The Joint Impact of Social Security and Medicaid on Incentives and Welfare

Karen A. Kopecky
Federal Reserve Bank of Atlanta
karen.kopecky@atl.frb.org

Tatyana Koreshkova
Concordia University and CIREQ
tkoreshk@alcor.concordia.ca

February 14, 2012

Abstract

We evaluate the joint effects of social security and Medicaid on labor supply, savings, economic inequality, and welfare in an environment with idiosyncratic risk in labor earnings, health expenses, and survival. In our model, a progressive social security benefit provides insurance against lifetime earnings, health expense, survival and spousal death risks. We show that the annuity role of social security benefit entails important welfare gains in the presence of health expense risk and Medicaid.

1 Introduction

Population aging has put a great strain on the Social Security and other old-age social insurance programs such as Medicaid. The concerns generated a large literature evaluating effects of the current and proposed social security systems on capital accumulation, labor supply, inequality, and welfare.[1] To date, the research has focused on the insurance role of social security against household earnings risk and mortality risk. That is, the studies examined the intra-generational redistribution due to the progressivity of the social security benefit, intergenerational redistribution through pay-as-you-go system and the annuity role of the social security benefit. In this paper, we evaluate effects of social security in an environment with uncertainty about health expenses in the presence of a safety net provided by Medicaid. Moreover, our model addresses gender differences in earnings, health expenses, survival, and allows us to examine the Social Security spousal and survivor benefits.

Introducing health expenses into a qualitative analysis of social security is important for the following reasons. First, Kopecky and Koreshkova (2009) find that the presence of health expenses substantially reduces the response of capital accumulation to the elimination of social security. Conesa and Krueger (1999), Huggett and Ventura (1999), Nishiyama and Smetters (2007) show that effects of social security largely depend on the amount of uncertainty faced by individuals. In our model, uncertainty about old-age health expenses and survival is particularly important. Second, social security provides insurance against impoverishment due to high health expenses. The highest health expenses tend to occur at the end of life, often leaving the surviving spouse in poverty. Third, there is an important interaction between Socail Security and Medicaid – a means-tested social insurance program that guarantees a minimum level of consumption. The means-tested transfers tax away all household wealth except pension wealth accumulated in Social Security claims. Fourth, Social Security survivor benefit partially insures a loss of income due to spousal death.

A crucial feature of our analysis is an explicit modeling of gender within a household. Guner, Kaygusuz, and Ventura (2009), Kaygusuz (2008), and Nishiyama (2010), find that response of female labor supply plays an important role in public policy effects. In our analysis, modeling gender is motivated by the following observations. First, relative to males, females on average have lower wages, lower labor market participation rate, higher health expenses, higher life expectancy and thus are more likely to live in poverty at the old age. Second, nearly 60 percent of Social Security female beneficiaries receive spousal or survivor benefit. In the view of these females, Social Security represents a pure tax with no

[1] See, for example, Conesa and Krueger (1999), Huggett and Ventura (1999), Fuster, Imrohoroglu, Imrohoroglu (2006, 2007), ADD MORE CITATIONS.

marginal benefit associated with an extra hour of work, and hence their response to changes in the Social Security system is dramatically different from that of males.

To address these issues, we build a general equilibrium, life-cycle model with overlapping generations of households consisting of a husband and a wife. Individuals are permanently heterogeneous in education, and their productivity evolves stochastically over the life-cycle. Individuals supply labor to the market till age 65, upon which they retire. Retired individuals face uncertainty with respect to their survival and health expenses, with both shocks specific to education type and gender. Thus retired households are heterogeneous not only in the accumulated wealth (private savings and pensions), but also in their health expenses and household composition, i.e. they include widows and widowers. We assume that individuals cannot borrow and that there are no markets to insure against labor market, health, or survival risk. Partial insurance, however, is available through three programs run by the government: a progressive pay-as-you-go social security program that includes spoual and survivor benefits, a welfare program that guarantees a minimum level of consumption to workers, and a Medicaid-like social safety net that guarantees a minimum consumption level to retirees with impoverishing medical and nursing home expenses.

We calibrate the benchmark economy to a set of moments from the U.S. data. Gender differences in earnings match lower labor market participation To pin down the stochastic processes for health costs and the effect of those shocks on mortality, we use data from the Health and Retirement Study. In particular, our calibrated economy captures high OOP health expenses at the end of life by associating large health expense shocks with a higher probability of spousal death. This is important because in the data widows often are left impoverished by high medical bills of their husbands. Thus, unlike in other studies, spousal death shock is associated not only with a loss of a major part of household income, but also with a wealth loss due to high end-of-life health expenses.

Not surprisingly, we find that survivor benefit plays an important role in insuring against the spousal death shock. Since females live longer and have larger life-time health expenses, this insurance is particularly important for females. When only survivor benefits are removed, the fraction of individuals qualifying for the Medicaid social safety net increases, with females accounting for a disproportionately larger part of the change. As wealthier households increase their precautionary savings to partially compensate for the absence of survivor benefits, capital stock increases, and wealth and consumption inequality rise. [Welfare results to be added later.]

Spousal benefits provide a partial insurance of household consumption against a low labor productivity of one spouse relative to the other. Similar to the progressivity feature of the benefit, the insurance is achieved through tax redistribution across households. Spousal benefit is particularly distortionary because it discourages labor market participation and hours of low-earning spouses in households with high earnings differential – either due to education or life-cycle earnings shocks. Removal of the spousal benefit increases work hours of females as well as males, and most of the hours increase comes from the change in the female labor force participation. Males' hours increase is caused by lower taxes and higher need for intra-household insurance of earnings shocks through savings.

Progressivity of the social security benefit formula introduces intragenerational redistribution that partially insures against labor earnings risk. However, Kopecky and Koreshkova (2009) show that in presence of health expense risk at retirement, workers' savings for old-age health expenses provide a buffer against earnings risk (self-insurance). Permanent heterogeneity in labor productivity (education) may be important because workers cannot insure permanent shocks experienced at the beginning of their lives while progressive social security does provide a partial insurance.

2 Old-age Benefits

In this section we discuss various government programs providing benefits to the elderly: social security, Medicare and Medicaid. While Medicare is a federal entitlement program for the elderly and disabled, Medicaid is a means-tested, federal/state program for the poor. Medicaid subsidizes nursing home expenses more than Medicare. Cite key observations from KK(2009)

Medicare by age pays about 50%. Can we model it as a proportional subsidy?

