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# Labor Supply Responses to Social Security

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## Abstract

Economists' most basic model for studying Social Security policy issues is the so—called life—cycle model of saving behavior. This paper sets up a life—cycle model in which a household simultaneously chooses its lifetime consumption profile and retirement age. The paper calibrates parameters from Consumer Expenditure Survey data, making special use of observations of changes in household consumption immediately following retirement. The paper's last section provides illustrative simulations of the effect of current Social Security provisions on average retirement ages, finding evidence of a several year reduction in working life in some cases.

# Labor Supply Responses to Social Security

## John Laitner

## June 6, 2003

Economists' workhorse dynamic framework for studying social security policy issues, national debt, and tax policy in general is the life–cycle saving model (e.g., Modigliani [1986], Diamond [1965], Tobin [1967], Auerbach and Kotlikoff [1987], and many others). Even analyses which incorporate bequests – in order to study the role of exceptionally wealthy families, for example — often rely on life–cycle saving as a model of the behavior of most households (e.g., Altig et al. [2001], Gookhale et al. [2001], Laitner [2001b, 2002]). The simplest life–cycle model merely describes household saving in youth and middle age, in preparation for retirement, and dissaving in old age. Although one can easily extend the framework to household choices over labor/leisure hours (e.g., Auerbach and Kotlikoff [1987], Gustman and Steinmeier [1986], etc.), basic utility–function coefficients are not easily calibrated for the simplest model (utility is not, after all, directly observable), and, since extensions introduce still more parameters, one might worry about the possibility of calibrating them accurately. This paper, however, proposes that we can employ evidence on behavior immediately after retirement to attempt to estimate key features of life–cycle preference orderings. The analysis suggests that as we augment the model to include labor/leisure decisions, the set of implications about household behavior expands in such a way that opportunities to calibrate parameters grows faster than the number of parameters. Based on our calibrations, this paper's last section provides illustrative simulations of the effect of social security taxes and benefits on retirement ages.

A number of recent papers document a drop in household consumption at retirement. Some suggest the decline may be inconsistent with the life–cycle theory's assumptions of rational behavior and careful planning.[1,2] Others, however, suggest that the drop represents intentional behavior. For example, Hurd and Rohwedder [2003] use novel questions on anticipations from a subsample of Health and Retirement Study participants to show that households expect their consumption to fall about 20% at retirement. Similarly, financial advisors have long said that retirees have less "need" for consumption than working people — for instance, Laitner [2001a] quotes a TIAA–CREF brochure suggesting "you'll need 60 to 90 percent of current income in retirement, adjusted for inflation, to maintain the

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[1] Bernheim et al. [2001] examine consumption declines using the Panel Study of Income Dynamics 1978–90. Data limitations force them to proxy consumption with food at home, food away from home, and rental value of home. Their Table 1 shows a consumption drop averaging 14% in the first two years after retirement – though the decline seems to build during retirement, perhaps averaging 9% in the first year and 18%, cumulatively, in the second. Table 3 implies the magnitude of the decline is negatively related to asset and pension resources. Bernheim et al. seem to favor explanations based on poor planning.

[2] Using British data, Banks et al. [1998, tab.1] measure consumption declines at retirement of 22 to 35%. The authors suggest that individuals may tend to overestimate their pension entitlements (e.g., p.784).

lifestyle you now lead," and a *Reader's Digest* article stating that "many financial planners say it will take 70 to 80 percent of your current income to maintain your standard of living when you retire."

The first part of the present paper examines evidence from the *Consumer Expenditure Survey* 1983–2001 and finds that household consumption does indeed fall substantially, on average, at retirement. The second part argues that not only is the evidence consistent with variants of many widely used life–cycle models but also that measurements of the size of the post–retirement drop in consumption can reveal valuable information about the magnitude of life–cycle model parameters.

The organization of this paper is as follows. Section 1 considers the possible structure of simple life–cycle saving models which incorporate labor/leisure choices. Section 2 examines U.S. data from the *Consumer Expenditure Survey*, using it to assess the possible life–cycle shape of household consumption profiles. Section 3 sets up a life–cycle model of family behavior with nonseparable consumption and leisure, and Section 4 calibrates the parameters of the latter model. Section 5 uses the new parameter estimates to attempt to assess the impact of social security on household decisions of when to retire.

## 1. Household Preferences

In this paper's model, every household chooses its saving and labor supply to maximize its utility subject to a lifetime budget constraint.[3] The analysis assumes indivisibilities in options for market work: our households must either work full time or retire (see, for example, Hurd [1996]). As Rust and Phelan [1997,p.786] write,

> The finding that most workers make discontinuous transitions from full time work to not working, and the finding that the majority of the relatively small number of 'gradual retirees' reduce their annual hours of work by taking on a sequence of lower wage partial retirement 'bridge jobs' rather than gradually reducing hours of work at their full-time pre-retirement 'career job' suggests the existence of explicit or implicit constraints on the individual's choice of hours of work.

The indivisibility assumption seems consistent with the fact that U.S. data show little trend in male work hours or participation rates after 1940, except for earlier retirement (e.g., Pencavel [1986], Blundell et al. [1999], and Burkhauser et al. [1999]). We omit sensitivity of utility or earning power to health status — the latter being a topic for future research. Although some analyses stress the importance of features of workers' private pension plans in determining retirement behavior (e.g., Stock and Wise [1990]), this paper takes the opposite point of view: this paper assumes that a worker picks an employer whose pension

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[3] The option to save (and dissave) contrasts to Stock and Wise [1990] and Rust and Phelan [1997], where households live pre-retirement on their earnings, and post-retirement on their social security and pension benefits. Lumsdaine and Mitchell [1999] find, however, that Health and Retirement Study respondents in 1992, all of whom are near retirement, have median net worth of $500,000. Although one quarter of the amount is social security wealth, and another quarter is private pension wealth, half is from other sources.

plan matches his requirements and/or that employers design their pension–plan options in accordance with worker preferences in the first place; thus, private pensions form a part of private wealth accumulation and do not require separate attention.[4] Economists adopt various simplifications about preference orderings for their models of household behavior. Since the implications of such assumptions can be very significant for the data on which this paper focuses, we begin with a comparison of specifications.

Many economic models employ utility functions which are time separable, and many find an additional assumption that concurrent leisure and consumption are separable natural as well (e.g., Gustman and Steinmeier [1986], Anderson et al. [1999]). Concurrent separability, however, certainly restricts a model's range of outcomes. Consider a specific example. Retirement is exogenously set (at this point). A household lives from $t = 0$ to $t = 2$, retiring at $t = 1$. Its time endowment at each $t$ is 1. When it works, its leisure falls to $\bar{\ell} \in (0, 1)$. This paper assumes that indivisibilities force $\bar{\ell}$ to be a fixed parameter. The wage is $W$; the interest rate is $r$. The household's consumption $c_t$ yields utility flow $u(c_t)$; its leisure $\ell_t$ yields utility flow $v(\ell_t)$; and, its assets (net worth) are $a_t$. Think of the household's behavior as originating from

$$\max_{c_t, \ell_t} \int_0^2 [u(c_t) + v(\ell_t)] \, dt \tag{1}$$

$$\text{subject to:} \quad \ell_t = \begin{cases} \bar{\ell}, & \text{for } t \leq 1 \\ 1, & \text{for } t > 1 \end{cases},$$

$$\dot{a}_t = r \cdot a_t + (1 - \ell_t) \cdot W - c_t,$$

$$a_0 = 0 = a_2.$$

Provided $u(.)$ is concave, specification (1) predicts that consumption will change continuously with age. To see this, note along an optimal consumption path, the additional utility at date $s$ from one extra dollar's consumption, $u'(c_s)$, must equal the additional utility from the dollar if it is saved until later date $t$, by which time it has grown to an amount $e^{r \cdot (t-s)}$:

$$u'(c_s) = e^{r \cdot (t-s)} \cdot u'(c_t). \tag{2}$$

Letting $c_{t-}$ be consumption the instant before $t$, and $c_{t+}$ the instant after, condition (2) yields

$$u'(c_{t-}) = u'(c_{t+}). \tag{3}$$

The latter is inconsistent with a jump in consumption at any $t$.

