RESTLESS: WHY DO SENIORS DELAY RETIREMENT?

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ABSTRACT

Since the mid-eighties, both labor force participation and hours worked (for those who work) of seniors in US started to grow steadily after about a century of decline. Current paper uses data from HRS and structral estimation approach to explore the relative importance of several possible factors that potentially affect the labor force participation behavior of different cohorts of elderly. The paper focuses on the differences in mortality rates, health, out-of-pocket medical expenditures, hourly wages as well as differential policies (e.g. changes in normal retirement age, eliminaion of earnings test etc); the model incorporates individual heterogeneity with respect to gender and education level.

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1 INTRODUCTION

Around three decades ago labor force participation of persons aged 65 and older in the US hit the historical minimum at 11%. Since then it was growing steadily and reached almost 20% in 2014. On top of that, not only elderly participate in the labor force more, but they also work more as well, with average number of hours worked per week increased from 30 to 33 between 1984 and 2014. Previously observed pattern of abrupt retirement has also been changing, with more and more people approaching full retirement through a span of part-time job ([14]). With the large cohort of Baby Boomers currently entering this age, the elderly will comprise more and more significant part of the labor force, if the trends will continue.

The paper focuses on two relatively large cohorts of individuals: born between 1915 and 1934 (post-WWI period and Great Depression) and born between 1945 and 1964 ("Baby Boomers"). Two man goals of the paper are, first, to document the differences in labor force participation behavior of senior in these two cohorts and, second, to estimate the relative importance of numerous factors that affect this behavior. Data from Health and Retirement Study is used to estimate a dynamic programming model of labor force perticipation behavior of seniors as well as to document the differences between two cohorts. Due to the limitations and structure of HRS dataset , the model focuses on individuals aged 50 and older.

The descriptive part of the paper documents the differences in behavior between the two cohorts of individuals as well as possible underlying forces that drive the behavior. Furthermore, it is well-perceived that persons of different sex, education level and marital status probably will behave differently on the labor market upon approaching the age of retirement. Therefore, the paper features descriptive statistics with respect to subgroups of population of different socio-economic status.

The quantitative part of the paper tries to estimate the relative importance of various explanations of the labor force participation trends that have been put forward in the literature. This paper focuses on several potentially important factors:

- *Increased life expectancy.* Increase in life expectancy, and associated changes in mortality rates, means the necessity to finance more years of retirement. Coupled with the fact that health condition gets worse with age, as well as medical expenditures grow rapidly at older age, this could lead to an incentive to stay on the job longer.

- *Evolution of health conditions.* Another possible source of differences between retirees of different cohorts is advances in medicine and differential evolution of health conditions of individuals with similar socioeconomic characteristics in different cohorts.

- *Increase in out-of-pocket medical expenditures.* Over the previous decades, the percentage of US GDP spent on health care has grown substantially. Although a part of individual medical expenditures is covered with insurance (if one has it), or Medicare after the age of 65, out-of-pocket spendings of individuals might still constitute a significant part of individual's spendings. Coupled with the increased life expectancy, this could provide a strong incentive to stay on the job longer.

- *Differences in earnings and wages.* Higher wages or opportunity to work part-time might provide the incentive to stay in the labor force longer.

- *Changes in government policies.* Numerous changes in government policies might have an effect on labor force participation of seniors. The important ones are increasing full retirement age for consequent cohorts, elimination of mandatory retirement, elimination of earnings test ([3]).

The differences in labor force participation between the two cohort must at least partially emerge from the changes in the listed factors, which the paper documents. To my limited knowledge, this is the first paper that incorporates increase in out-of-pocket medical expenses as one of the reasons behind the behavioral change of seniors.

However, some other important factors, such as spousal coordination in retirement decision, shift from defined benefit to defined contribution pension plans, are out of scope of current research.

2 LITERATURE REVIEW

There are number of papers that document the trend towards later retirement that started in 1980's.