Social security rules. Under the current law, a married (or divorced after a minimum of 10 years of marriage) individual benefit can be topped up with an auxiliary benefit up to a half of his/her spouse's PIA (spousal benefit). A spouse (or a former spouse after 10 years of marriage) of a deceased individual is entitled to an auxiliary benefit up to 100 percent of his/her spouse's PIA (survivor benefit). More than 98 percent of persons with dual entitlement are women. In 2007, 29+27.8=56.8% of elderly women (62+) received at least part of their retirement benefit from a spousal or survivor benefit, tied to their husband's earnings history (SSA 2008 Table 5.A14, p. 269). Thus, for a majority of women, their earnings history does not affect their social security benefits. Spousal and survivor benefits provide partial insurance against low spousal earnings.

3 The Model

Builds on Kopecky and Koreshkova (2009). Added labor-leisure choice, gender, education, spousal and survivor benefits, 50% Medicare subsidy.

3.1 Demographics

Time is discrete. The economy is populated by overlapping generations of households, consisting of either married couples or widows/widowers. Each individual lives to a maximum of J periods, works during the first R periods of his/her life, and retires at age $R+1$. We assume that all working-age households are married and there is no divorce. While working, each household member faces uncertainty about earnings, and starting from the retirement age – uncertainty about survival, health and medical expenses. Thus the population of the retired individuals includes not only married couples but also widows and widowers. Demographic status of a household is described by a variable d: $d = 1$ for a widow, $d = 2$ for a widower, and $d = 0$ otherwise.

Since in the data male labor supply is relatively inelastic, compared to females, we assume that males labor supply is inelastic while the female labor supply is chosen by the household. Retired individuals do not supply labor to the market but receive social security benefits that include not only those based on the individual earnings history but also spousal and survivor benefits. Households are permanently heterogeneous in education E, which affects the stochastic processes for their earnings, initial distribution of health status and health expenses, and hence affects their survival probabilities. Moreover, heterogeneity in education allows us to more realistically match individuals into married couples. The fraction of agents of gender i with education type k is given by x_k^i, and the distribution of households across education types $\mathbf{k} \equiv \{k^m, k^f\}$ is $\Gamma_{\mathbf{k}}$.

Agents face survival probabilities (from age j to age $j+1$ that are functions of age, gender, marital status, and health status: $s_j^i(h,d)$. Since a working-age agent does not face health or mortality risk, his/her survival probability is $s(j,i,0) = 1$, $j = 1,2,...,R$ for all i. Population grows at a constant rate n. Then the size of cohort j relative to that of cohort 1 for each individual type (i,h,d) is given by $\lambda_j(i,h,d)$ with the following laws of motion: THIS NEEDS TO BE REWRITTEN (PLEASE IGNORE)

$$\lambda_j^0(h) = \frac{1}{1+n}\lambda_{j-1}^0(h)s_j^m(h)s_j^f(h),$$

$$\lambda_j^1(E) = \frac{1}{1+n}\Big[\lambda_{j-1}^0(E)(1-s_j^m(E)) + \lambda_{j-1}^1(E)\Big]s_j^f(E),$$

$$\lambda_j^2(E) = \frac{1}{1+n}\left[\lambda_{j-1}^0(E)(1 - s_j^f(E)) + \lambda_{j-1}^2(E)\right] s_j^m(E),$$

for $j = 2, 3, ..., J$ and given $\lambda_1^0(E) = 1$ and $\lambda_1^{d\in\{1,2\}}(E) = 0$ for all E. The size of cohort j relative to that of cohort 1 is then $\eta_j = \sum_E \sum_d \lambda_j^d(E) x_E$.

3.2 Earnings and Health Expense Uncertainty

Individual earnings evolve over the life-cycle according to a function $\Omega^i(j, z^i, k^i)$, $i \in \{m, f\}$, that maps individual age j, current earnings shock z^i, and education type k^i into efficiency units of labor, supplied to the labor market at wage rate w. The earnings shock z^i follows an age-invariant Markov process with transition probabilities given by $\Lambda^i_{zz'}$. The efficiency units of the new-born households is distributed according to a p.d.f. Γ^i_z.

Individual health status takes two values, good ($h = 1$) and bad ($h = 0$), follows a Markov process with transition probabilities depending on the individual age, gender and marital status: $\Gamma^i_{hh'}$. The initial distribution of health status, $\Gamma^i_h(k^i)$, depends on the individual education.

Finally, household medical expenditures evolve stochastically according to a function $M(j, \mathbf{h}, \epsilon, d)$ that maps household age j, household health status $\mathbf{h} \equiv \{h^m, h^f\}$, health expenditure shock ϵ, and demographic status d into out-of-pockets costs of health care. The medical expenditure shock ϵ follows an age-invariant Markov process with transition probabilities $\Lambda^d_{\epsilon\epsilon'}$. The initial distribution of medical expenditure shocks, $\Gamma_\epsilon(\mathbf{k})$, depends on the household education level $\mathbf{k} \equiv \{k^m, k^f\}$. We assume that the health shock does not directly affect agents' utility.

3.3 Social Security, Medicaid, and Taxes

The government runs a social insurance program that guarantees a minimum consumption level and a pay-as-you-go social security program.

Similarly to the current U.S. social security system, in the model retired individuals of age 65 and older receive two types of benefits: a social security income and a medical expense subsidy covered by Medicare. The social security income includes spousal and survival benefits and is related to the individual/spousal lifetime earnings according to a function $\hat{S}(\bar{\mathbf{e}}, d)$, where $\bar{\mathbf{e}}$ is a vector of spousal earnings. Apart from the changes in the benefit entitlement due to spousal death, the social security income stays constant over the individual life time, but grows at the rate of technological progress for newly retired individuals. Both pension and medical expense benefits are financed by taxing workers' earnings at rate τ_e (up to a certain amount?).

Let an individual benefit be described by a function $S(\bar{e})$, such that the replacement rate decreases with the individual lifetime earnings $\bar{e}$. Household total benefit is then defined as follows:

$$\hat{S}(\bar{\mathbf{e}}, d) = \begin{cases} S(\max_{i\in\{m,f\}}\{\bar{e}^i\}) + \max\{0.5S(\max_{i\in\{m,f\}}\{\bar{e}^i\}), S(\min_{i\in\{m,f\}}\{\bar{e}^i\})\}, & \text{if } d = 0, \\ \max\{S(\bar{e}^m), S(\bar{e}^f)\}, & \text{if } d \in \{1, 2\}, \end{cases}$$

where $\max\{0.5S(\max_{i\in\{m,f\}}\{\bar{e}^i\}) - S(\min_{i\in\{m,f\}}\{\bar{e}^i\}), 0\}$ represents an auxiliary spousal benefit and $|S(\bar{e}^m) - S(\bar{e}^f)|$ represents an auxiliary survivor benefit.