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[4] In fact, the central aim of this paper — to calibrate the intertemporal elasticity of substitution from post–retirement consumption — does not depend on our treatment of private pensions. However, this paper's exposition does.

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Other papers assume intertemporal separability but not intra-temporal separability.[5] A well–known example is Auerbach and Kotlikoff [1987]. We can easily modify example (1) to illustrate. Let a household have a constant returns to scale "neoclassical" production function $f : R^2 \mapsto R^1$ which combines current consumption and leisure to generate a flow of services, the latter yielding a flow of utility, say, $u(f)$. The household solves

$$\max_{c_t, \ell_t} \int_0^2 u(f(c_t, \ell_t)) \, dt \qquad (4)$$

$$\text{subject to:} \quad \ell_t = \begin{cases} \bar{\ell}, & \text{for } t \leq 1 \\ 1, & \text{for } t > 1 \end{cases},$$

$$\dot{a}_t = r \cdot a_t + (1 - \ell_t) \cdot W - c_t \,,$$

$$a_0 = 0 = a_2 \,.$$

As before, post–retirement leisure is 1, pre-retirement leisure is $\bar{\ell} < 1$, and we fix the retirement age to be $t = 1$. Since a bivariate neoclassical production function has $f_{12}(.) > 0$, inputs are complementary in the sense that more leisure (consumption) raises the marginal product of consumption (leisure). If $u(.)$ is linear, this would make the household want to step up its consumption at retirement: consumption would discontinuously increase after the discrete rise in leisure at retirement because the marginal product of consumption rises. If, on the other hand, $u(.)$ is very concave, a household would strongly desire a very even flow of consumption services at different ages. Since the household produces such services more easily during retirement, it may then choose more consumption prior to $t = 1$. In the end, rational behavior may lead to an age profile of consumption which discontinuously changes in either direction at retirement.

To be more specific, let $f(.)$ have the familiar Cobb–Douglas form

$$f(c, \ell) = [c]^\alpha \cdot [\ell]^{1-\alpha}, \quad \alpha \in (0, 1) \,.$$

Let $u(.)$ have the familiar isoelastic form

$$u(f) = \frac{[f]^\gamma}{\gamma}, \quad \gamma < 1 \,.$$

Condition (3) at retirement date $t = 1$ is

$$([c_{t-}]^\alpha \cdot [\bar{\ell}]^{1-\alpha})^{\gamma-1} \cdot \alpha \cdot [c_{t-}]^{\alpha-1} \cdot [\bar{\ell}]^{1-\alpha} = ([c_{t+}]^\alpha)^{\gamma-1} \cdot \alpha \cdot [c_{t+}]^{\alpha-1} \iff$$
$$[c_{t-}]^{\alpha \cdot \gamma - 1} \cdot [\bar{\ell}]^{(1-\alpha) \cdot \gamma} = [c_{t+}]^{\alpha \cdot \gamma - 1} \iff$$
$$[c_{t-}] \cdot [\bar{\ell}]^{-\frac{\gamma \cdot (1-\alpha)}{1 - \alpha \cdot \gamma}} = [c_{t+}] \,. \qquad (5)$$

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[5] E.g., King et al. [1988], Hurd and Rohwedder [2003].

If $\gamma$ is nearly 1, $u(.)$ is nearly linear. Then we would expect an upward jump in consumption at retirement. In fact,

$$c_{t-} < c_{t+} \quad \text{if} \quad [\bar{\ell}]^{-\frac{\gamma \cdot (1-\alpha)}{1-\alpha \cdot \gamma}} > 1 \Longleftrightarrow$$
$$-\frac{\gamma \cdot (1-\alpha)}{1-\alpha \cdot \gamma} < 0 \Longleftrightarrow$$
$$\gamma > 0 \,.$$

So, indeed, whenever $\gamma > 0$, under rational planning, consumption discontinuously rises at retirement . On the other hand, we have

$$c_{t-} > c_{t+} \quad \text{if} \quad [\bar{\ell}]^{-\frac{\gamma \cdot (1-\alpha)}{1-\alpha \cdot \gamma}} < 1 \Longleftrightarrow$$
$$-\frac{\gamma \cdot (1-\alpha)}{1-\alpha \cdot \gamma} > 0 \Longleftrightarrow$$
$$\gamma < 0 \,.$$

Thus, whenever $\gamma < 0$, the model predicts a discontinuous drop in consumption at retirement. Not only is an abrupt adjustment in consumption at retirement fully consistent with rational behavior, but also we can see that data on the size of change can potentially help us to calibrate $\gamma$ — an otherwise difficult task.

## 2. Consumer Expenditure Survey

The most complete source of disaggregate consumption data for the U.S. is the *Consumer Expenditure Survey* (CXS). The CXS has respondent households collect extensive diary information on small purchases over a multi–week time period. It conducts interviews at longer intervals asking about major purchases. The interviews also collect demographic data, data on current income, on value of house, etc. The sample is large (the BLS uses the survey in setting the CPI). The survey was conducted at multi–year intervals prior to 1984, and annually thereafter. The web site is

http://stats.bls.gov.gov/csxhome.htm .

The following discussion uses, at this point, data from the site's "standard tables" for 1984–2001.

Tables 1–3 compare National Income and Product Account (NIPA) personal consumption for 1985, 1990, 1995, and 2000 with population–weighted totals from the *CXS* for similar categories. The following observations seem justified. (A) For categories such as food, apparel, personal care, and recreation, the *CXS* captures 65–75% of the NIPA figures in 1985; the *CXS* captures about 110% of 1985 NIPA transportation (primarily private automobiles). (B) Other categories differ significantly between the two sources in terms of definition. NIPA "shelter" imputes service flows to owner occupied houses, whereas *CXS* housing does not. NIPA "medical care" is the output of the private medical sector, but *CXS* medical care is private household spending on the same — excluding

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| Category | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|
| food[b] | 498.5 | 677.9 | 802.5 | 1027.2 |
| apparel | 188.3 | 261.7 | 317.3 | 409.8 |
| personal care | 37.6 | 53.7 | 67.4 | 87.8 |
| shelter | 406.8 | 585.6 | 740.8 | 960.0 |
| household operation | 344.0 | 433.6 | 555.0 | 723.9 |
| transportation | 372.8 | 455.4 | 560.3 | 768.9 |
| medical care | 367.4 | 619.7 | 888.6 | 1171.1 |
| recreation | 187.6 | 284.9 | 401.6 | 564.7 |
| education | 53.8 | 83.7 | 114.5 | 164.0 |
| personal business | 188.1 | 284.7 | 406.8 | 632.5 |
| miscellaneous[c] | 67.9 | 90.8 | 114.2 | 174.0 |
| total | 2712.6 | 3831.5 | 4969.0 | 6683.7 |

a. Source: http://www.bea.doc.gov/bea/dn/nipaweb/AllTables.asp,
   Section 2, Table 2.4.
b. Includes tobacco and alcohol.
c. Includes religious activities and foreign travel.

employer contributions to private medical insurance. The *CXS* measures household out-lays on education such as tuition; the corresponding NIPA category includes the entire output (i.e., the entire cost of operation) of the education and private foundation sectors (less government grants). NIPA "personal business" includes the output of the financial services sector, much of which households implicitly support through low interest on bank accounts, etc.; *CXS* "personal business" is completely different — it includes household payments for life insurance and pensions. *CXS* "miscellaneous" consumption incorporates household cash contributions to charity and alimony payments, whereas the same NIPA category does not. (C) *CXS* totals slip at an annual rate of 1.7% relative to NIPA personal consumption — perhaps the BLS is having more and more difficulty obtaining accurate responses.

