$ and $\mathcal{Z}$ with $\mathcal{A} \times \mathcal{Z}$ an invariant set for the Markov process, and there is a unique stationary distribution for the process in this set. In terms of distribution functions $F : \mathcal{A} \times \mathcal{Z} \to [0, 1]$ — recall (26), the Markov process induces a mapping, say, J with

$$F^{t+26} = J(F^t) \,. \tag{31}$$

Iterating (31) from any starting distribution on $\mathcal{A} \times \mathcal{Z}$, we have convergence to the unique stationary distribution. Again, our numerical grid in practice is 250×25. The stationary distribution and lifetime behavior yield expected net worth per household normalized by average current earnings. Using the law of large numbers, we treat the latter ratio, $NW_t/(w \cdot E_t)$, as nonstochastic.[16] This generates the supply curve of Figure 6.

Laitner's [1992] propositions show $NW_t/(w \cdot E_t)$ varies continuously with r and has an asymptote at $r = \bar{r}/(1-\tau)$ as shown in the figure; thus, we must have an intersection of the demand and the supply curves. An intersection determines an equilibrium for the model. There are no steady states above the asymptote — as household net worth is infinite for $r \geq \bar{r}/(1-\tau)$.

7. Timing and Taxes

Dynamic programming determines a given dynasty's desired transfer, say, $b_{48} = \psi(a_{22}, t, z, z')$, as in (16). If the heir faces binding liquidity constraints (see (10)), the transfer must be made promptly — delays or impediments will invalidate our Bellman equations. If liquidity constraints do not bind, or if a fraction of b_{48} suffices to lift them, the timing of remaining transfers is, in mathematical terms, indeterminate. In terms of the model, a parent is then indifferent between completing his transfer at age 48, leaving a fraction of his transfer for his estate at death, making a sequence of gifts over many years, etc. This section considers the timing of transfers in more detail, and presents the resolution of indeterminacy on which our computations are based. Then it turns to the related issue of the specification of estate taxes.

[16] Note that assuming $w = 1$ above is not restrictive: with homothetic preferences, a differ w raises the numerator and denominator of the steady–state ratio $NW_t/(w \cdot E_t)$ in the same proportion.

In practice, conflicting forces influence the age at which a parent makes his intergenerational transfer. On the one hand, taxes encourage early transfers — Section 5 notes that tax rates on *inter vivos* gifts are lower than those on estates. Further, since tax rates are progressive, an early–in–life transfer faces lower taxes than a late–in–life sum with the same present value. On the other hand, a wealthy donor may feel that he can earn a higher rate of return on financial investments than his heirs (e.g., Poterba [1998]); a parent may value wealth for its own sake (e.g., Kurz [1968]) or as a means of securing his children's attentions (e.g., Bernheim *et al.* [1985]); or, a parent may want to delay in transferring his estate to protect himself against possible strategic behavior on the part of his children (e.g., a parent making a prompt transfer might find that his child consumes the sum quickly and then asks for more help — see Laitner [1997]). Although presumably many wealthy decedents make *inter vivos* transfers, data show that taxable estates empirically are an order of magnitude larger than taxable gifts (e.g., Pechman [1987,tab. 8.2] and Poterba [1998,tab.4]).

In light of the evidence, this paper's model presumes that parents strongly prefer to hold off on taxable intergenerational transfers until death. Specifically, our computations assume that parents who want to make intergenerational transfers to their children do so through *inter vivos* gifts when liquidity constraints bind on the children, but that once a parent has transferred enough to (just) lift his child's constraints, the parent saves his remaining transfers for his bequest. We make the following additional assumption purely for the sake of simplicity: if a parent remains alive at age 74 (when his child is 48), we assume that he makes his "bequest" (i.e., his final transfer) then.[17]

We must specify federal gift and estate taxes in a way consistent with this timing.[18]

There are many opportunities for avoiding federal taxes on intergenerational transfers which are only available to living donors. A husband and wife, for instance, can each annually transfer a \$10,000 gift to each child, and to the spouse of each child, without incurring any tax liability. Policing lifetime gifts is extremely difficult; thus, parents presumably can shelter their grown children, provide facilities and resources for joint vacations, etc., without, in practice, reporting to the IRS. Transfer pricing provides other options. Suppose, for instance, that a father's labor has annual marginal revenue product of \$10 million and his son's marginal revenue product is \$1 million. Then the father might agree to work for \$8 million with an implicit understanding that his son, employed at the same firm, will earn \$3 million.

With such a perspective, this paper assumes zero tax liability on *inter vivos* gifts. For a net–of–tax transfer x, our analysis of timing determines the present value of *inter vivos* gifts, say, x_1, and the actuarial present value of bequests at death, x_2. (By definition, $x_1 + x_2 = x$.) For a current–value bequest X_2, we can determine the current gross bequest,

[17] The reason for the age limit of 74 for transfers is that after that time the grandchild's earning ability is revealed. While the additional information would affect the parent's planning in theory, in practice it seems unlikely that surviving 75 year olds alter their consumption and wills appreciably on the basis of their grandchildren's early success in the labor market.

[18] This paper ignores state gift, estate, and inheritance taxes beyond the level of the allowable federal credit for state taxes — recall Section 5.

say, Y_2, consistent with Section 5's "perceived effective" 1995 U.S. tax system (ie, column 6 of Table 3). At parent age 48, let the present actuarial value of desired gross bequests Y_2 for all possible ages of death be y_2. Then for gross transfer x_1+y_2 at parent age 48, the tax liability is $y_2 - x_2$. In particular, for a parent age 48 at time 0, last section's tax function is

$$T(x_1 + y_2, 0, z') = y_2 - x_2. \tag{32}$$

Since our calculations for y_2 depend on the way x is split between gifts and bequests, which, in turn, depends on z', the latter must be an argument of $T(.)$. Note also that our treatment assumes parents deduce their potential tax rate realizing that they will apportion their net transfer in accordance with our timing assumption, and that the latter itself, under our treatment, is insensitive to the nominal tax rate. In Section 8's computations, we assume a tax function, say, $T^0(.)$ of form (11), stored as a 250×25 matrix over Section 6's grid for $\mathcal{A} \times \mathcal{Z}$; we solve the Bellman equation for $V^{young}(.)$ and $V^{old}(.)$ conditional on $T^0(.)$; deducing the division of possible net transfers between gifts and estates on the basis of these value functions, we construct a new tax function, say, $T^1(.)$; we solve the Bellman equations for $V^{young}(.)$ and $V^{old}(.)$ conditional on $T^1(.)$; repeat our steps to derive $T^2(.)$; etc. Provided we have convergence to a fixed point $T(b, 0, z')$, i.e.,

$$T^j(b, 0, z') \to T(b, 0, z') \quad \text{all} \quad (b, z'), \tag{33}$$

$T(.)$ is a usable tax function. (In our computations, convergence is never a problem.)

8. Calibration

In addition to an estate tax system, described in Sections 5 and 7, and model of earning abilities, described in Section 4, our framework has parameters α, δ, υ, ω, τ^{ss}, g, τ, β, ξ, and γ. We calibrate the first 6 directly from sources described below. We then set τ, β, ξ, and γ to balance the government budget constraint, to match empirical patterns of household consumption growth, to match the U.S. stock of physical capital and government debt, and to match empirical aggregate estate–tax revenues. Finally, we compare our simulated steady–state distribution of wealth with Section 3's 1995 data.