In addition, the government provides Medicaid transfers to individuals destituted by health expenses. The transfers are determined through means-testing: if a household after-tax income from savings and social security net of health expenses does not allow the household achieve a certain level of consumption $\underline{c}^d$, the government provides the transfers just enough to achieve that minimum level. Medicaid transfers and exogenously determined government consumption G are financed by individual income taxes defined by a progressive formula $\tau_y(y)$, where y includes taxable individual earnings plus individual asset income. Note that we use an individual income to determine tax liabilities not only because in our economy progressive taxation creates incentives to file taxes individually, but also to be consistent with the study by Gouveia and Strauss (1994), estimating a relationship between individual taxable income and tax liabilities. For simplicity, so as to avoid keeping track of individual assets and transfers over the life-cycle, we require that a married couple splits assets equally for tax purposes.

3.4 Technologies

Firms produce goods by combining capital K_g and labor L_g according to a constant-returns-to-scale production technology: $F(K_g, L_g) = K_g^\alpha (AL_g)^{1-\alpha}$. Similarly, medical and nursing home services are produced with capital and labor $H(K_h, L_h) = K_h^\alpha (AL_h)^{1-\alpha}$. Technology level is common to all sectors and grows at rate g. Capital depreciates at rate δ and can be accumulated through investments of goods: $I = K' - (1 - \delta)K$. Firms maximize profits by renting capital and labor from households. Perfectly competitive markets ensure that factors of production are paid their marginal products. Goods can be consumed by individuals, used in health care, and invested in physical capital.

3.5 Market Structure

Markets are competitive. There are no insurance markets to hedge either earnings, medical expenditure, or mortality risks. Self-insurance is achieved with precautionary savings (labor supply is exogenous). Individuals cannot borrow. Unintended bequests are taxed away by the government and are used to finance government expenditure and social insurance transfers.[2]

3.6 Working-age Household Problem

The state of a working household consists of assets a, vectors of the average individual lifetime earnings to date, $\bar{\mathbf{e}} \equiv \{\bar{e}^m, \bar{e}^f\}$, current productivity shocks $\mathbf{z} \equiv \{z^m, z^f\}$ and education types $\mathbf{k} \equiv \{k^m, k^f\}$ for both spouses. The household total taxable income y consists of the interest income ra and labor earnings $e^m + e^f$ net of the payroll taxes $\tau_e(e^m) + \tau_e(e^f)$. We assume that spouses file taxes individually, claiming equal shares of the household asset income. Household decides the female labor supply l and allocates its resources – assets a, after-tax income $(y - T_y(\mathbf{e}, a))$, and transfers from the government $T(y, a)$ – between consumption c and savings a' by solving

$$V(j, a, \bar{\mathbf{e}}, \mathbf{z}; \mathbf{k}) = \max_{c,l,a' \geq 0} \left\{ U^j(c, l) - \varphi \mathbf{I}_{l>0} + \beta V^e(j) \right\} \tag{1}$$

subject to

$$\begin{aligned}
c + a' &= a + y(\mathbf{e}, a) - T_y(\mathbf{e}, a) + Tr(\mathbf{e}, a), & (2)\\
y(\mathbf{e}, a) &= e^m + e^f - \tau_e(e^m) - \tau_e(e^f) + ra, & (3)\\
e^i &= w\Omega^i(j, z^i, k)(1 - l\mathbf{I}_{i=f}), \quad i \in \{m, f\} & (4)\\
\bar{e}^{i\prime} &= \Delta^i(e^i, \bar{e}^i), \quad i \in \{m, f\} & (5)\\
T_y(\mathbf{e}, a) &= \tau_y(e^m - \tau_e(e^m) + 0.5ra) + \tau_y(e^f - \tau_e(e^f) + 0.5ra), & (6)\\
Tr(\mathbf{e}, a) &= \max\left\{0, \underline{c}^0 - \left[a + y(\mathbf{e}, a) - T_y(\mathbf{e}, a)\right]\right\} & (7)\\
V^e(j) &= \begin{cases} \mathbf{E}\left[V(j+1, a', \bar{\mathbf{e}}', \mathbf{z}'; \mathbf{k})\right] & \text{if } j < R, \\ \mathbf{E}\left[V(j+1, a', \bar{\mathbf{e}}, \mathbf{h}, \epsilon, 0)\right] & \text{if } j = R \end{cases} & (8)\\
h^i &\sim \Gamma_h^i(k^i), \ \ i \in \{m, f\} \text{ and } \epsilon \sim \Gamma_\epsilon(\mathbf{k}). & (9)
\end{aligned}$$

where $\underline{c}^0$ is a minimum household consumption level, $\Delta^i(e, \bar{e})$ updates accumulated social security claims, and φ is a fixed cost of work for females.[3] The period utility function $U(c, l, j)$

[2]We do this to avoid the unrealistic impact that redistributing bequests as lump-sum transfers would have on agents eligibility for means-tested transfers. In addition, we wish to avoid the unrealistic impact that an arbitrary redistribution of bequests would have on individuals' saving behavior in response to policy changes.

[3]A fixed cost of working for females is introduced to match a relatively low female labor force participation. Note that we cannot simply add a zero productivity state ($z = 0$) for females because that would make their labor force participation exogenous.

discounts total household consumption using household age-specific weights, reflecting the evolution of the size of the household over the life cycle due to children. At age $R+1$, the state of the household includes a vector of individual health $\mathbf{h} \equiv \{h^m, h^f\}$, health expense shock ϵ', and household demographic status d.

3.7 Retired Household Problem

Age-j household with current health $\mathbf{h}$ and demographic status d faces the following survival probabilities $S_j(d'|\mathbf{h}, d)$:

	$d'=0$	$d'=1$	$d'=2$
$d=0$	$s^m_{j+1}(h^m,0)s^f_{j+1}(h^f,0)$	$\left[1-s^m_{j+1}(h^m,0)\right]s^f_{j+1}(h^f,0)$	$s^m_{j+1}(h^m,0)\left[1-s^f_{j+1}(h^f,0)\right]$
$d=1$	0	$s^f_{j+1}(h^f,1)$	0
$d=2$	0	0	$s^m_{j+1}(h^m,2)$