Clark and Quinn (2002[3]) is one of the first papers to document the trend reversal, with elimination of mandatory retirement, social security amendments and changes in employer pensions being offered as possible reasons for it. Friedberg in 2007[8] brief highlights the trend for males and females aged 55+. The paper identifies changes in public policy, private pensions and health care as a possible reasons for people to work longer. Juhn et al. (2006[10]) notes the reversal in the decline of labor force participation of older individuals and attributes it to the changes in social security as a possible explanation. DiCeccio et al. (2008[5]) marks this trend as countervailing to the overall decline in the labor force participation during the previous decade, and along with the possible reasons mentioned above argues that increased life expectancy can play a role.

Blau and Goodstein (2010[1]) claim Social Security changes can account for 18-20% of the change, but to the less extent can explain the long decline in LFP of elderly throughout the 20th century. The counterfactual experiments they run suggest that under assumption that the marginal college attendee today may have lower ability than in previous periods when college attendance was less common, the chngin educational composition of the labor force can explain up to 100% of the increase.

Hurd and Rohwedder (2011[9]) use HRS data to study the effect of pensions (in particular, moving from DB to DC pension plans) on labor force participation of elderly. The main finding is that changes in the prevalence of DB and DC pensions are associated with changes in retirement rates. The authors' simulations demonstrate that shift from DB to DC between 1992 and 2004 will increase labor force participation rates of people in their 60s by about 2.5 percentage points.

Schirle (2008[15]) identifies a coordination in retirement schedule among spouses as another important reason and finds that husband's response to wives' labor force participation can explain 25% of the increase.

Maestas and Zissimopoulos (2010[12]) summarize recent literature on the topic, dividing possible causes to supply (skill and educational composition of the workforce, spousal complementarity in retirement decision, changes in social security, mortality decline) and demand (skill-biased technological change, shift form defined benefit plans to defined contribution plans, reduction in employer-provided health insurance) sides.

Burtless (2013[2]) finds that those who stay in the labor force longer tend to be more productive than those who leave, thus finding little evidence the aging workforce has hurt aggregate productivity.

3 DATA

The Health and Retirement Study is an individual level panel data collected every two years from 1992 to 2013, intended to follow individuals from age 50 until their death. The data consists of several waves of respondents starting from age 50, as well as their spouses regardless of age. The dataset has very detailed individual information on demographic characteristics, employment, income, medical expenditures, health status and education achievement among others.

4 FACTS

The data sample is extracted from March supplement of Current Population Survey and spans from 1964 to 2014. The population is split into four categories: 16 to 24 years old, 25 to 54 years old, 55 to 64 years old, and 65+ years.

Four panels of Figure 1 are intended to give a broad idea of changes in each group's behavior.