Although the *CXS* data seems to have its share of problems, it has the virtues of comprehensiveness and of providing age–related detail; hence, this paper uses it — after adjusting it in several ways. The "adjustments" are as follows. (1) We drop mortgage payments from "shelter" but substitute NIPA housing service flows assigned to ages in proportion to relative *CXS*–reported housing values. (2) We drop "personal business" — for which the BLS definition differs greatly from the NIPA, and for which the BLS data

## Table 2. Consumer Expenditure Survey Consumption (billions of current dollars)[a]

| Category | 1985 | 1990 | 1995 | 2000 |
|---|---|---|---|---|
| food[b] | 366.4 | 471.6 | 520.9 | 639.7 |
| apparel | 130.0 | 156.9 | 175.7 | 203.0 |
| personal care | 27.7 | 35.3 | 41.6 | 61.7 |
| shelter | 351.0 | 468.9 | 611.3 | 778.0 |
| household operation | 297.9 | 375.0 | 467.1 | 569.3 |
| transportation | 420.0 | 496.5 | 620.2 | 811.2 |
| medical care | 101.5 | 143.5 | 178.6 | 226.0 |
| recreation[c] | 120.0 | 152.7 | 182.9 | 219.7 |
| education | 29.4 | 39.4 | 48.6 | 69.1 |
| personal business[d] | 184.6 | 251.3 | 305.7 | 368.0 |
| miscellaneous[e] | 122.1 | 160.8 | 174.4 | 215.2 |
| total | 2150.8 | 2752.0 | 3327.2 | 4160.9 |

a. Source: http://stats.bls.gov/csxhome.htm, "one year standard tables."
b. Includes tobacco and alcohol.
c. Includes entertainment and reading.
d. Includes personal insurance and pensions.
e. Includes cash contributions.

includes pension contributions (which correspond to saving rather than consumption in our framework of analysis). (3) For rows in which Tables 1–2 are very similar — food, apparel, personal care, household operation, transportation, and recreation — we proportionately adjust $CXS$ values so that category (weighted) totals coincide with NIPA figures. (4) We proportionately scale the remaining $CXS$ categories — medical care, education, and miscellaneous — with an arithmetic average of the scaling factors from adjustment 3.

Table 4 presents $CXS$ data on consumption and income by age and this paper's adjusted consumption. Website tables present average data for (10–year wide) age groups. Table 4 interpolates consumption and after–tax income figures for each age in each year; then it computes rates of change of consumption for each year $t$ and age $s$, taking, for example the age–25 consumption in 1984 away from the age–26 consumption in 1985 to derive $\Delta \ln(c_{25,1985})$; finally, for each age $s = 25, ..., 75$, it reports the mean of the 13 available $\Delta \ln(c_{st})$ annual figures, $t = 1984, ..., 2000$, as $\Delta \ln(c_s)$. It does the same for $CXS$–reported household income and for this paper's adjusted household consumption.

Figure 1 plots the consumption and income changes.[6] Carroll and Summers [1991] note

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[6] This is the only place in which we use the BLS measure of income.

| Table 3. Consumer Expenditure Amount ÷ NIPA Amount (percent)[a] | | | | |
|---|---|---|---|---|
| Category | 1985 | 1990 | 1995 | 2000 |
| food | 73.5 | 69.6 | 64.9 | 62.3 |
| apparel | 69.0 | 60.0 | 55.4 | 49.5 |
| personal care | 73.8 | 65.7 | 61.7 | 70.3 |
| shelter | 86.3 | 80.1 | 82.5 | 81.0 |
| household operation | 86.6 | 86.5 | 84.2 | 78.6 |
| transportation | 112.7 | 109.0 | 110.7 | 105.5 |
| medical care | 27.6 | 23.2 | 20.1 | 19.3 |
| recreation | 64.0 | 53.6 | 45.6 | 38.9 |
| education | 54.6 | 47.0 | 42.4 | 42.1 |
| personal business | 98.1 | 88.3 | 75.1 | 58.2 |
| miscellaneous | 179.9 | 177.1 | 152.7 | 123.7 |
| total | 79.3 | 71.8 | 67.0 | 62.3 |

a. Source: see Tables 1–2.

that consumption and income grow at the same high rate for early ages in the *CXS*, and they suggest that liquidity constraints may play a role. Browning and others, in contrast, argue that children's births, and children's departures to form new households, lead to high, then low, consumption growth rates as parent households age. When Mariger [1986] considers these hypotheses together, he concludes that demographics may be the more important factor.

In fact, for ages less than 30, the following scenario presumably dominates the data: Mr. M, with annual income of $10,000 and consumption of $8,000, marries Miss F, who has annual income of $10,000 and consumption of $8,000, and the next year they constitute a married household MF with income $20,000 and consumption $16,000. Thus, marriage can cause average per household consumption and income to skyrocket.

To bypass changes due strictly to marriage, this paper concentrates on households of ages 30–75 or 35–75. Issues of children and liquidity constraints remain potentially important. The rest of this section seeks to measure the role of children but ignores possible liquidity constraints; the next section returns to the latter.

To incorporate children into our analysis, let the number of "equivalent adults" per household be $n_t$. For example, if a household has two parents, let parent each constitute 1 "equivalent adult." Suppose children consume 50% as much as adults. Then a two–child family with two parents might have $n_t = 3$ for parent ages $t$ at which the children remain at home. Following Tobin [1967] and others, let household's utility flow at age $t$ be

## Table 4. Consumer Expenditure Survey Data: Growth Rates for Real Consumption and Real Income[a]

| Age | Consumption[b] | Adjusted Consumption[c] | Income[d] |
|---|---|---|---|
| 25 | 0.0690 | 0.0729 | 0.1025 |
| 26 | 0.0652 | 0.0696 | 0.0962 |
| 27 | 0.0619 | 0.0666 | 0.0909 |
| 28 | 0.0589 | 0.0639 | 0.0863 |
| 29 | 0.0503 | 0.0573 | 0.0733 |
| 30 | 0.0306 | 0.0425 | 0.0449 |
| 31 | 0.0295 | 0.0411 | 0.0436 |
| 32 | 0.0284 | 0.0397 | 0.0424 |
| 33 | 0.0274 | 0.0384 | 0.0413 |
| 34 | 0.0265 | 0.0372 | 0.0402 |
| 35 | 0.0255 | 0.0360 | 0.0391 |
| 36 | 0.0246 | 0.0349 | 0.0381 |
| 37 | 0.0238 | 0.0339 | 0.0372 |
| 38 | 0.0230 | 0.0329 | 0.0363 |
| 39 | 0.0126 | 0.0226 | 0.0254 |
| 40 | 0.0077 | 0.0179 | 0.0206 |
| 41 | 0.0077 | 0.0180 | 0.0206 |
| 42 | 0.0077 | 0.0180 | 0.0207 |
| 43 | 0.0077 | 0.0181 | 0.0207 |
| 44 | 0.0076 | 0.0182 | 0.0207 |
| 45 | 0.0076 | 0.0182 | 0.0208 |
| 46 | 0.0076 | 0.0183 | 0.0208 |
| 47 | 0.0076 | 0.0183 | 0.0208 |
| 48 | 0.0076 | 0.0184 | 0.0209 |
| 49 | -0.0110 | 0.0015 | 0.0003 |
| 50 | -0.0159 | -0.0028 | -0.0049 |
| 51 | -0.0160 | -0.0027 | -0.0054 |
| 52 | -0.0161 | -0.0027 | -0.0058 |
| 53 | -0.0162 | -0.0026 | -0.0063 |
| 54 | -0.0163 | -0.0025 | -0.0068 |
| 55 | -0.0164 | -0.0024 | -0.0073 |
| 56 | -0.0165 | -0.0023 | -0.0078 |
| 57 | -0.0167 | -0.0023 | -0.0084 |
| 58 | -0.0168 | -0.0022 | -0.0089 |
| 59 | -0.0190 | -0.0031 | -0.0165 |