Resources of a retired household of age $j>R$ come from the return on its savings $(1+r)a$, its social security benefit $S(\bar{\mathbf{e}}, d)$ (includes *spousal* and *survivor* benefits when applicable). After paying health care costs $m = M(j, \mathbf{h}, \epsilon, d)$ and income taxes $T_y(a, m, d)$, and receiving government transfers $T(a, m, d)$, the household allocates its remaining resources between consumption and savings. An age-j household with assets a, average lifetime earnings $\bar{\mathbf{e}}$, health h, health expense shock ϵ and demographic status d solves

$$V(j, a, \bar{\mathbf{e}}, \mathbf{h}, \epsilon, d) = \max_{c, a' \geq 0} \left\{ U^d(c) + \beta \sum_{d'=0}^{2} S_j(d'|\mathbf{h}, d) \mathbf{E}\big[V(R+1, a', \bar{\mathbf{e}}, \mathbf{h}', \epsilon, d')\big] \right\} \tag{10}$$

subject to

$$c + m + a' = a + y - T_y(a, m, d) + Tr\,(a, m, d)\,, \tag{11}$$

$$m = M(j, \mathbf{h}, \epsilon, d), \tag{12}$$

$$y = S(\bar{\mathbf{e}}, d) + ra, \tag{13}$$

$$T_y(a, m, d) = n^d \tau_y \Big(\max\Big\{0, \frac{1}{n^d}(ra - \max[0, m - \kappa ra)]\Big\}\Big), \tag{14}$$

$$Tr\,(a, m, d) = \max\Big\{0, \underline{c}^d + m - [a + y - \tau_y(ra)]\Big\} \tag{15}$$

where $n^0 = 2$ and $n^1 = n^2 = 1$, $\underline{c}^d$ is the minimum consumption level guaranteed to a household of type d. Agents receive a medical expense income tax deduction. In other words, individuals pay taxes on their interest income minus the fraction of their medical expenses that exceed κ percentage of their taxable income. Here again we assume that income taxes are filed individually, with spouses splitting the asset income net of deductions equally.

3.8 General Equilibrium

We consider a steady-state competitive equilibrium in this economy. For the purposes of defining an equilibrium in a compact way, we suppress the individual state into a vector (j, x, d, E), where

$$x = \begin{cases} x_W \equiv (a, mathbf\bar{e}, z, E), & \text{if } 1 \leq j \leq R, \\ x_R \equiv (a, \bar{\mathbf{e}}, h, d, E), & \text{if } R < j \leq J, \end{cases}$$

Accordingly, we redefine value functions, decision rules, taxable income and transfers to be functions of the individual state (j, x): $V(j, x)$, $c(j, x)$, $a'(j, x)$, $y(j, x_W)$ and $Tr(j, x)$. Define the individual state spaces: $X_W \subset [0, \infty) \times [0, \infty) \times [0, \infty) \times (-\infty, \infty) \times (-\infty, \infty) \times \{E_1, E_2, ..., E_n\}$, $X_R \subset [0, \infty) \times [0, \infty) \times [0, \infty) \times (-\infty, \infty) \times \{0, 1, 2\} \times \{E_1, E_2, ..., E_n\}$, and denote by $\Xi(X)$ the Borel σ-algebra on $X \in \{X_W, X_R\}$. Let $\Psi_j(X)$ be a probability measure of individuals with state $x \in X$ in cohort j. Note that these agents constitute an $\eta_j \Psi_j^d(X)$ fraction of the total population.

DEFINITION. Given a fiscal policy $\{\hat{S}(mathbf\bar{e}, d), G, \underline{c}^d, \kappa\}$, a steady-state equilibrium is
$\{c(j, x), a'(j, x), l(j, x), V(j, x)\}$, $\{\Psi_j\}_{j=1}^J$, $\{w, r, K, L\}$ and $\{\tau_s(e), \tau_y(y)\}$ such that

1. Given prices, the decision rules $c(j, x)$, $a'(j, x)$ and $l(j, x)$ solve the dynamic programming problems of the households.
2. Prices are competitive: $w = F_L(K, L)$ and $r = F_K(K, L) - \delta$.
3. Markets clear:
   (a) Goods: $\sum_j \eta_j \int_X c(j, x) d\Psi_j + (1 + n)K + \tilde{M} + G = F(K, L) + (1 - \delta)K$, where $\tilde{M} = \sum_{j=R}^J \eta_j \int_{X_R} M(j, h) d\Psi_j$.
   (b) Capital: $\sum_j \eta_j \int_X a'(j, x) d\Psi_j = (1 + n)K$.
   (c) Labor: $\sum_j \eta_j \int_X (1 - l(j, x))(1 + \omega)\Omega(j, z) d\Psi_j = L$.

4. Distributions of agents are consistent with individual behavior:

$$\Psi_{j+1}(X_0) = \int_{X_0} \left\{ \int_X Q_j(x, x') \mathbf{I}_{j'=j+1} d\Psi_j \right\} dx',$$

   for all $X_0 \in \Xi$, where $\mathbf{I}$ is an indicator function and $Q_j(x, x')$ is the probability that an agent of age j and current state x transits to state x' in the following period. (A formal definition of $Q_j(x, x')$ is provided in the Appendix.)

5. Social security budget balances: $\sum_{j=R+1}^{J} \eta_j \int_{X_R} S(\hat{x}) d\Psi_j = \sum_{j=1}^{R} \eta_j \int_{X_W} \{\tau_e(e) + \tau_e(\omega e)\} d\Psi_j$.

6. The government's budget is balanced: $IT + B = MT + G$, where income taxes are given by

$$IT = \sum_{j=1}^{J} \eta_j \int_X T_y(x) d\Psi_j,$$

   bequests are given by

$$B = \frac{1+r}{1+n} \sum_{j=R+1}^{J} \eta_{j-1} \int_X \Big\{ \lambda_{j-1}^0(E)(1 - s_j^f(E))(1 - s_j^m(E)) + \lambda_{j-1}^1(E)(1 - s_j^f(E)) + \lambda_{j-1}^2(E)(1 - s_j^m(E)) \Big\} a'(j-1, x) d\Psi_{j-1},$$

   and total means-tested transfer payments are

$$MT = \sum_{j=1}^{J} \eta_j \int_X Tr(j, x) d\Psi_j.$$

4 Calibration

- MALE EARNINGS
- FEMALE EARNINGS
- HEALTH EXPENSES

The model is calibrated to match a set of aggregate and distributional moments for the U.S. economy, including demographics, earnings, medical and nursing home expenses, as well as features of the U.S. social welfare, Medicaid, social security and income tax systems. Some of the parameter values can be determined ex-ante, others are calibrated by making the moments generated by a stationary equilibrium of the model target corresponding moments in the data. The calibration procedure minimizes the difference between the targets from the data and model-predicted values. Our calibration strategy for stochastic processes for earnings and medical expenses is similar to Castaneda et al. (2003): we do not restrict the processes to, for example, AR(1), but instead target a wide set of moments characterizing the earnings and OOP health expense distributions. Unlike Castaneda et al., we do not target the distribution of wealth because part of our objective is to learn how much wealth inequality can be generated by idiosyncratic risk in earnings, health expenses, and survival in a pure life-cycle model.

We start by presenting functional forms and setting parameters whose direct estimates are available in the data. Although the calibration procedure identifies the rest of the parameters by solving a simultaneous set of equations, for expositional purposes, we divide the parameters to be calibrated into groups and discuss associated targets and their measurement in the data. Most of the data statistics used in the calibration procedure are averages over or around 2000-2006, which is the time period covered by the HRS. More fundamental model parameters rely on long-run data averages.