As stated, a household begins with a 22 year old adult; when the adult is 26, he has one child; the child forms his own household when his parent is 48; each person retires at the close of age 65; and, no one dies later than the close of age 87.

Parameters and ratios. Letting 1995 wages and salaries from *The Economic Report of the President* [1999] be c_1, proprietor's incomes be c_2, national income be c_3, and depreciation be c_4, labor's share of output, $1 - \alpha$, solves

$$1 - \alpha = \frac{c_1}{c_3 + c_4 - c_2} \ .$$

This generates our estimate $\alpha = .3251$. Using the 1995 GDP and stock of business inventories from *The Economic Report of the President* [1999], and combining the latter with the 1995 fixed private capital stock from *U.S. Department of Commerce* [1997, p.38], we have $K_t/Q_t = 2.3386$. This implies an interest rate $r = .069$, closely resembling Auerbach and Kotlikoff's [1987] .067 and Cooley and Prescott's [1995] .072, when $\delta = .07$.

There is no population growth in our simulations. We simply set our technological progress factor g to 1.01.

We set a proportional tax τ^{ss} on earnings up to the 1995 social security limit ($61,200) so that taxes exactly cover 1995 retirement benefits ($287.0 bil.). Within each birth cohort, social security benefits are progressive: for each cohort, we allocate benefits across our earning groups according to the benefit formula and maximum in *U.S. Social Security Administration* [1998].

Using 1995 Federal, state, and local expenditures on goods and services, $G_t/(w \cdot E_t) = .2765$. Taking the 1995 ratio of Federal debt to $1 - \alpha$ times GDP, $D_t/(w \cdot E_t) = .6716$. The empirical ratio $(K_t + D_t)/(W \cdot E_t)$ is 4.1367 for 1995.

We assume no child mortality, and we assume no adult mortality until age 48. Table 5 presents our figures for q_s, which reflect average 1995 mortality rates for U.S. men and women. The implied average life span is 77 years. Column 2 of Table 5 presents our age profile for experiential human capital, taken from 1995 SCF household earnings (as in column 1, Table 2).[19] The figures correspond to $w \cdot e_s$ in the model.

First–order conditions for lifetime optimization imply that an adult will choose υ times as much consumption after retirement, *cet. par.*, as before, and that he will allocate ω times as much consumption to his minor child as to himself. People tend to have lower consumption needs after retirement: a recent TIAA–CREF brochure suggests, for example, that "you'll need 60–90 percent of your current income in retirement, adjusted for inflation, to maintain your standard of living when you retire;" and, a recent *Reader's Digest* article on retirement planning writes, "Many financial planners say it will take 70 to 80 percent of your current income to maintain your standard of living when you retire." Using the midpoint of these brackets, we set $\upsilon = .75$. Mariger [1986] estimates that children consume 30% as much as adults. Similarly, Burkhauser *et al.* [1996] estimate that consumption needs of 4–person relative to 2–person families have a ratio of 1.34–1.42. We set $\omega = .3$.

Lifetime first–order conditions for adult consumption at different ages imply

$$q_s \cdot [c_s]^{\gamma-1} \geq q_{s+1}\beta \cdot R_s \cdot [c_{s+1}]^{\gamma-1} \Longleftrightarrow [\beta \cdot (1 + r \cdot (1-\tau))]^{1/(1-\gamma)} \cdot c_s \leq c_{s+1},$$

with equality when the nonnegativity constraint on household net worth does not bind. Tables from the 1984–97 *U.S. Consumer Expenditure Survey* present consumption data for households of different ages.[20] We adjust the treatment of service flows from owner occupied houses.[21] Then we compute the average ratio of consumption at age $s+1$ to

[19] In order to convert take home pay to total compensation, we multiply SCF wages and salaries by 17.49/12.58 — see *Statistical Abstract of the United States* [1997,tab.676].

[20] See http://stats.bls.gov.csxhome.htm.

[21] The adjustment is as follows. We subtract mortgage payments and repairs to owner occupied houses and scale remaining consumption to NIPA levels for aggregate consumption less housing flows. Then we distribute NIPA housing service flows across ages using proportional housing values given in the survey. See Laitner [2000a].

that at age s for households of ages 30–39 — attempting to avoid ages at which liquidity constraints bind, at which children leave home, and at which retirement begins. The average ratio is 1.0257; hence, we require

$$[\beta \cdot (1 + r \cdot (1 - \tau))]^{1/(1-\gamma)} = 1.0257. \tag{34}$$

Fixing α, δ, υ, ω, τ^{ss}, g, as described above, we are left with τ, β, γ, and ξ. We adjust these until in the simulation (i) the government budget constraint holds, (ii) consumption growth condition (34) holds for unconstrained ages, (iii) aggregate estate tax collections (roughly) equal \$17.8 billion, and (iv) the empirical capital stock plus government debt to earnings ratio matches the right–hand side of (25). (Note that since the empirical ratio capital and debt to earnings and our aggregate production function alone determine the interest rate, in all calibrations $r = .069$.)

In the calculations, it is easy to compute τ from (24) given our assumptions and requirement that estate–tax revenues equal their empirical counterpart. Given τ, it is also simple to compute β from (34). For a selection of values of γ, we then iterate on ξ until the right–hand sides of (25) and (27) agree. (A higher ξ leads to higher bequests and, in general, to a greater supply of wealth.) Table 8 presents simulations for different γ values. By far the best match with empirical estate–tax revenues is $\gamma = .7$. Notice that a higher γ implies more flexibility on the part of households in dealing with intertemporal consumption differences and a higher tolerance for risk; hence, a higher γ tends to lead to lower bequests. To match the aggregate stock of net worth, a higher γ then requires a higher ξ. In the end, with a higher γ we tend to have widespread intergenerational transfers many of which are small. Given the progressivity of the tax system, this implies lower estate–tax revenues.

9. Results

Questions of interest are: (a) How well does the simulated distribution of wealth in column 6 of Table 8 match U.S. data? (b) Does the best calibration imply an equilibrium in Figure 5 resembling E or F? And, (c) What does the model imply about the long–run effect of changes in the U.S. social security system or the level of the national debt?

Distribution of Wealth. In comparing column 6 of Table 8 with column 5 of Table 1, the question is not whether the mean wealth per household of column 5 is borne out in the simulated equilibrium: since the simulated mean reflects the aggregate wealth to earnings ratio, which we calibrate ξ to duplicate, it should roughly correspond to the mean of column 1, Table 1; the "adjustments" embodied in column 5 of Table 1 spoil the normalization of the original survey weights, invalidating comparisons of levels with our model. What we do want to consider is how relative measures, such as percentage shares of wealth, line up between column 5, Table 1, and the simulation.

Before proceeding, note that Table 1's distribution of wealth is enormously more concentrated than the distribution of earnings in column 3, Table 2. Using our stationary distribution of earning abilities, our rate of technological progress, and our mortality rates, Table 7 presents the Gini coefficient and quantile shares for the model's distribution of earnings for ages 22–65.[22] Column 5 of Table 1 shows an empirical wealth share of the top 1% of households of 32.0 percent; the share of earnings for the top 1% is only 10.9 percent according to Table 7. In each of our calibration simulations, life cycle saving alone (at our calibrated gross interest rate) accounts for 64.8% of household wealth. Column 2 of Table 7 shows the stationary distribution of wealth generated solely by life cycle accumulation. The concentration exceeds that of earnings. For example, the share of the top 1% of wealth holders is 16.4 percent, and the Gini coefficient is .71. This is a natural consequence of the facts (i) that life cycle accumulations are zero at age 22 and at death, but quite high near retirement, and (ii) that the replacement ratio for social security benefits is greater for low earners, who consequently save proportionately smaller amounts than higher earners. Nevertheless, inequality arising from life cycle patterns is not nearly sufficient to explain the empirical degree of wealth inequality (see also Huggett [1996]).