### Table 4. Consumer Expenditure Survey Data: Growth Rates for Real Consumption and Real Income[a]

| Age | Consumption[b] | Adjusted Consumption[c] | Income[d] |
|-----|-----|-----|-----|
| 60 | -0.0207 | -0.0035 | -0.0230 |
| 61 | -0.0208 | -0.0029 | -0.0243 |
| 62 | -0.0209 | -0.0023 | -0.0257 |
| 63 | -0.0210 | -0.0016 | -0.0272 |
| 64 | -0.0211 | -0.0009 | -0.0288 |
| 65 | -0.0212 | -0.0002 | -0.0306 |
| 66 | -0.0213 | 0.0005 | -0.0325 |
| 67 | -0.0214 | 0.0013 | -0.0347 |
| 68 | -0.0215 | 0.0021 | -0.0371 |
| 69 | -0.0137 | 0.0042 | -0.0176 |
| 70 | -0.0105 | 0.0047 | -0.0088 |
| 71 | -0.0109 | 0.0043 | -0.0096 |
| 72 | -0.0113 | 0.0038 | -0.0104 |
| 73 | -0.0118 | 0.0034 | -0.0112 |
| 74 | -0.0123 | 0.0029 | -0.0121 |
| 75 | -0.0128 | 0.0024 | -0.0130 |

a. Source: see Table 2. All nominal amounts deflated with NIPA
   personal consumption chain index.
b. Log real consumption age $i+1$ at $t+1$ less same age $i$ at $t$
   for $t = 1984, ..., 1996$.
c. Drops pension and social security contributions, drops mortgage
   payments, adds service flow from owner occupied dwellings. See text.
d. Same formula (and deflator) as consumption.

$$n_t \cdot u(\frac{f_t}{n_t}).$$

The new version of our life–cycle maximization model allows $n_t \neq 1$ and allows a household to choose its retirement age $R$. If the age of death is $T$, and if households discount the future at subjective discount rate $\rho$, replace (4) with

$$\max_{c_t, R} \int_0^T e^{-\rho \cdot t} \cdot n_t \cdot u(\frac{f(c_t, \ell_t)}{n_t}) \, dt \qquad (6)$$

$$\text{subject to:} \quad \ell_t = \begin{cases} \bar{\ell}, & \text{for } t \leq R \\ 1, & \text{for } t > R \end{cases},$$