4.1 Age structure

In the model, agents are born at age 21 and can live to a maximum age of 100. We set the model period to two years because the data on OOP health expenses is available bi-annually. Thus the maximum life span is $J = 40$ periods. For the first 44 years of life, i.e. the first 22 periods, the agents work, and at the beginning of period $R + 1 = 23$, they retire.

Population growth rate n targets the ratio of population 65 year old and over to that 21 years old and over. According to U.S. Census Bureau, this ratio was 0.18 in 2000. We target this ratio rather than directly set the population growth rate because the weight of the retired in the population determines the tax burden on workers, which is of a primary importance to our policy analysis.

4.2 Preferences

The momentary utility function is assumed to be of the constant-relative-risk-aversion form

$$U(c) = \frac{(c^{\gamma} l^{1-\gamma})^{1-\sigma}}{1-\sigma},$$

so that $1/\sigma$ is the intertemporal elasticity of substitution. Based on estimates in the literature, we set σ equal to 2.0. γ is calibrated to the average work hours constituting 1/3 of the time endowment. The subjective discount factor, β is determined in the calibration procedure such that the rate of return on capital in the model is consistent with an annual rate of return of 4 percent.

4.2.1 Technology

Consumption goods are produced according to a production function,

$$F(K, L) = AK^{\alpha}L^{1-\alpha},$$

where capital depreciates at rate δ. The parameters α and δ are set using their direct counterparts in the U.S data: a capital income share of 0.3 and an annual depreciation rate of 7 percent (Gomme and Rupert (2007)). The parameter A is set such that the wage per an efficiency unit of labor is normalized to one under the baseline calibration .

4.3 Earnings Process

In the model, worker's productivity depends on his age and an idiosyncratic productivity shock according to a function $\Omega(j, z)$. We assume that this function consists of a deterministic age-dependent component and a stochastic component as follows:

$$\log \Omega(j, z) = \beta_1 j + \beta_2 j^2 + z,$$

where z follows a finite-valued Markov process with probability transition matrix $\Lambda_{zz'}$. Initial productivity levels are drawn from the distribution Γ_z.

We assume that there are 5 possible values for z. Thus, specifying the earnings process requires setting 26 parameters: 2 coefficients on age and age-squared in the deterministic component, 5 productivity shock levels, 25 elements of $\Lambda_{zz'}$ and 5 grid points for the initial distribution of z. In order to reduce the number of unknowns, we fix the grid points. Moreover, we assume that the probabilities of going from the two lowest productivity levels to the highest one and from the two highest ones to the lowest one are 0. These restrictions, combined with imposing the condition that the rows of $\Lambda_{zz'}$ must sum to one, reduces the number of parameters in the probability transition matrix to be calibrated from 25 to 16. Finally imposing that the elements of the initial distribution sum to one leaves 22 parameters that need to be determined.

The coefficients on age and age-squared are obtained from 1968 to 1996 PSID data for male workers.[4] Thus β_1 is set to 0.109 and β_2 is set to -0.001. The 20 remaining parameters

[4]The sample is restricted to the heads of household, between the age of 18 and 65, not self-employed, not working for the government, working at least 520 hours during the year; excluding observations with the

are chosen by targeting the variance of log earnings of 55 year-olds relative to 35 year-olds, the first-order autocorrelation of the stochastic component, the Gini coefficient for earnings, 8 points on the Lorenz curve for earnings, corresponding to the five quintiles and top 1, 5, and 10 percent of the distribution, the same 8 points in the Lorenz curve for Social Security income, and mean Social Security income levels by Social Security income quintile. Using PSID data, Storesletten et al. (2004) estimate the variance of log annual earnings to be 0.46 for 35 year-olds and 0.87 for 55 year-olds. Thus we target a relative variance for 55 year-olds of 1.89. The target for the first-order autocorrelation of annual z is 0.98, taken from Guvenen (2008) and also based on PSID data. The data points for the earnings Lorenz curve are taken from Rodriguez at el. (2002). The targets on the Lorenz curve for Social Security income and mean Social Security by quintile are computed using the sample from the HRS data described in Section 2. We target mean Social Security income by quintiles since we also target mean OOP medical expenditures by Social Security income quintiles, as discussed below. We use social security income quintiles as a proxy for lifetime earnings quintiles because lifetime earnings is not available to us.

4.3.1 Medical Expense Process

Make survival probability depend on h? If highest value of h is drawn, probability of death increases by a factor θ. Calibrate so as to hit a ratio of health expenses in the last 2 years of life relative to the average expenses in population. (Similar to what we did with nursing home)

We focus on average (deterministic) differences in health expenses due to age, marital status and gender.

Retired agents face medical expenses that are a function of their current age, household demographic status and medical expense shock. Similarly to the earnings process, we assume that medical expenses can be decomposed into a deterministic age component and a stochastic component:

$$\ln M(j,h,d) = \beta^d_{m,0} + \beta^d_{m,1} j + \beta^d_{m,2} j^2 + h^d,$$

where h follows a finite state Markov chain with probability transition matrix $\Lambda_{hh'}$ and newly retired agents draw their medical expense shock h from an initial distribution denoted by Γ_h.

average hourly wage (computed as annual earnings over annual hours worked) less than half the minimum wage in that year; weighted using the PSID sample weights. We thank Gueorgui Kambourov for providing us with the regression results.

We assume that for each age there are 4 possible medical expense levels, which we fix exogenously. Thus specifying the process for h requires choosing 20 parameters: 16 parameters specifying the probability transition matrix for h, $\Omega_{hh'}$, and 4 parameters characterizing the initial distribution of medical expenditure shocks, Γ_h. Since the rows of the transition matrix and the initial distribution must sum to one, the degrees of freedom to be determined reduces to 15. Thus, including the coefficients in the deterministic component, 17 parameters still remain to be chosen to specify the medical expense process.

To calibrate the 17 parameters governing the OOP health expense process, we use 20 aggregate and distributional moments for OOP health expenses: the Gini coefficient and 8 points in the Lorenz curve of the OOP medical expense distribution, shares of OOP health expenses and Medicaid expenses in GDP for each age group – 65 to 74 year-olds, 75 to 84 year-olds, and those 85 and above – and the shares of the OOP health expenses that are paid by each social security income quintile. The targets and their values in the data are summarized in the next section. The distributional moments were documented in section 2 using the HRS data. OOP and Medicaid expenses by age groups are 2001-2006 averages based on the aggregate data from the U.S. Department of Health and Human Services. Note that our measure of OOP health expenditures corresponds to the sum of all private health care expenditures, including the costs of health insurance.