Table 8 presents simulations of our complete model for different values of γ. Column 6 is the best simulation from the standpoint of replicating aggregate estate–tax collections. Comparing it with column 5 of Table 1, notice that the data show that the top .5% of households own 24.5 percent of U.S. wealth, the top 1% own 32.0 percent, the top 5% own 53.3 percent, and the top 10% own 65.1 percent. For column 6, Table 8, the top .5% hold 20.3 percent of aggregate net worth, the top 1% own 24.6%, the top 5% own 43.1 percent, and the top 10% own 55.4 percent. Looking at the amount of wealth relative to the mean amount, in the data the bracket for the top .5% begins at 21 times the mean, the bracket for the top 1% begins at 11 times the mean, and the bracket for the top 5% begins at 3 times the mean. In the best simulation, the corresponding multiples are 9.5, 8, and 3.2. The Gini coefficient for the data is .77; for the simulation with $\gamma = .7$ it is .74.

Table 8 also reports a "chi–square" statistic. If the SCF was a random sample, we could do a formal χ^2 test for equality of the frequencies by quantile from column 5, table 1, and any column from table 8. Letting s_i be the share which the model predicts for quantile i, s_i^* the empirical share, and m the sample size, the test statistic is

$$\sum_{i=1}^{11} \frac{(s_i^* - s_i)^2 \cdot m^2}{m \cdot s_i} = \sum_{i=1}^{11} m \cdot s_i \cdot (\frac{s_i^*}{s_i} - 1)^2 \ , \tag{35}$$

distributed χ^2 with 10 degrees of freedom in a conventional test. The column from Table 8 favored under the metric of minimizing this statistic has $\gamma = .06$ — although $\gamma = .7$ is very close. (Clearly all of the statistics are huge, so that if the test were valid, we would reject the model.)

In the end, the model does much better in matching the SCF wealth data than life–cycle saving alone. Nevertheless, the model's fit is far from perfect. The model omits many factors — such as the charitable bequests mentioned in Section 5. It is also the case that further processing of the wealth data might reduce its apparent concentration — for example, Section 3 mentions problems with the treatment of pensions and most consumer

[22] The distribution of earning abilities in this paper's model differs from Table 2 in omitting the short–term fluctuations of ϵ (recall Section 4) and in depending on a parametric representation of the distribution of η.

durables.[23]

Shape of the Financing Supply Curve. Our discussion of Figure 5 in Section 1 shows that the interest elasticity of the supply of financing at the steady–state equilibrium point can be crucially important for policy results. We solve for elasticities numerically for each value of γ in Table 8.

Table 9 presents elasticities. The demand elasticities are all small and identical; all come from (27). The supply elasticities, on the other hand, vary greatly. For $\gamma = -2$, the supply elasticity is .8. However, in the neighborhood of $\gamma = .7$, it is about 11.5. In terms of Figure 5, evidently our best calibration implies an outcome resembling E rather than F. This leads us to expect that changes in social security policy and national debt will not affect the economy's steady–state interest rate and capital intensivity very much.

Policy Results. Table 10 presents policy simulations. The first column repeats column 6 of Table 8. The second and third columns cut social security benefits (and taxes) by 50 percent and 90 percent, respectively. The fourth and fifth columns cut the national debt by 50 percent and 90 percent, simultaneously adjusting the income tax τ to preserve the government's budget constraint. The bottom part of the table shows the effect on the economy's long–run interest rate and capital intensivity; the top part shows the outcome for the long–run distribution of net worth. Cuts in social security of $x\%$ here roughly correspond to privatization of $x\%$ of our current system.

As expected given the very large supply elasticity at $\gamma = .70$ in Table 9, changes in social security corresponding to privatizing — or funding — 50 to 90% of the current U.S. system yield miniscule reductions in the steady–state equilibrium interest rate and tiny increases in $(K + D)/(w \cdot E)$.

Looking at the top section of Table 10, reducing unfunded social security does decrease the inequality of the long–run distribution of wealth. The share of the top 1 percent of wealth holders declines from 24.6 to 22.0 percent if we fund 90% of social security. The share of the top 5 percent drops from 43.1 to 38.1 percent. Intuitively, life–cycle and bequest–motivated saving provide the aggregate supply of financing for the economy. Life–cycle saving tends to be proportional to earnings. Estate–motivated saving, on the other hand, is more unequal: only the most prosperous households engage in it at all (less than half of all households leave bequests at death in column 1 of Table 10). It is the latter saving which gives the aggregate supply its great interest elasticity. Reducing unfunded social security increases life–cycle saving. As the equilibrium interest rate accordingly falls, estate saving is strongly affected — falling. Then life–cycle net worth accumulation becomes a larger fraction of the economy's total wealth. Since it is more equal, the long–run distribution of wealth becomes more equal.[24]

Table 10 also considers reductions in the national debt. As in the case of social security, we are making comparative–static comparisons of steady–state equilibria (this paper's analysis does not compute transition paths between long–run equilibria). The bottom of the table shows the effects on r are small. $K + D$ falls even as r does because

[23] Hurst *et al.* [1998, tab.5] report concentration data from an alternate source. They find a share for the top 1 percent of 25.6% and for the top 5 percent of 47.3%.

[24] See Laitner [2000a].

D falls.

The top of the table is more surprising, however: wealth inequality actually increases with a smaller national debt. Consider paying down 90% of the national debt. Life–cycle saving does rise in importance, explaining 72 percent of $K + D$ with a lower national debt, but 65% initially. The absolute wealth holdings of, say, the top 1 percent do decline. Nevertheless, apparently the relative importance of remaining estate–motivated saving increases in the lower wealth environment with a smaller national debt. Part of the explanation may be that reducing the debt allows a lower income tax, so that the net of tax interest rate only declines from 5.26% to 5.19% between columns 1 and 5.

10. Conclusion

This paper studies a model which combines life–cycle and dynastic motives for saving. We calibrate a steady–state equilibrium version of the model using U.S. data on total national wealth, the distribution of wealth among households, and aggregate estate tax revenues. The U.S. distribution of wealth is very concentrated, with the top 5 percent of wealth holders accounting for over half of total net worth. The model is consistent with a high degree of inequality, although it does not match the empirical distribution perfectly.

The most surprising result of our calibration efforts is that the model strongly favors parameter values which yield a very high overall interest elasticity for the supply of financing. The implication is that funding part, or all, of the social security system — as by setting up private lifetime accounts for individual households — would have very little long–run effect on interest rates or the economy's capital intensivity. This does not imply, of course, that the administrative advantages of reform would not be worthwhile. And, this paper's model has an inelastic labor supply, which precludes an analysis of the possible efficiency gains from the less onerous taxes on earnings that a privatized social security system might deliver. Our results do warn, however, that policy analyses based on conventional overlapping generations models may considerably overstate the long–run effect of social security reform on national capital accumulation.