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      FIG 1. CXS LOG DIFFERENCES ADJUSTED CONSUMPTION AND INCOME, 1984--2001
                        (+ INCOME, * CONSUMPTION, M OVERLAP)
        0.125 ::::::+:::::::::::::::::::+:::::::::::::::::::+:::::::::::::::::+
              .                                                             .
              .                                                             .
              .                                                             .
        0.100 +                                                             +
              .+ +                                                          .
              .   +                                                        .
              .                                                            .
        0.075 *     +                                                      +
              .* *                                                         .
   P          .   *                                                        .
   E          .    *                                                       .
   R    0.050 +                                                            +
   C          .      MM++                                                  .
   E          .       ** MMM++                                             .
   N          .         **                                                 .
   T    0.025 +            M                                               +
              .             MM MMMMMMM                                     .
              .                                                            .
              .                                                     *** ** .
        0.000 +------------------------M*******-***-***-*****------**
              .                          +++++++ ++ *            +         .
              .                                              + ++++
              .                            +            +        .
       -0.025 +                                ++++                 +
              .                                    +++              .
              :::::::+:::::::::::::::::::+:::::::::::::::::::+::::::::++:::::::+
                  30                  45                  60                  75
                                        AGE
```
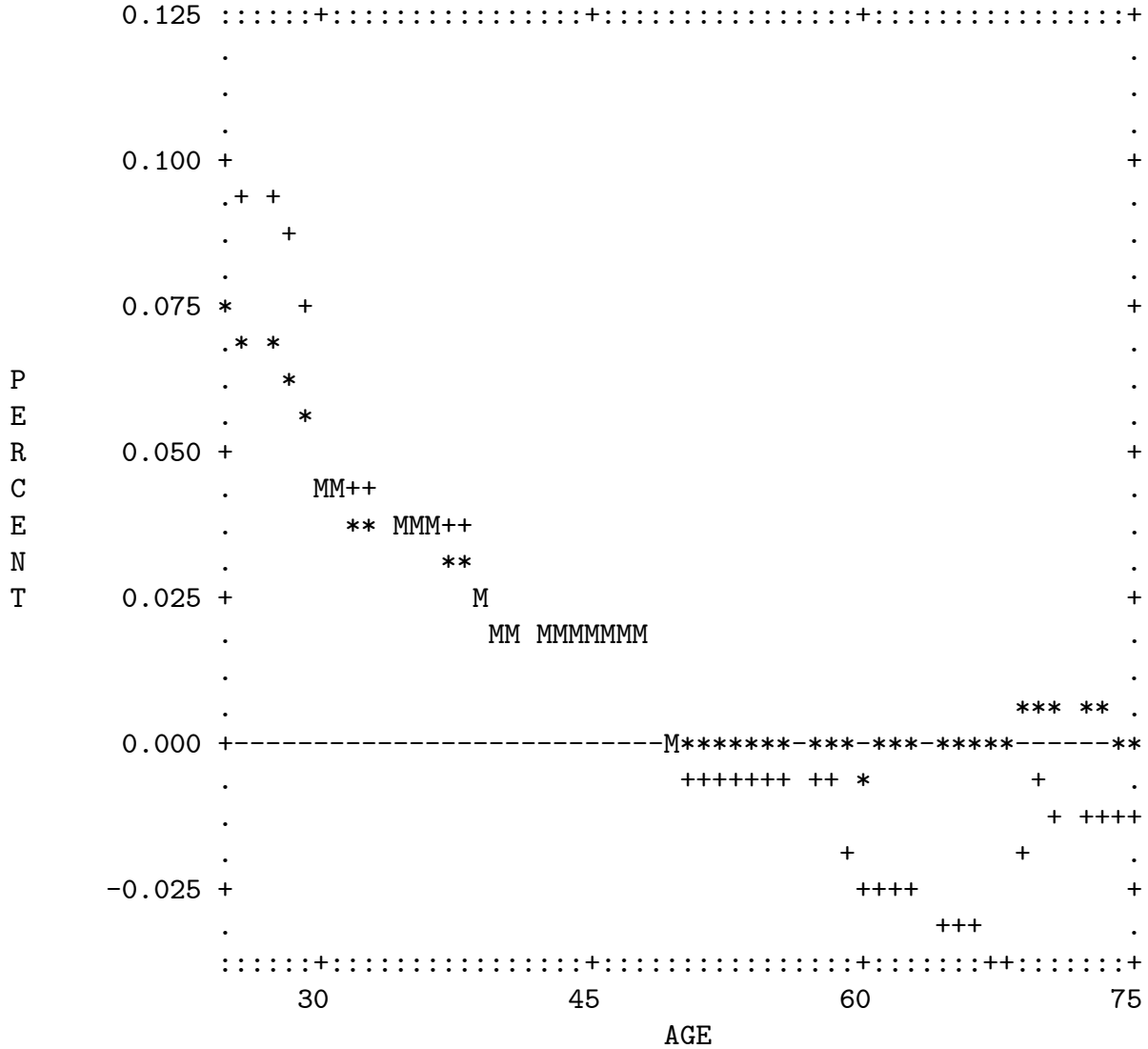
$$\dot{a}_t = r \cdot a_t + (1 - \ell_t) \cdot W_t - c_t \, ,$$

$$a_0 = 0 = a_T \, .$$

As before, let $f(.)$ be Cobb–Douglas, and let $u(.)$ be isoelastic. The Euler equation (e.g., (2)–(3)) yields

$$
\begin{aligned}
[c_t]^{\alpha \cdot \gamma - 1} \cdot [n_t]^{1-\gamma} &= e^{r-\rho} \cdot [c_{t+1}]^{\alpha \cdot \gamma - 1} \cdot [n_{t+1}]^{1-\gamma} \quad \text{for} \quad t \neq R, R-1 \, , \\
[c_t]^{\alpha \cdot \gamma - 1} \cdot [n_t]^{1-\gamma} \cdot [\bar{\ell}]^{\gamma \cdot (1-\alpha)} &= e^{r-\rho} \cdot [c_{t+1}]^{\alpha \cdot \gamma - 1} \cdot [n_{t+1}]^{1-\gamma} \quad \text{for} \quad t = R \, .
\end{aligned}
\tag{7}
$$

If

$$\chi_t(R) = \begin{cases} 1, & \text{if } t = R \\ 0, & \text{if } t \neq R \end{cases},$$

and if

$$\Delta x_t \equiv x_{t+1} - x_t \quad \text{and} \quad \Delta \ln(x_t) \equiv \ln(x_{t+1}) - \ln(x_t),$$

the Euler equation implies

$$\Delta \ln(c_t) = \frac{1}{1 - \alpha \cdot \gamma} \cdot (r - \rho) + \frac{1 - \gamma}{1 - \alpha \cdot \gamma} \cdot \Delta \ln(n_t) - \chi_t(R) \cdot \frac{\gamma \cdot (1 - \alpha)}{1 - \alpha \cdot \gamma} \cdot \ln(\bar{\ell}). \qquad (8)$$

In practice, each household in our data has at least one adult, and it may have two (or, with grandparents, for instance, even more). Normalize the first adult's equivalency weight to one. Let $n_t^A$ and $n_t^C$ be the number of additional adults and the number of children, respectively, in a household when the first adult's age is $t$. Let $\xi^A$ and $\xi^C$, respectively, be the adult equivalency of adults beyond the first and of each child. Although $\xi^A$ may be 1, it could also be substantially less than this if there are scale economies for consolidating single–adult households. We have

$$n_t = 1 + \xi^A \cdot n_t^A + \xi^C \cdot n_t^C.$$

Then the following approximates (8)

$$\Delta \ln(c_t) \approx \frac{1}{1 - \alpha \cdot \gamma} \cdot (r - \rho) + \frac{1 - \gamma}{1 - \alpha \cdot \gamma} \cdot \xi^C \cdot \Delta n_t^C + \frac{1 - \gamma}{1 - \alpha \cdot \gamma} \cdot \xi^A \cdot \Delta n_t^A$$
$$- \chi_t(R) \cdot \frac{\gamma \cdot (1 - \alpha)}{1 - \alpha \cdot \gamma} \cdot \ln(\bar{\ell}). \qquad (9)$$

We use a regression equation based on (9) to summarize our adjusted $CXS$ data. Equation (9) applies to an individual household. Since the $CXS$ lacks a panel structure, we estimate population averages for each time and age group. Our dependent variable is the difference of the logs of the averages. For example, we compute average "adjusted" consumption for age $s$ at time $t$, say, $\bar{c}_{st}$. Then we find average adjusted consumption for age $s + 1$ at $t + 1$ and set

$$\Delta \ln(\bar{c}_{st}) = \ln(\bar{c}_{s+1,t+1}) - \ln(\bar{c}_{st}).$$

This is our regression's dependent variable.

Our first independent variable is a constant. Turning to demographic information, the $CXS$ measures average numbers of people per household and numbers of children under 18. Our "adults" per household equal "people" minus children under 18. Our second independent variable is $\Delta \bar{n}_{st}^C$, the average number of children (under 18) in age $s + 1$ households at time $t + 1$ less the average for age $s$ households at $t$, etc. Our third

independent variable, $\Delta \bar{n}_{st}^A$, measures changes in adults per household. Our fourth variable, $\Delta \bar{R}_{st}$, is the average proportion of retired males of age $s+1$ at $t+1$ minus the average for age $s$ at time $t$.[7] We add a time dummy, say, $D_t$, for each year 1984–2000, constraining the sum of the coefficients on the dummies to equal 0. Appending an error to the right–hand side of (9) — capturing measurement error in consumption — our regression equation is

$$\Delta \ln(\bar{c}_{it}) = \beta_0 + \beta_1 \cdot \Delta \bar{n}_{it}^C + \beta_2 \cdot \Delta \bar{n}_{it}^A + \beta_3 \cdot \Delta \bar{R}_{it}+$$
$$\beta_4 \cdot D_{1984} + ... + \beta_{19} \cdot D_{1999} - (\beta_4 + ... + \beta_{19}) \cdot D_{2000} + \epsilon_{it} \,. \tag{10}$$

Table 5 relates the regression coefficients to the parameters of our theoretical model.

| Table 5. Regression Coefficients and the Model's Parameters[a] | |
|:---:|:---:|
| Regression Coefficient | Theoretical Coefficient |
| $\beta_0$ | $(r - \rho)/(1 - \alpha \cdot \gamma)$ |
| $\beta_1$ | $\xi^C \cdot (1 - \gamma)/(1 - \alpha \cdot \gamma)$ |
| $\beta_2$ | $\xi^A \cdot (1 - \gamma)/(1 - \alpha \cdot \gamma)$ |
| $\beta_3$ | $-[(\gamma \cdot (1 - \alpha))/(1 - \alpha \cdot \gamma)] \cdot \ln(\bar{\ell})$ |

a. See equations (8)–(9).

Tables 6a–b present regression results; the next section interprets the estimates in more detail.[8] The signs of the constants imply that a household's consumption per equivalent

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[7] See Fullerton [1999] and the data on male retirement ages at ftp://ftp.bls.gov/pub/special.requests/ep/labor.force/clra8000.txt.

[8] Since the data at this point has been constructed using interpolation, the standard errors are not trustworthy. The next revision will use data on individual ages rather than the "standard tables."

**Table 6a. OLS Log Difference Adjusted Real Consumption, Ages 30–75, Times 1984–2000, Regressed on Differenced Number of Children, Adults (beyond the first), and Retirement Rate**

| Regressor | Coefficient | Std. Error | T-Stat |
|---|---|---|---|
| CONSTANT | 0.0214 | 0.0011 | 19.4179 |
| CHANGE CHILDREN | 0.1341 | 0.0166 | 8.0725 |