4.3.2 Survival Probabilities

Recall that while agents of age $j = R+1, \ldots, J$ not residing in a nursing home have probability s_{j+1} of surviving to age $j+1$ conditional on having survived to age j, retired agents residing in nursing homes face different survival probabilities, given by $\{s_j^n\}_{j=R+2}^J$. These two sets of survival probabilities are not set to match their counterparts in the data for two reasons: first, there are no estimates of survival probabilities by nursing home status available for the U.S., and second, since we are targeting statistics on aggregate nursing home costs, it is important for the model to be consistent with the data on nursing home usage. Therefore, the survival probabilities are set as follows. First, we assume that for each cohort, the probability of surviving to the next age while in a nursing home is a constant fraction of the probability of surviving to the next age outside of a nursing home:

$$s_j^n = \phi^n s_j, \quad \text{for } j = R+2, \ldots, J.$$

Then we pin-down the value of ϕ^n by targeting the fraction of individuals aged 65 and over residing in nursing homes in the U.S. in 2000 subject to the restriction that the unconditional age-specific survival probabilities are consistent with those observed in the data.[5] According to U.S. Census special tabulation for 2000, the fraction of the 65 plus population in a nursing home in 2000 was 4.5 percent.

4.3.3 Government

The government-run welfare program in the model economy guarantees agents a minimum consumption level. The welfare program, which is available to all agents regardless of age, represents public assistance programs in the U.S. such as food stamps, Aid to Families with Dependent Children, Supplemental Social Security Income, and Medicaid. Since estimates of the government-guaranteed consumption levels for working versus retired individuals are found to be very similar, we assume that they are the same. However, the consumption level provided by the government differs for nursing home versus medical bankruptcy. In the literature, estimates of the consumption level for a family consisting of one adult and two children is approximately 35 percent of expected average annual lifetime earnings, while the minimum level for retired households has been estimated to be in the range of 15 to 20 percent (Hubbard, Skinner, and Zeldes (1994) and Scholz, Seshadri, and Khitatrakun (2006)).[6] These estimates suggest that the minimum consumption floor for individuals is somewhere in the range of 10 to 20 percent.[7] We set the consumption floor for consumer and medical bankruptcy, $\underline{c}^w = \underline{c}^m$, to 15 percent of the average value of the agents' expected average lifetime earnings.

Obtaining an estimate of a consumption floor provided under a nursing home bankruptcy is problematic because it requires estimating the value of the rooms and amenities that nursing homes provide to Medicaid-funded residents. Instead, we calibrate the minimum consumption level for nursing home residents, $\underline{c}^n$, to match Medicaid's share of nursing home expenses for individuals 65 and over. According to the Current Medicare Beneficiary

[5]The data on survival probabilities is taken from Table 7 of *Life Tables for the United States Social Security Area 1900-2100* Actuarial Study No. 116 and are weighted averages of the probabilities for both men and women born in 1950.

[6]Expected average annual lifetime earnings in 1999 is computed as a weighted average of estimates of average lifetime earnings for different education groups taken from *The Big Payoff: Educational Attainment and Synthetic Estimates of Work-Life Earnings.* U.S. Census Bureau Special Studies. July 2002. The weights are taken from *Educational Attainment: 2000* Census Brief. August 2003.

[7]However, this statement should be taken with caution. The consumption floor is difficult to measure due to the large variation and complexity in welfare programs and their coverage. In addition, families with two adults and adults under 65 without children would receive substantially less in benefits then found above. Consistent with this, by estimating their model, DeNardi, French, and Jones (2006), find a much lower minimum consumption level: approximately 8 percent of expected average annual lifetime earnings. This is similar to a value of about 6 percent used by Palumbo (1999). However, health expenses in the model of DeNardi et al. include nursing home costs, and hence their estimate is not directly comparable to the non-nursing home minimum consumption level in our model. Thus we do not use their estimate.

Survey, over the period 2000 to 2003, on average, Medicaid's share of the elderly's total nursing home expenses net of those paid by Medicare was approximately 45 percent.

The social security benefit function in the model captures the progressivity of the U.S. social security system by making the marginal replacement rate decrease with average lifetime earnings. Following Fuster, Imrohoroglu, and Imrohoroglu (2006), the marginal tax replacement rate is 90 percent for earnings below 20 percent of the economy's average lifetime earnings $\bar{E}$, 33 percent for earnings above that threshold but below 125 percent of $\bar{E}$, and 15 percent for earnings beyond that up to 246 percent of $\bar{E}$. There is no replacement for earnings beyond 246 percent of $\bar{E}$. Hence the payment function is

$$S(\bar{e}) = \begin{cases} s_1\bar{e}, & \text{for } \bar{e} \leq \tau_1, \\ s_1\tau_1 + s_2(\bar{e} - \tau_1), & \text{for } \tau_1 \leq \bar{e} \leq \tau_2, \\ s_1\tau_1 + s_2(\tau_2 - \tau_1) + s_3(\bar{e} - \tau_2), & \text{for } \tau_2 \leq \bar{e} \leq \tau_3, \\ s_1\tau_1 + s_2(\tau_2 - \tau_1) + s_3(\tau_3 - \tau_2), & \text{for } \bar{e} \geq \tau_3. \end{cases}$$

where the marginal replacement rates, s_1, s_2, and s_3 are set to 0.90, 0.33, and 0.15, respectively. While the threshold levels, τ_1, τ_2, and τ_3, are set respectively to 20 percent, 125 percent and 246 percent of the economy's average lifetime earnings.

The payroll tax which is used to fund the social security system is assumed to be proportional, thus

$$\tau_e(e) = \hat{\tau}_e e,$$

where the tax rate $\hat{\tau}_e$ is determined in equilibrium. Likewise, income taxes in the model economy are assumed to be proportional so that

$$\tau_y(y) = \hat{\tau}_y y.$$

The tax rate $\hat{\tau}_y$ is also determined in equilibrium. As is the case under the U.S. tax system, taxable income is income net of health expenses that exceed 7.5 percent of income. Thus κ is set to 0.075. Finally, government spending, G is set such that, in equilibrium, government spending as a fraction of output is 19 percent.

4.4 Baseline calibration

The model parametrization is summarized in Table 1. Information on the algorithm used to compute the equilibrium along with the transition probability matrices and other parameters governing the earnings and OOP health expense processes are included in the Appendix. The benchmark model performance relative to calibration targets is discussed in the next section. The equilibrium tax rates in the benchmark economy are 0.254 for income tax and 0.079 for payroll tax. Note that our calibration produced a value for the nursing home consumption floor, $\underline{c}^n$, which lies below the non-nursing home consumption floor, $\underline{c}^m$. We view this differential as reflecting a lower quality of life enjoyed in a public nursing home facility relative to receiving public assistance while living at home. As we show later in our quantitative analysis, the low quality of life under public nursing care plays an important role in individual saving decisions.