Table 1. Unadjusted and Adjusted 1995 SCF Distribution of Wealth					
	Variant				
Statistic	1	2	3	4	5
Gini	.79	.78	.78	.76	.77
Share Top .5%	27.3%	26.0%	25.9%	24.9%	24.5%
Lower Bound	$4,477,000	$4,273,000	$4,273,000	$5,480,000	$5,365,000
Share Top 1%	34.9%	33.5%	33.4%	32.3%	32.0%
Lower Bound	$2,430,000	$2,319,000	$2,319,000	$2,904,000	$2,847,000
Share Top 2%	43.1%	41.7%	41.6%	40.6%	40.5%
Lower Bound	$1,316,000	$1,256,000	$1,256,000	$1,604,000	$1,570,000
Share Top 3%	48.5	47.1%	46.9%	45.7%	45.7%
Lower Bound	$990,000	$951,000	$9,511,000	$1,604,000	$1,140,000
Share Top 4%	52.6%	51.2%	51.1%	49.8%	49.9%
Lower Bound	$786,000	$755,000	$755,000	$947,000	$955,000
Share Top 5%	56.0%	54.7%	54.5%	53.2%	53.3%
Lower Bound	$678,000	$651,000	$651,000	$776,000	$778,000
Share Top 10%	67.9%	66.7%	66.5%	64.6%	65.1%
Lower Bound	$380,000	$375,000	$375,000	$472,000	$470,000
Share Top 20%	80.6%	80.0%	79.5%	78.1%	78.7%
Lower Bound	$197,000	$197,000	$197,000	$256,000	$247,000
Share Top 50%	96.4%	96.3%	96.0%	95.3%	95.4%
Lower Bound	$57,000	$57,000	$57,000	$74,000	$71,000
Share Top 90%	100.3%	100.3%	100.0%	100.0%	100.0%
Lower Bound	$0	$0	$0	$0	$1,000
Mean	$212,000	$204,000	$204,000	$257,000	$250,000
Observations (incl. all imputations)	21,495	21,495	21,495	21,495	19,111
Households	4299	4299	4299	4299	3823

Source: col. 1: 1995 SCF. See text.
col. 2: Previous, adjusted for capital gains tax.
col. 3: Previous, adjusted for nonnegativity.
col. 4: Previous, double singles' wealth and halve their weight.
col. 5: Previous, restricted to age 22–73.

Table 2. The Distribution of Earnings					
	SCF Data			Theoretical Model	
Statistic	Un–adjusted	Adjusted Singles	Normalized, Ages 22–64, Restricted Amounts	DF=100	DF=3.820
Gini	.62	.57	.40	.42	.45
Share Top .5%	10.3%	9.9%	8.3%	2.7%	8.4%
Lower Bound	\$312,000	\$385,000	\$6.971	\$4.855	\$5.451
Share Top 1%	14.1%	13.3%	11.1%	4.6%	10.5%
Lower Bound	\$245,000	\$268,000	\$4.592	\$4.132	\$4.240
Share Top 2%	19.8%	18.3%	15.0%	7.9%	13.8%
Lower Bound	\$171,000	\$200,000	\$3.370	\$3.441	\$3.365
Share Top 3%	24.1	22.3%	18.0%	10.8%	16.5%
Lower Bound	\$135,000	\$160,000	\$2.766	\$3.073	\$2.945
Share Top 4%	27.5%	25.6%	20.6%	13.4%	19.0%
Lower Bound	\$112,000	\$140,000	\$2.463	\$2.835	\$2.671
Share Top 5%	30.5%	28.5%	23.0%	15.8%	21.3%
Lower Bound	\$100,000	\$120,000	\$2.271	\$2.649	\$2.464
Share Top 10%	42.5%	40.0%	32.5%	26.1%	30.8%
Lower Bound	\$75,000	\$90,000	\$1.624	\$2.091	\$1.924
Share Top 20%	60.4%	56.6%	46.5%	42.0%	45.5%
Lower Bound	\$53,000	\$66,000	\$1.229	\$1.568	\$1.439
Share Top 50%	91.4%	88.6%	75.4%	73.8%	75.0%
Lower Bound	\$24,000	\$33,000	\$.769	\$.910	\$.851
Share Top 90%	100.1%	100.1%	97.3%	97.1%	97.2%
Lower Bound	\$0	\$0	\$.325	\$.406	\$.392
Mean	\$35,000	\$45,000	\$1.000	\$1.000	\$1.000
Observations (incl. all imputations)	21,270	21,270	14,021	NA	NA
Households	4254	4254	2805	NA	NA

Source: col. 1: 1995 SCF. See text.

col. 2: Previous, double singles' earnings and halve weight.

col. 3: Previous, normalize mean, ages 22–64, and amounts .2–10,000.

col. 4: Model, degrees freedom on $t = 100$.

col. 5: Model, degrees freedom 3.820.

Table 3. Estate Tax Rates 1995 (Percent)					
Tax Bracket ($ thousands)	Nominal Marginal Tax Rate	Effective Marginal Tax Rate		Perceived Marginal Tax Rate After Correction For Capital Gains	
		Empirical	Assumed For Simulations	Empirical	Assumed For Simulations
0 – 10	18	0	0	0	-4
10 – 20	20	0	0	0	-4
20 – 40	22	0	0	0	-4
40 – 60	24	0	0	0	-4
60 – 80	26	0	0	0	-4
80 – 100	28	0	0	0	-4
100 – 150	30	0	0	0	-4
150 – 250	32	0	0	0	-4
250 – 500	34	0	0	0	-4
500 – 750	37	0	0	0	-4
750 – 1000	39	0	0	0	-4
1000 – 1250	41	21	21	17	18
1250 – 1500	43	23	23	18	18
1500 – 2000	45	24	24	19	18
2000 – 2500	49	24	24	20	18
2500 – 3000	53	26	26	21	18
3000 – 10000	55	32	30	27	18
10000 – 15000	55	32	30	21	18
1500 – 20000	55	32	30	21	18
20000 – 30000	55	30	30	19	18

Source: see text.

Table 4. Gross Estates, Marital and Charitable Deductions						
Bracket	Gross Estate		Marital Deductions		Charitable Deductions	
(thousand $)	number (000)	amount (bil $)	number (000)	amount (bil $)	number (000)	amount (bil $)
1995 U.S. Federal Estate Tax Data						
0 – 600	37.3	26.5	14.9	5.4	5.8	1.0
600 – 1000	24.6	34.3	12.2	10.5	5.0	1.8
1000 – 2500	5.3	17.1	2.8	6.3	1.4	.9
2500 – 5000	1.7	10.9	.9	4.2	.5	1.0
5000 – 10000	.6	7.4	.3	3.2	.2	.7
10000 – 20000	.3	14.7	.2	6.1	.1	3.4
Simulations Using Estimated θ's						
0 – 600	22.5	17.2	13.9	5.6	22.5	1.0
600 – 1000	16.6	24.8	12.4	9.5	16.6	1.3
1000 – 2500	6.0	19.8	3.4	6.3	6.0	1.1
2500 – 5000	3.2	21.2	2.0	7.1	3.2	1.2
5000 – 10000	1.1	15.2	.6	4.0	1.1	.9
10000 – 20000	.3	12.4	.3	4.7	.3	3.4

Source: see text.