| CHANGE ADULTS | 0.2146 | 0.0187 | 11.4776 |
| CHANGE MALE PARTICIPATION[a] | -0.2716 | 0.0392 | -6.9326 |
| 1984 | 0.0168 | 0.0034 | 4.9533 |
| 1985 | 0.0005 | 0.0033 | 0.1573 |
| 1986 | 0.0037 | 0.0031 | 1.1710 |
| 1987 | -0.0073 | 0.0031 | -2.3270 |
| 1988 | 0.0051 | 0.0031 | 1.6229 |
| 1989 | -0.0218 | 0.0033 | -6.7052 |
| 1990 | -0.0422 | 0.0031 | -13.4402 |
| 1991 | -0.0136 | 0.0032 | -4.2674 |
| 1992 | 0.0214 | 0.0031 | 6.8320 |
| 1993 | 0.0106 | 0.0033 | 3.2408 |
| 1994 | -0.0234 | 0.0032 | -7.2513 |
| 1995 | 0.0069 | 0.0031 | 2.2012 |
| 1996 | 0.0009 | 0.0031 | 0.2827 |
| 1997 | 0.0218 | 0.0031 | 6.9374 |
| 1998 | 0.0202 | 0.0031 | 6.4502 |
| 1999 | -0.0060 | 0.0031 | -1.9348 |
| AOV | | | |
| SSQ regression | 0.4094 | deg. freedom | 19 |
| SSQ error | 0.3591 | deg. freedom | 762 |
| SSQ total | 0.7684 | deg. freedom | 781 |
| R squared | 53.2739 | | |

a. Decline in male labor force participation post age 49.

### Table 6b. OLS Log Difference Adjusted Real Consumption, Ages 35–75, Times 1984–2000, Regressed on Differenced Number of Children, Adults (beyond the first), and Retirement Rate

| Regressor | Coefficient | Std. Error | T-Stat |
|---|---|---|---|
| CONSTANT | 0.0176 | 0.0013 | 13.7319 |
| CHANGE CHILDREN | 0.0864 | 0.0184 | 4.6872 |
| CHANGE ADULTS | 0.1873 | 0.0191 | 9.7947 |
| CHANGE MALE PARTICIPATION | -0.2359 | 0.0389 | -6.0708 |
| 1984 | 0.0176 | 0.0034 | 5.1273 |
| 1985 | -0.0021 | 0.0034 | -0.6338 |
| 1986 | 0.0038 | 0.0032 | 1.1945 |
| 1987 | -0.0113 | 0.0032 | -3.5640 |
| 1988 | 0.0078 | 0.0032 | 2.4081 |
| 1989 | -0.0233 | 0.0033 | -7.1004 |
| 1990 | -0.0412 | 0.0032 | -12.8269 |
| 1991 | -0.0161 | 0.0033 | -4.9556 |
| 1992 | 0.0289 | 0.0032 | 9.0201 |
| 1993 | 0.0077 | 0.0033 | 2.3103 |
| 1994 | -0.0279 | 0.0033 | -8.4630 |
| 1995 | 0.0092 | 0.0032 | 2.9000 |
| 1996 | -0.0008 | 0.0032 | -0.2584 |
| 1997 | 0.0253 | 0.0032 | 7.8768 |
| 1998 | 0.0217 | 0.0032 | 6.8095 |
| 1999 | -0.0100 | 0.0032 | -3.1633 |
| AOV | | | |
| SSQ regression | 0.3618 | deg. freedom | 19 |
| SSQ error | 0.2949 | deg. freedom | 677 |
| SSQ total | 0.6567 | deg. freedom | 696 |
| R squared | 55.0909 | | |

a. Decline in male labor force participation post age 49.

adult increases with age. The magnitude of the rise for a household's consumption over say 50 years is a factor of 2.92 according to Table 6a, and a factor of 2.41 according to Table 6b. Since earnings (corrected for inflation) roughly double for a typical household as it ages, these factors seem intuitively plausible. The negative estimates of $\beta_3$ imply that a household's consumption declines in the year it retires. The estimated magnitude of the drop for the year of retirement is 24% in Table 6a and 21% in Table 6b. The signs and magnitudes of the change in consumption at retirement seem consistent with Bernheim et al. [2001], Banks et al. [1998], and Hurd and Rohwedder [2003].

## 3. Calibration

This section modifies our life–cycle saving model to include income taxes, social security, and a nonnegativity constraint on net worth at each age. Bankruptcy laws presumably lead to the latter constraint.[9] Existing work has noted the possible effect of binding constraints. For example, if the constraint binds consistently in youth, consumption growth at early ages will mimic income growth — biasing upward Table 6's constant term, and presumably biasing downward our estimate of the adult equivalency of children. After presenting the new model, we use it to extract key economic parameters from Section 2's reduced–form estimates. We can then check whether the parameter values lead to binding liquidity constraints past age 30 (or 35 in the case of Table 6b) — in which case Section 2's estimation procedures need to be revised.

The new model is

$$\max_{c_t, R} \int_0^T e^{-\rho \cdot t} \cdot n_t \cdot u(\frac{f(c_t, \ell_t)}{n_t}) \, dt \tag{11}$$

$$\text{subject to:} \quad \ell_t = \begin{cases} \bar{\ell}, & \text{for } t \leq R \\ 1, & \text{for } t > R \end{cases},$$

$$\dot{a}_t = r \cdot (1 - \tau) \cdot a_t + (1 - \ell_t) \cdot e_t \cdot e^{g \cdot t} \cdot W_t \cdot (1 - \tau - \tau^{ss}) + \text{SSB}_t \cdot (1 - \frac{\tau}{2}) - c_t,$$

$$a_t \geq 0 \quad \text{all} \quad t,$$

$$a_0 = 0 = a_T.$$

The term $e_t$ registers increases in "effective labor supply" with experience; $g$ is the rate of labor–augmenting technological progress. As before, assume

$$f(c, \ell) = [c]^\alpha \cdot [\ell]^{1-\alpha}, \quad \alpha \in (0, 1), \quad \text{and} \quad u(f) = \frac{[f]^\gamma}{\gamma}, \quad \gamma < 1. \tag{12}$$

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[9] Note that the models of Stock and Wise [1990] and Rust and Phelan [1997], which assume no saving, can be thought of as particular cases in which the nonnegativity constraint binds at all ages.

We solve (11) using Mariger's [1986] algorithm — essentially determining (numerically) one by one the age–intervals on which the liquidity constraint $a_t \geq 0$ does, and does not, bind.

We fix a number of features of our model as follows. We assume each household has two adults. Time 0 corresponds to the adults each being age 22; time $T$ corresponds to their being 76 (e.g., $T = 76 - 22 = 54$). We set $\tau = .25$ and $\tau^{ss} = .13$. We assume a social security replacement rate of .44 if a household retires at 62 and the Social Security "normal retirement age" is 65; if the normal retirement age is 67, our replacement rate for early retirement at 62 is .39.[10] We compute average lifetime wages up to age 62, multiplied by this replacement rate. This is adjusted if benefits begin after age 62 in such a way that the present value of lifetime benefits remains the same (see the discussion in the next section). Half of social security benefits are subject to income tax. The aftertax (real) interest rate is .05.

The age profile of household earnings, the shape of which $e_t$ determines, follows Auerbach–Kotlikoff [1987]. We, however, assume that technological progress raises wages 1% per year every year. Note that because preferences are homothetic, the scaling of the earnings profile — and the scaling of the lifetime profile of equivalent adults — does not affect retirement age $R$ or $\Delta \ln(c_t)$ or the magnitude of the discontinuous change in consumption at retirement. (Nor does the scaling of equivalent adults or earnings affect the ratio of assets to earnings generated by the model.)

A household's two adults both work the same hours: 40 hours per week until retirement; 0 hours per week after retirement. With $16 \times 7$ waking hours per week, we set[11]

$$\bar{\ell} = \frac{16 \times 7 - 40}{16 \times 7} = .6429 \,.$$

In some examples below we omit children and normalize $n_t = 1$ all $t$. (This corresponds to most of the analysis, for instance, in Auerbach and Kotlikoff [1987].) In other cases, we assume that two children are born when a household's adults are 24 and that the children leave home to form their own families when their parents are 46. As stated above, the normalization of our equivalent adults profile is unimportant; nevertheless, the relative size of $n_t$ at different ages is significant. Table 5 shows that we can only identify the consumption weight $\xi^C$ for children after we have determined *gamma* and *alpha*.

We set the key parameters $\rho$, $\alpha$, and $\gamma$ from the regression results of Tables 6a–b and the empirical retirement age. Roughly speaking, we can think of the parameter estimate $\widehat{\beta_3}$, measuring the discontinuous drop in consumption upon retirement, as determining $\gamma$: as noted above, a positive *gamma* leads to a rise in consumption at retirement, and a negative *gamma* to a fall; thus, in terms of magnitudes, a *gamma* near 0 will tend to lead to a small discontinuity, and a gamma far from zero to a large one. *Alpha* determines the role