To show the importance of medical and nursing home expenses and Medicaid in the analysis of social security system, we also consider a version of the model without these features as is standard in the literature.

5 Quantitative Results

It is well known that in a pure life-cycle model social security reduces capital stock and labor supply. The effects operate through the following channels: *(i)* social security redistributes resources from individuals with high marginal propensity to save (young) to individuals with low marginal propensity to save (old), *(ii)* social security provides an annuity that aprtially insures against survival risk, *(iii)* progressivity of social security reduces precautionary savings due to earnings risk, *(iv)* lower labor supply due to the distortions imposed by the payroll tax reduces marginal product of capital, resulting in a lower interest rate.

5.1 Elimination of Social Security

In this section we examine the effects of social security policy on savings in the presence of health expenses and Medicaid. The social security system crowds out savings for old age by redistributing resources from working years to retirement years. In addition, it crowds out precautionary savings by insuring against survival risk in the form of an annuity payment. The question we ask here is does the presence of health expenses at old age matter for the crowding out effect and how much? Moreover, the progressivity of the social security benefit redistributes resources across the permanent earnings distribution, from rich to poor. These distributional effects are of interest to us because saving behavior differs dramatically across individuals in our benchmark economy. Hence, another question we ask is how does the progressivity of social security benefits impact saving for health expenses?

To provide a quantitative answer to these questions, we consider four additional policies: relative to the baseline, policies 9 and 11 replace progressive benefits with a proportional one – the proportion is equal to that of an individual with average lifetime earnings in the

Table 1: Calibrated Parameters

parameter	**description**	**values**
β	subjective discount factor	0.954^{*}
γ	coefficient of risk aversion	2.0
n	population growth rate	0.021
	consumption floors	
$\underline{c}^w$	consumer bankruptcy	$0.15^{\dagger}$
$\underline{c}^m$	medical bankruptcy	$0.15^{\dagger}$
$\underline{c}^n$	nursing home bankruptcy	$0.09^{\dagger}$
M^n	medical cost of nursing home care	$0.86^{\dagger}$
ϕ^n	relative survival probability for nursing home residents	0.919
	probabilities of entering a nursing home in next 2 years	
$\bar{\theta}_{65-74}$	65 to 74 year-olds	0.004
$\bar{\theta}_{75-84}$	75 to 84 year-olds	0.0136
$\bar{\theta}_{85+}$	85 and up	0.0551
$\beta_{n,2}$	growth rate of nursing home prob. with medical expenses	0.938
	coefficients in the deterministic component of medical expenses	
$\beta_{m,1}$	age	0.13
$\beta_{m,2}$	age-squared	-0.0058
A	TFP in production	1.17
α	capital's share of output	0.3
δ	capital's deprecation rate	0.07

*All numbers are annual unless otherwise noted.
†Fraction of expected average annual lifetime earnings.

benchmark economy,– and policies 10 and 12 completely remove the social security system. In addition, under policies 11 and 12 all OOP health expenses are removed through a public health care program. The results of the policy experiments are presented in Table 2. Overall, the results indicate that the presence of OOP health expenses has non-trivial aggregate and distributional implications for the impact of social security on capital accumulation.

Replacing the progressive social security benefit formula with a proportional one has a large negative effect on aggregate capital, and the presence of OOP health expenses slightly amplifies this effect. Removing progressivity reduces the aggregate capital stock by 8 percent in the economy with OOP health expenses (policy 9 relative to baseline) and by 7 percent in the economy without them (policy 11 relative to policy 3). Similarly to other policies we have considered, changes in the aggregate capital are driven by wealth accumulation of the top permanent earnings quintile. Here the role of the top quintile is pronounced the most because this is the only quintile that sees a substantial increase in its social security replacement rate when moving to the proportional benefit formula. 98 percent of the fall in the aggregate capital under policy 9 is due to lower wealth accumulation by the top quintile.

Contrary to the above results, the presence of the social security system affects savings more in the economy without OOP health expenses. Complete removal of the social security system increases the capital stock by 37 percent in the economy with OOP health expenses (policy 10 relative to baseline) and by 55 percent in the economy without these expenses (policy 12 relative to policy 3). Why does the presence of OOP health expenses reduce the crowding out effect of social security on capital accumulation? Without public health care, individuals maintain large savings well into the retirement to pay OOP health expenses that grow with age. These savings also serve as a self-insurance against survival risk when the social security annuity is removed. As a result, individuals do not need to increase their savings as much as in the economy without OOP health expenses.

Another way to see the above results is by varying the presence of OOP health expenses for a fixed social security system. The presence of a social security system amplifies the effect of the OOP health expenses on wealth accumulation. Elimination of OOP health expenses through public health care in the economy without social security reduces aggregate capital by only 1 percent, while in the economy with the progressive and proportional social security systems the capital stock falls by 12 and 11 percent respectively.

6 Conclusion

We have built a theory of life-cycle inequality with uninsurable idiosyncratic risk in earnings, medical and nursing home expenses, and survival in order to quantitatively assess effects of

Table 2: Effects of Social Security Policies With and Without OOP Health Expense Risk

Policies	**Baseline**	**9**	**10**	**3**	**11**	**12**
Social Security	Prog.	Prop.	None	Prog.	Prop.	None
Public Health Care	No	No	No	Yes	Yes	Yes
Aggregates						
relative to baseline						
Agg. Output	1.00	0.975	1.099	0.962	0.941	1.096
Agg. Capital	1.00	0.919	1.368	0.878	0.818	1.357
relative to Progressive SS, Public Health Care						
Agg. Capital				1.00	0.932	1.547
relative to No Public Health Care, fixed SS system						
Agg. Capital				0.878	0.889	0.992
change in wealth of PI quintiles, % of agg. capital change						
All		100	100	100	100	100
First Quintile		0.3	0.3	0.0	-0.2	0.6
Second Quintile		-2.9	3.6	6.0	0.3	6.1
Third Quintile		-3.1	12.6	15.3	7.3	15.2
Fourth Quintile		5.8	31.4	35.0	25.8	30.2
Fifth Quintile		98.0	51.2	39.6	63.2	47.0
wealth of PI quintiles relative to baseline						
First Quintile	1.00	0.95	1.31	1.00	1.07	1.60
Second Quintile	1.00	1.07	1.37	0.80	0.98	1.61
Third Quintile	1.00	1.03	1.50	0.80	0.86	1.59
Fourth Quintile	1.00	0.98	1.54	0.80	0.78	1.50
Fifth Quintile	1.00	0.88	1.30	0.92	0.82	1.26
SS replacement rates by PI quintiles						
First Quintile	0.88	0.44	0	0.88	0.44	0
Second Quintile	0.61	0.44	0	0.61	0.44	0
Third Quintile	0.49	0.44	0	0.49	0.44	0
Fourth Quintile	0.43	0.44	0	0.43	0.44	0
Fifth Quintile	0.34	0.44	0	0.34	0.44	0
Social Security Tax Rate	0.079	0.098	0	0.079	0.98	0
Income Tax Rate	0.254	0.266	0.235	0.257	0.268	0.219
OOP, % output	1.4	1.4	0.96	0	0	0
OOP, % total health exp.	70	66	50	0	0	0
Wealth Gini	0.83	0.82	0.81	0.84	0.83	0.81