Table 5. Survival Rates and Experiential Human Capital

Age	q_s	e_s	Age	q_s	e_s
22	1.0000	20004	55	.9678	72799
23	1.0000	24376	56	.9608	70447
24	1.0000	28747	57	.9533	68094
25	1.0000	33120	58	.9451	64482
26	1.0000	37492	59	.9362	59609
27	1.0000	41863	60	.9264	54738
28	1.0000	44672	61	.9158	49866
29	1.0000	45915	62	.9042	44994
30	1.0000	47159	63	.8918	40123
31	1.0000	48402	64	.8785	35250
32	1.0000	49646	65	.8643	30378
33	1.0000	51166	66	.8493	
34	1.0000	52961	67	.8333	
35	1.0000	54757	68	.8163	
36	1.0000	56552	69	.7982	
37	1.0000	58347	70	.7789	
38	1.0000	60101	71	.7585	
39	1.0000	61816	72	.7370	
40	1.0000	63528	73	.7143	
41	1.0000	65241	74	.6904	
42	1.0000	66956	75	.6654	
43	1.0000	69637	76	.6393	
44	1.0000	73290	77	.6120	
45	1.0000	76941	78	.5835	
46	1.0000	80593	79	.5539	
47	1.0000	84244	80	.5233	
48	1.0000	85331	81	.4918	
49	1.0000	83853	82	.4476	
50	.9957	82375	83	.3875	
51	.9909	80898	84	.3098	
52	.9858	79420	85	.2169	
53	.9803	77505	86	.1197	
54	.9743	75153	87	.0396	

Sources: Column 1 from average death rates 1900, *Statistical Abstract of the United States* [1997,p.89]. Column 2 from 1995 SCF — see text.

Table 6. Parameter Values and Empirical Ratios

Name	Value
Parameter	
α	.3251
δ	.0700
g	1.0100
τ^{ss}	.0607
μ_η	-.1024
σ_η	.3032
n	3.8200
ζ	.45
υ	.7500
ω	.3000
Ratio	
$G_t/(W \cdot E_t)$	.2765
$(K_t + D_t)/(W \cdot E_t)$	4.1367
$[\beta \cdot (1 + r \cdot (1 - \tau))]^{\frac{1}{1-\gamma}}$	1.0257

Source: see text.

Table 7. Simulated Distribution of Labor Earnings and Life Cycle Wealth

Statistic	Earnings	Life Cycle Wealth
Gini	.36	.71
Share Top .5%	9.0%	13.3%
Lower Bound	$177,000	$923,000
Share Top 1%	10.9%	16.4%
Lower Bound	$131,000	$655,000
Share Top 2%	13.7%	21.8%
Lower Bound	$108,000	$555,000
Share Top 3%	16.3	25.9%
Lower Bound	$95,000	$398,000
Share Top 4%	18.5%	29.3%
Lower Bound	$83,000	$387,000
Share Top 5%	20.4%	32.7%
Lower Bound	$75,000	$376,000
Share Top 10%	29.0%	48.0%
Lower Bound	$66,000	$307,000
Share Top 20%	43.2%	68.7%
Lower Bound	$49,000	$210,000
Share Top 50%	73.2%	99.2%
Lower Bound	$33,000	$20,000
Share Top 90%	97.2%	100.0%
Lower Bound	$16,000	$0
Mean	$40,000	$113,000

Table 8. Simulated Distribution of Wealth for Different Values of γ				
Statistic or Variable	$\gamma = -2.0$	$\gamma = -1.0$	$\gamma = 0.0$	$\gamma = 0.3$
Gini	.79	.79	.78	.77
Share Top .5%	38.7%	36.7%	34.1%	30.7%
Lower Bound	$1,561,000	$1,610,000	$1,698,000	$1,707,000
Share Top 1%	42.1%	41.2%	37.8%	34.6%
Lower Bound	$1,047,000	$1,074,000	$1,158,000	$1,228,000
Share Top 2%	46.1%	45.5%	42.4%	39.7%
Lower Bound	$688,000	$696,000	$744,000	$792,000
Share Top 3%	49.6%	48.9%	46.1%	43.6%
Lower Bound	$592,000	$603,000	$645,000	$686,000
Share Top 4%	52.2%	51.6%	49.1%	46.8%
Lower Bound	$425,000	$437,000	$488,000	$543,000
Share Top 5%	54.4%	53.3%	51.5%	49.5%
Lower Bound	$401,000	$404,000	$432,000	$469,000
Share Top 10%	64.1%	63.7%	61.8%	60.1%
Lower Bound	$337,000	$343,000	$361,000	$370,000
Share Top 20%	77.8%	77.5%	76.3%	75.2%
Lower Bound	$221,000	$222,000	$228,000	$233,000
Share Top 50%	99.1%	99.1%	99.0%	98.9%
Lower Bound	$32,000	$33,000	$40,000	$44,000
Share Top 90%	100.0%	100.0%	100.0%	100.0%
Lower Bound	$0	$0	$0	$0
Mean	$189,000	$189,000	$189,000	$189,000
Estate Tax Revenue	$66.6 bil.	$63.9 bil.	$54.7 bil.	$46.0 bil.
Chi Square[a]	1,324	1,242	1,004	828
Parameters				
β	1.025	.999	.974	.967
ξ	.077	.188	.451	.584
τ	.238	.238	.238	.238

a. See Section 3.

Table 8. Simulated Distribution of Wealth (continued)

Statistic or Variable	$\gamma = 0.6$	$\gamma = 0.7$	$\gamma = 0.8$
Gini	.75	.74	.73
Share Top .5%	24.1%	20.3%	15.9%
Lower Bound	1,782,000	\$1,802,000	\$1,841,000
Share Top 1%	28.3%	24.6%	20.4%
Lower Bound	\$1,404,000	\$1,475,000	\$1,553,000
Share Top 2%	34.3%	31.3%	27.4%
Lower Bound	\$911,000	\$992,000	\$1,107,000
Share Top 3%	38.7%	35.7%	32.4%
Lower Bound	\$767,000	\$813,000	\$867,000
Share Top 4%	42.4%	39.7%	36.7%
Lower Bound	\$641,000	\$686,000	\$743,000
Share Top 5%	45.5%	43.1%	40.4%
Lower Bound	\$547,000	\$601,000	\$658,000
Share Top 10%	57.0%	55.4%	53.6%
Lower Bound	\$390,000	\$402,000	\$418,000
Share Top 20%	73.6%	72.7%	71.8%
Lower Bound	\$246,000	\$254,000	\$268,000
Share Top 50%	98.8%	98.7%	98.6%
Lower Bound	\$48,000	\$54,000	\$58,000
Share Top 90%	100.0%	100.0%	100.0%
Lower Bound	\$0	\$0	\$0
Mean	\$190,000	\$189,000	\$189,000
Estate Tax Revenue	\$30.0 bil.	\$20.8 bil.	\$10.7 bil.
Chi Square[a]	637	640	770
Parameters			
β	.960	.957	.955
ξ	.743	.798	.854
τ	.238	.238	.238

a. See Section 3.