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[10] See Gruber and Wise [2001, Tab.5.1, p.181]. For a normal retirement age of 67, this paper multiplies .44 by Gruber and Wise's replacement rate for 65 divided by the rate for 67.

[11] Cf. Cooley and Prescott [1995]. On the basis of time–use studies, they determine that households devote 1/3 of waking hours to work.

of consumption relative to leisure in producing utility. If *alpha* is one, only consumption matters, so a household should never retire. If *alpha* is zero, only leisure matters, so a household should retire at age 22. Hence, we can expect information on the empirical retirement age to help us set $\alpha$. Finally, a higher *rho* implies greater impatience, hence, less of a rise in consumption with age. We can then think of $\widehat{\beta_0}$, which measures the growth rate of adult consumption with age, as determining *rho*.

Table 7 presents our calibrations. In the actual computations, we choose a prospective value of $\gamma$, determine a corresponding $\alpha$ from $\widehat{\beta_3}$ (see Table 5), determine a corresponding $\rho$ from $\widehat{\beta_0}$, determine $\xi^C$ from $\beta_1$ and $\xi^A$ from $\beta_2$. Then we solve maximization problem (11) for the desired retirement age. The sign of $\widehat{\beta_3}$ implies $\gamma < 0$. A grid search reveals the model's desired retirement age $R$ rises monotonically as $\gamma$ falls. The median retirement age in our data (for each year 1984–2000) is between 63 and 64; so, Table 7 presents the range of choices for $\gamma$ which imply a retirement age between 63 and 64.[12] Table 7 also presents ranges for the corresponding $\alpha$, $\rho$, $\xi^C$, and $\xi^A$.

For none of the rows of Table 7 do household liquidity constraints bind at any age. This is broadly consistent with Mariger's [1986] findings. It seems to release us from having to reconsider the specification of Section 2's reduced–form regression equation.

Our calibrated values of $\gamma$ fall within the range of the existing literature. For example, Auerbach and Kotlikoff [1987, p.50–51] suggest $\gamma = -3$; Zeldes [1989] suggests $\gamma = -1$; Laitner [2002] suggests $\gamma = .6 - .7$; Cooley and Prescott [1995] assume $\gamma = 0$; Rust and Phelan [1997] estimate $\gamma = -.072$; and, Stock and Wise [1990] have estimates ranging from .632–.813. The values of $\rho$ are also standard. Auerbach and Kotlikoff [1987,p.51] write, "There is scant evidence of the appropriate value of [this parameter]," and they choose .015. Cooley and Prescott [1995,p.22] choose .053.[13]

Auerbach and Kotlikoff use a CES functional form for $f(.)$ and their ("base case") choice for the elasticity of substitution between capital and labor is .8. They warn [p.51], "There is far less direct empirical evidence concerning the value of [the elasticity of substitution]." A Cobb–Douglas function is a special case of a CES function with production elasticity of substitution equaling 1. Cooley and Prescott use the Cobb Douglas form, and their calibrated value for *alpha* is .36. After minor algebraic manipulation, the utility function of Stock and Wise [1990] can be seen to be the same as well. The Cobb–Douglas, but no other CES function is compatible with constant labor supply in the face of secular increases in wages and permanent changes in proportional wage–tax rates (see below); recalling Section 1, our Cobb–Douglas specification is therefore consistent with U.S. data since 1940 provided factors such as rising social security benefits prove sufficient to explain a gradually falling male retirement age.

The estimated equivalency weight of two children relative to two adults in Table 6a is

$$\frac{2 \times .0830}{1 + .1329} = .1465\,;$$

for Table 6b it is

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[12] Footnote 7 details the source of the retirement data.
[13] See also Barsky et al. [1997].

$$\frac{2 \times .0563}{1 + .1221} = .1003 \,.$$

This compares to Tobin's [1967] assumed adult equivalency of .3 for minor children and .7 for teenagers, and to Mariger's estimated relative weight of .30.[14] Equation (7) shows the actual step up in consumption in going from two adults to two adults plus two children is

$$[\frac{1 + \xi^A + 2 \cdot \xi^C}{1 + \xi^A}]^{(1-\gamma)/(1-\alpha \cdot \gamma)} \,.$$

For Table 6a the step in levels is 1.2472; for 6b it is 1.1581.[15]

The estimated equivalency weight for a second adult, 13% as much as the first adult in Table 6a and 12% in Table 6b, is quite low. Such a weight implies very substantial economies of scale in household operation. There are several potentially interesting ramifications: as the elderly choose more and more to live separately from their children, and as rising divorce rates and, perhaps, later marriages, leave more young adults living alone, the economy will more and more sacrifice these scale economies; and, the U.S. Social Security System's provision of 50% incremental benefit payments for retired workers with spouses may be more generous than equality of living standards for singles and couples requires.

A great advantage of our approach is that we can jointly employ data on retirement ages and recent evidence on the drop in consumption after retirement to pin down *alpha* and *gamma* in a more direct way than previous studies have be able to do. Nevertheless, at this point, consensus estimates of the parameters from the existing literature are surprisingly well borne out, with the possible exception of child and adult equivalency scalings.

## 4. Social Security Policy Implications

This section uses our calibrated parameters to ask how much of a reduction in labor supply the present U.S. Social Security System causes. In our context, the reduction takes place entirely through decisions of when to retire. The calibrations could, of course, yield predictions of labor–supply responses to potential future changes in the Social Security System (see, for example, President's Commission [2001]).

There are several ways to think about social security's influence on household labor supply. One which is convenient here conceptually separates the impact of social security taxes and benefits, first comparing an economy with no social security to one with taxes but no benefits, and second comparing an economy with social security taxes but no benefits to one with both taxes and benefits.

For the first step, suppose society imposes a new proportional tax on earnings — but there are no corresponding transfer payments (i.e., benefits). Let the tax rate be $\tau^{ss}$. Consider a household. With the new tax, the household's time endowment is worth only $1 - \tau^{ss}$ times as much as before. That should induce the household to consume less

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[14] See also Browning *et al.* [1985].

[15] Arguably these compare with Tobin's equivalencies since most of Tobin's analysis assumes $\gamma = 0$.

| | Table 7. Parameter Calibrations (see text) | | | |
|:---:|:---:|:---:|:---:|:---:|
| $\gamma$ | $\alpha$ | $\rho$ | $\xi^C$ | $\xi^A$ |
| Table 6a coefficients; no children | | | | |
| -1.30 to -1.31 | .3264 to .3286 | .0195 to .0194 | .0830 | .1329 |
| Table 6a coefficients; two children | | | | |
| -1.30 to -1.31 | .3264 to .3286 | .0195 to .0194 | .0830 | .1329 |
| Table 6b coefficients; no children | | | | |
| -1.03 | .3139 | .0267 | .0563 | .1221 |
| Table 6b coefficients; two children | | | | |
| -1.03 | .3139 | .0267 | .0563 | .1221 |