alternative social insurance policies on wealth accumulation and inequality. We find that medical and nursing home expenses greatly stimulate aggregate capital accumulation but have a small effect on wealth inequality in the presence of social insurance. Removing old-age safety nets including Medicaid has a large positive effect on aggregate capital accumulation and generates a large reduction in wealth inequality. Overall, we find that distributional effects in our model have important aggregate implications. We also find that differential social insurance of medical versus nursing home expenses makes nursing home risk a relatively more important driving force of the saving behavior of richer individuals. Furthermore, we show that OOP health expenses have important implications for the effects of social security on savings. We conclude that modeling medical and nursing home expenses is crucial for social policy analysis.

Our calibration strategy exploits the assumption that the positive relationship observed between individual permanent income and OOP health expenses (De Nardi et al. (2006)) is completely accounted for by the presence of safety nets. That is, richer individuals face higher OOP expenses due to the means-testing of Medicaid transfers. However, it would be interesting to relax this assumption by incorporating a choice of health care quality and study how this margin responds to policy changes.

In order to make our results transparent, we simplified our analysis by abstracting from differential mortality, marriages, and endogeneity of labor supply. Since in the data life expectancy is higher for high-income individuals, the lifetime health expense risk faced by these individuals is also higher, which may enhance the differential effects of social insurance policies we found in our study. Marriages may be important because nursing home risk is potentially different for married couples and risk-sharing is available within a household. Abstraction from labor supply decisions means we have not taken into account labor income tax distortions and the insurance role of labor through intertemporal substitution in response to productivity shocks. Moreover, we have focused on life-cycle inequality and omitted bequest motives and any other kind of intergenerational interactions. The strategic survey in Ameriks et al. (2007) shows that the desire to leave bequests is an important saving motive. Moreover, Fuster (1999) has shown how dynastic linkages have important consequences for the effects of social security policies on wealth inequality. Introducing two-sided altruism, along with the option for informal care through the family – an important substitute for nursing home care – and intergenerational transfers would allow one to analyze the importance of intergenerational links for savings. In addition, under this framework, care-takers' labor supply responses to social insurance policies could be explored. We leave these issues for future research.

References

[1] Ameriks, J, A. Caplin, S. Laufer, S. Van Nieuwerburgh (2007). "The Joy of Giving or Assited Living? Using Strategic Surveys to Separate Bequest and Precautionary Motives." NBER Working Paper 13105.

[2] Brown, J. and A. Finkelstein (2008). "The Interaction of Public and Private Insurance: Medicaid and the Long-Term Care Insurance Market." *American Economic Review*, vol. 98, no. 3, pp: 1083-1102.

[3] Castaneda, A., J. Diaz-Gimenez, J.V. Rios-Rull (2003). "Accounting for the U.S. Earnings and Wealth Inequality," *Journal of Political Economy,* vol. 111, no. 4, pp: 818-857.

[4] Dick, A., A. Garber, and T. MaCurdy (1994) "Forecasting Nursing Home Utilization of Elderly Americans." In David Wise (ed.) Studies in the Economics of Aging.

[5] De Nardi, M., E. French, J. B. Jones (2006). " Differential Mortality, Uncertain Medical Expenses, and the Saving of the Elderly Singles," mimeo.

[6] Dynan, K., J. Skinner and S. P. Zeldes (2004). "Do the Rich Save More?" *Journal of Political Economy,* vol. 112, no. 2, pp: 397-444.

[7] French, E. and J. B. Jones (2003). "The Effects of Health Insurance and Self-Insurance on Retirement Behavior," mimeo.

[8] French, E., and J. B. Jones (2004). "On the Distribution and Dynamics of Health Care Costs," *Journal of Applied Econometrics,* vol. 19, no. 4, pp: 705-721.

[9] Fuster, L. (1999). "Is Altruism Important for Understanding The Long Run Effects of Social Security?," *Review of Economic Dynamics, vol. 2, no. 3, pp: 616-637.*

[10] Fuster, L., A. Imrohoroglu and S. Imrohoroglu (2006). "Elimination of Social Security in a Dynastic Framework," forthcoming, *Review of Economic Studies.*

[11] Gertler, P., and J. Gruber (2006). "Insuring Consumption Against Illness," *American Economic Review,* vol. 92, no. 1, pp: 51-69.

[12] Gomme, P. and P. Rupert (2007). "Theory, Measurement and Calibration of Macroeconomic Models," *Journal of Monetary Economics,* vol. 54, no. 2, pp: 460-497.

[13] Guvenen,F. (2008) "An Empricial Investigation of Labor Income Processes," forthcoming *Review of Economic Dynamics.*

[14] Hubbard, G.R., J. Skinner, and S. Zeldes (1994). "The Importance of Precautionary Motives in Explaining Individual and Aggregate Saving," *Carnegie-Rochester Conference Series on Public Policy,* vol. 40, pp: 59-125.

[15] Hubbard, G.R., J. Skinner, and S. Zeldes (1995). "Precautionary Savings and Social Insurance," *Journal of Political Economy,* vol. 103, no. 2, pp: 360-399.

[16] Huggett, M. (1996). "Wealth Distribution in Life-Cycle Economies," *Journal of Monetary Economics,* vol. 38, pp: 469-494.

[17] Palumbo, M.G. (1999). "Uncertain Medical Expenses and Precautionary Saving Near The End of Life Cycle," *Review of Economic Studies,* vol. 66, pp: 395 -421.

[18] Rodriguez, S. B., J. Diaz-Gimenez, V. Quadrini, J.-V. Rios-Rull (2002). "Updated Facts on the U.S. Distributions of Earnings, Income and Wealth," Federal Reserve Bank of Minneapolis Quarterly Review, vol. 26, no. 3, pp: 2-25.

[19] Scholz, J.K., A. Seshadri, S. Khitatrakun (2006). "Are Americans Saving Optimally for Retirement?" *Journal of Political Economy,* vol. 114, no. 4, pp:607-643.

[20] Storesletten, K., C. Telmer, and A. Yaron (2004). "Consumption and Risk Sharing Over the Life Cycle," *Journal of Monetary Economics,* vol. 51, pp: 609-633.