Table 9. Elasticities of Supply and Demand (absolute values)		
γ	Supply	Demand
-2	.801	.457
-1	1.519	.457
0	3.891	.457
.3	7.379	.457
.6	11.336	.457
.7	11.496	.457
.8	11.946	.457

Table 10. Policy Changes: Contracting Unfunded Social Security or Reducing the National Debt ($\gamma = .70$)

Statistic or Variable	No Policy Change	Reduction in Social Security 50%	Reduction in Social Security 90%	Reduction in National Debt 50%	Reduction in National Debt 90%
	Wealth Distribution				
Gini	.73	.73	.72	.74	.74
Share Top .5%	20.3%	19.2%	18.1%	21.0%	21.7%
Lower Bound	$1,802,000	$1,742,000	$1,659,000	$1,700,000	$1,641,000
Share Top 1%	24.6%	23.3%	22.0%	25.4%	26.1%
Lower Bound	$1,475,000	$1,337,000	$1,239,000	$1,339,000	$1,233,000
Share Top 2%	31.1%	29.1%	27.3%	31.6%	32.0%
Lower Bound	$992,000	$893,000	$855,000	$862,000	$792,000
Share Top 3%	35.7%	33.5%	31.6%	36.1%	36.5%
Lower Bound	$813,000	$773,000	$748,000	$741,000	$682,000
Share Top 4%	39.7%	37.3%	35.1%	40.0%	40.3%
Lower Bound	$686,000	$632,000	$601,000	$615,000	$552,000
Share Top 5%	43.1%	40.4%	38.1%	43.4%	43.4%
Lower Bound	$601,000	$551,000	$533,000	$533,000	$474,000
Share Top 10%	55.4%	52.7%	50.9%	55.4%	55.5%
Lower Bound	$402,000	$428,000	$441,000	$380,000	$359,000
Share Top 20%	72.7%	70.6%	69.4%	72.6%	72.7%
Lower Bound	$254,000	$272,000	$295,000	$235,000	$228,000
Share Top 50%	98.7%	98.7%	98.7%	98.9%	00.1%
Lower Bound	$54,000	$54,000	$52,000	$44,000	$39,000
Share Top 90%	100.0%	100.0%	100.0%	100.0%	100.0%
Lower Bound	$0	$0	$0	$0	$0
Mean	$189,000	$188,000	$188,000	$175,000	$164,000
	Capital Intensity				
gross of tax interest rate	6.90%	6.86%	6.82%	6.76%	6.64%
$(K_{t+1} + D_{t+1})/(w \cdot E_t)$	4.177	4.189	4.203	3.880	3.633

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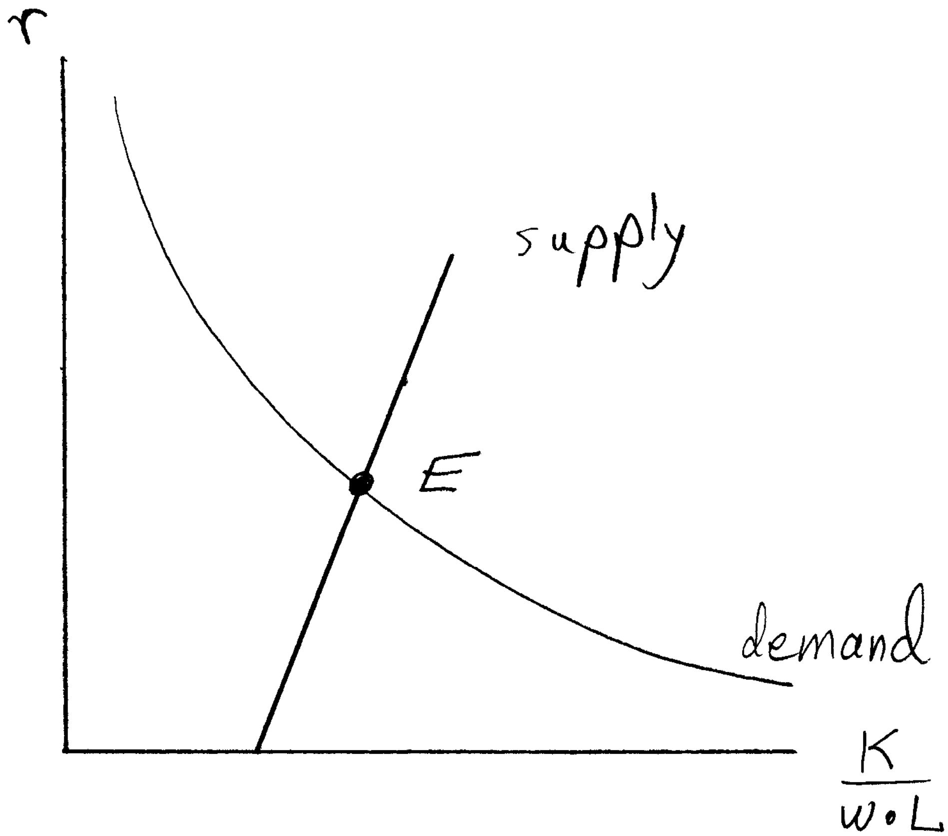