leisure and less goods — hence to supply more labor. Microeconomists refer to this as the "income effect" of the tax. On the other hand, since a tax falls upon work hours but not leisure, it should induce the household to supply less labor relative to leisure. This is the "substitution effect." A special property of a Cobb–Douglas home production function $f(.)$ is that a proportional tax's income and substitution effects on labor supply exactly counterbalance one another, leaving desired labor supply unchanged.

Second, add social security benefits. As society institutes benefits, a typical household is made better off, leading to an "income–effect" increase in household demand for leisure and goods, hence to a reduction in market labor supply. The "substitution effect" from benefits is more complicated. To the extent that benefits rise with retirement age, they implicitly act as a subsidy to wage earnings, inducing households to substitute work for leisure. The question is how large this inducement is. Consider an extra year of work under the present U.S. system — i.e., consider retirement at, say, age $R + 1$ instead of $R$. The U.S. Social Security System's "normal retirement age" is 65 and 8 months. Early retirement, for age 62 or later, leads to a benefit reduction for any given AIME (see below). Since this particular reduction is roughly neutral in terms of the expected present value of a household's lifetime benefits, it has no substitution–effect implications (e.g., Hurd and Smith [2002]). At least two factors remain. (i) Upon retirement, a worker computes his AIME ("average indexed monthly earnings") from the average of his 35 highest earning years. (For future reference, note that the calculation procedure removes the effects of inflation and secular earnings growth due to technological progress.) (ii) The worker then computes his PIA ("primary insurance amount") from a formula which provides more generous benefits at lower income: in the calculations below, which are based on 1995 data, a worker's PIA equals 90% of his first $426 of AIME, 32% of his next $2141, and 15% of higher amounts. Steps (i)–(ii) both attenuate the "substitution effect" of social security benefits: in step (i), postponing retirement may provide a higher earning year for

one's 35–year average, but only the increment of the new year's earnings over the earnings it replaces counts; step (ii) reduces the marginal impact of an extra dollar of earnings by 10, 68, or 85%. In our numerical examples, a worker's effective labor supply, cleansed of the effect of technological progress, rises with age into his 40s but then falls. Because of the latter fall, the step (i) correction is severe. For our representative worker, step (ii) provides a marginal benefit rate of 32%. In the end, an extra year of work at age 62 increases social security benefits only .04%.

For comparison, consider a private–sector defined benefit pension with proportionate contributions in each working year. A worker of age 62 contemplating postponing retirement for 1 more year can add a full year's contribution to his pension account. The percentage increase in the account in this case depends on all previous contributions and their appreciation, and our computations assume a 5% annual interest rate. There is no private–sector analogue to the step (ii) adjustment. In our sample computation, an extra year of work at age 62 raises the defined benefit account 3.01% — almost two orders of magnitude more than the social security case.[16]

In view of the tenuous linkage of social security benefits and retirement age, the remainder of our analysis simply ignores the substitution effect of social security benefits; hence, social security reduces desired labor supply because of the "income effect" of social security benefits.

Table 8a computes, for each of Table 7's parameter combinations, the increase in the desired retirement age for an economy without a social security system versus one with a normal retirement age of 65; Table 8b performs the same calculations if the system's normal retirement age is 67. Note that the U.S. Social Security System's normal retirement age was 65 in 1995; it will be 67 in 2022. Social Security seems to shift the desired age of retirement 3–4 years earlier when the normal retirement age is 65, and the same when it is 67.

There are several reasons why the simulation results should be viewed as upper limits for the effect of social security on retirement. First, as stated, the analysis omits the impact of health status. Declining health status clearly can affect retirement plans, possibly overwhelming the influence of economic incentives (e.g., Anderson et al. [1999]). Second, business downturns may lead companies to offer buy outs for early retirement (e.g., Brown [2002]). It is also the case that income heterogeneity complicates interpretation of our results: social security benefits tend to be a lower share of lifetime resources for workers with higher earnings; thus, the impact of social security on the retirement age of such workers will tend to be less.

We should note that the results in Tables 8a–b are positive rather than normative. While a complete analysis of possible social security reforms would require, for instance, a general equilibrium framework, this paper investigates a way of calibrating one key component of such a framework.

## 5. Conclusion

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[16] This analysis overlooks the facts (a) that social security benefits are not fully taxed under the U.S. income tax and (b) that balances in a defined–benefit–pension account will accrue interest during retirement at the market rate.

| Table 8a. Desired Retirement Age without Social Security: "Normal Retirement Age" 65[a] | | | |
|---|---|---|---|
| Formulation | Desired Age with Social Security | | Change Desired Age |
| | Present | Absent | |
| Tab. 5a coefs; no children; $\gamma = -1.30$ to -1.31 | 63 | 66 | 3 |
| Tab. 5a coefs; two children; $\gamma = -.130$ to -1.31 | 63 | 66 | 3 |
| Tab. 5b coefs; no children; $\gamma = -1.03$ | 63 | 67 | 4 |
| Tab. 5b coefs; two children; $\gamma = -1.03$ | 63 | 67 | 4 |

a. Social security replacement rate .44 for early retirement age 62. See text.

| Table 8b. Desired Retirement Age: "Normal Retirement Age" 67[a] | | | |
|---|---|---|---|
| Formulation | Desired Age with Social Security | | Change Desired Age |
| | Present | Absent | |
| Tab. 5a coefs; no children; $\gamma = -1.30$ to -1.31 | 63 | 66 | 3 |
| Tab. 5a coefs; two children; $\gamma = -.130$ to -1.31 | 63 | 66 | 3 |
| Tab. 5b coefs; no children; $\gamma = -1.03$ | 63 | 67 | 4 |
| Tab. 5b coefs; two children; $\gamma = -1.03$ | 63 | 67 | 4 |

a. Social security replacement rate .39 for early retirement age 62. See text.

A number of recent papers measure a decline in average household consumption following retirement. One possible explanation is that people tend to plan poorly and must subsequently retrench. Another is that households compensate themselves for working hard before they retire with relatively high consumption, and they cease this extra spending after they retire.

Under the second story, one can use the sign and magnitude of the change in consumption at retirement to calibrate parameters of the life–cycle saving model — in particular, the intertemporal elasticity of substitution in consumption, an important, but otherwise rather subtle, determinant of indifference–curve shapes. Using data from the *Consumer Expenditure Survey*, this paper illustrates how this can be done.

When Section 4 employs the calibrated parameters to study the effect of the existing U.S. social security system on retirement behavior, the simulations point to a reduction in the average retirement age of three to four years. Overlooking health status presumably leads to overstatements. Nevertheless, results point to substantial consequences for labor supply from potential future changes in social security.

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