Figure 1: The demand for capital and supply of credit in an OLG model

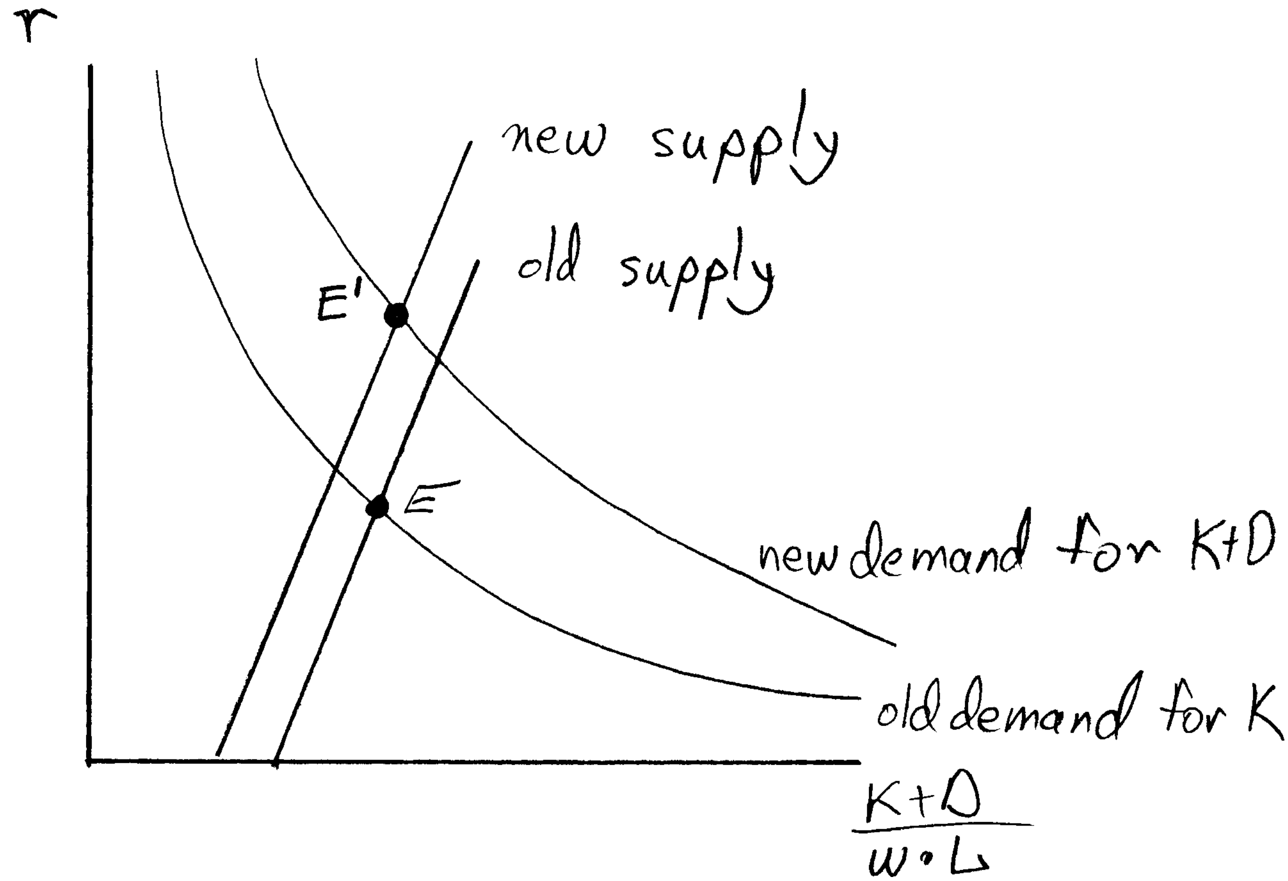

Figure 2: Equilibrium with national debt and an unfunded social security system

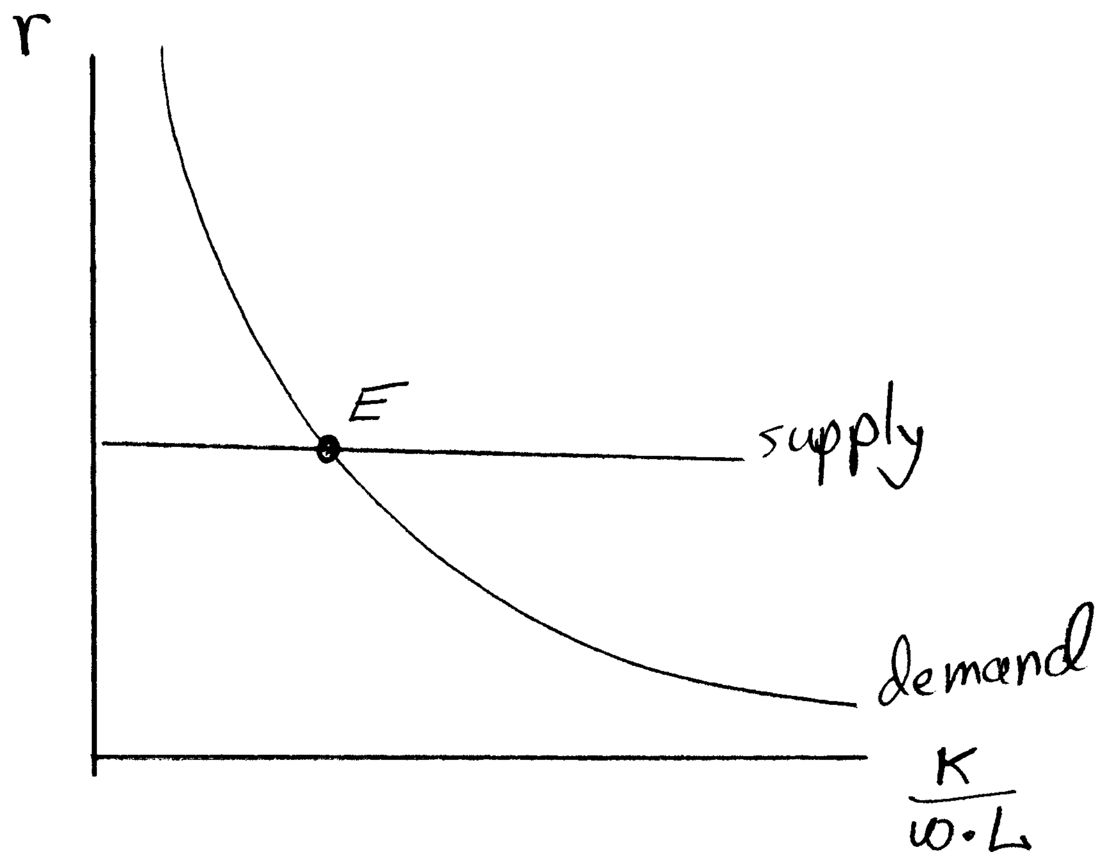

Figure 3: The demand for capital and supply of financing with dynastic family lines

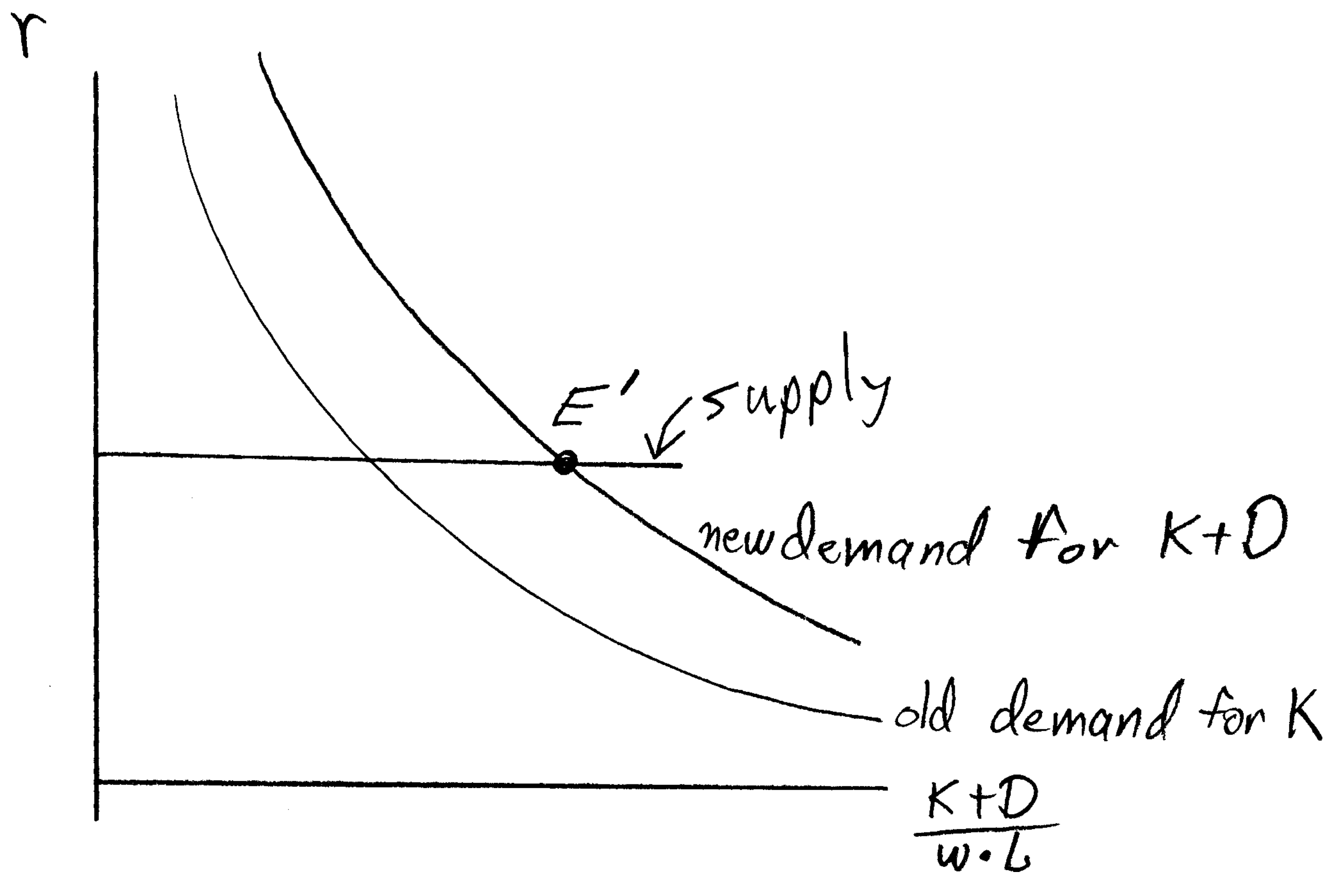

Figure 4: Changes in social security and national debt in the case of dynastic families

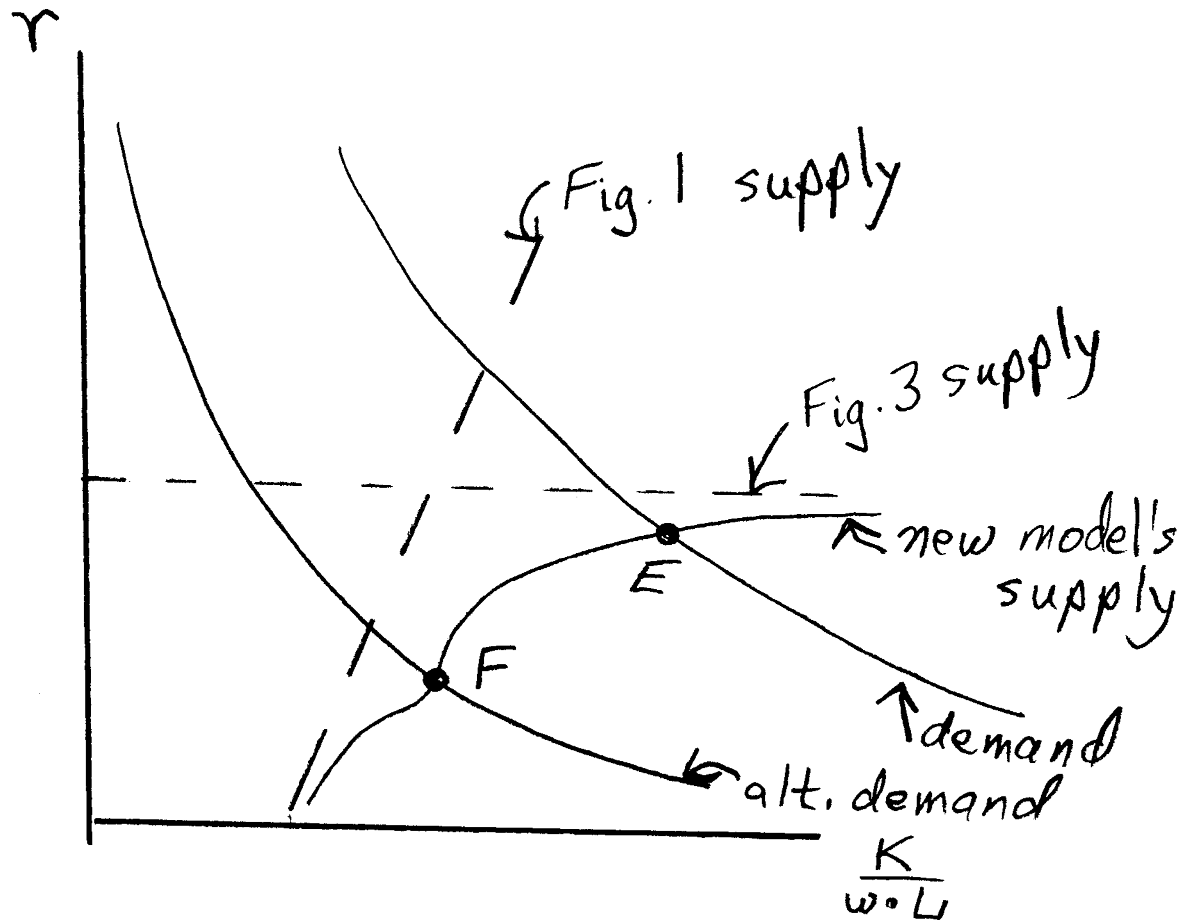

Figure 5: The demand and supply of financing in the hybrid model

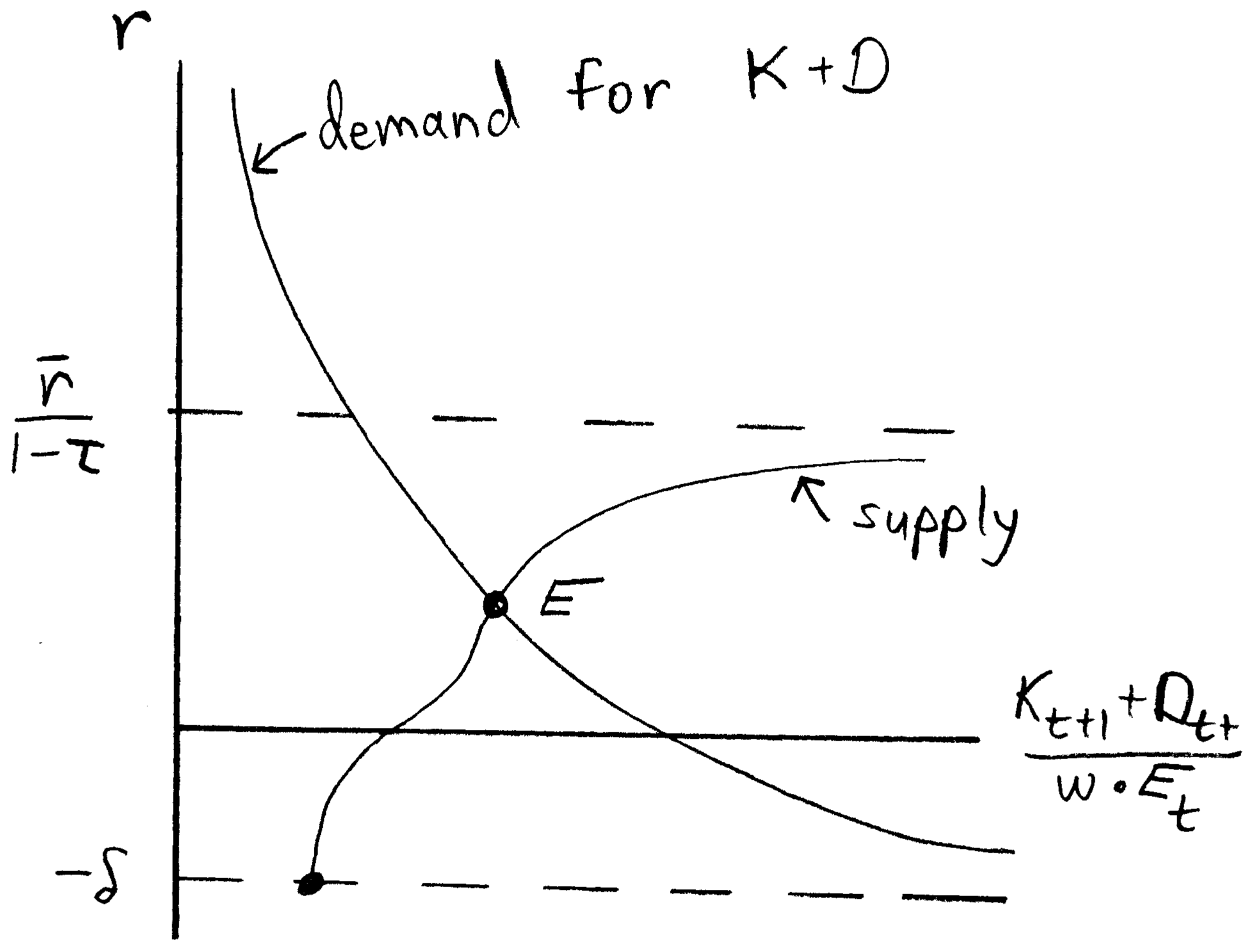

Figure 6: The steady–state equilibrium demand and supply of financing