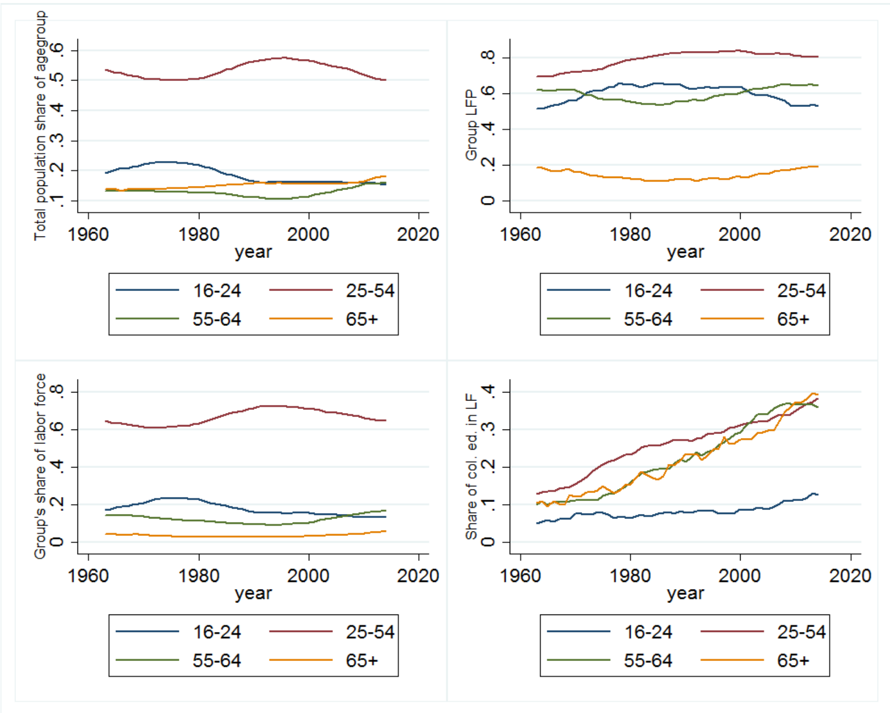
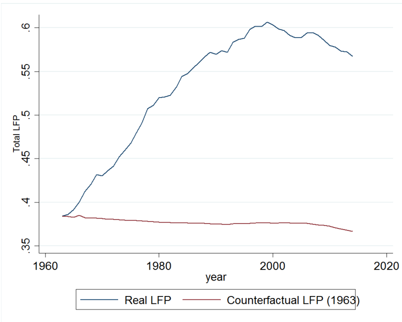


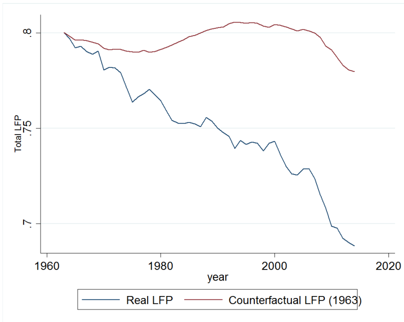
Figure 1: Labor force behavior of different age groups (CPS March supplement, 1963-2014, both sexes.)

Top left panel shows that total population share of individuals aged 55+ has increased substantially in last two decades. Top right panel shows that labor force participation of individuals aged 55+ is increasing steadily since mid-eighties, which stands in contrast to labor force participation of other age groups. Bottom left panel shows that share of labor force that individuals aged 55+ constitute is again increasing since mid-eighties, whereas corresponding shares of other age groups are decreasing. Bottom-right panel represents the share of labor force that constitute individuals with at least college education. It is clearly seen that for each age group except for 16-24 years old the share of college educated persons increased dramatically since 1963 from about 12% to almost 40%.

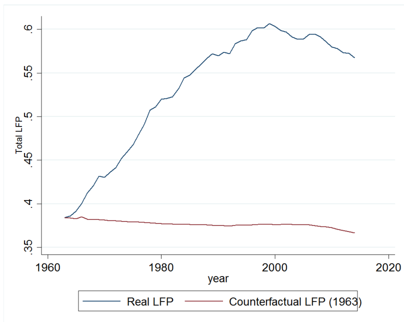
Counterfactual experiment. In order to confirm that there is some behavioral change and not just composition effects, figure 2 presents a counterfactual experiment: keep the labor force participation as in 1963, and change change the population shares of age groups. It clearly shows that there are behavioral changes. Although this figure doesn't give a clear picture of particular changes in LFP of elderly, it gives a broad picture of the dramatic changes that were overwhelming the US labor market since the sixties.



(a) Both sexes, 16+ years old.



(b) Only males, 16+ years old.



(c) Only females, 16+ years old.

Figure 2: Counterfactual experiment.

Older individuals work longer hours. Figure 3 on the following page represents change in labor supply in terms of weekly hours worked for college graduates and individuals without a college degree for the same time span. The increase in hours is visible for 55+ years old individuals and is more pronounced since the beginning of 2000s. This keeps for both educational categories.

Older males and females behave similarly. The well known and deeply investigated fact is that labor force participation of working age males is steadily decreasing since the middle of last century, whereas labor supply

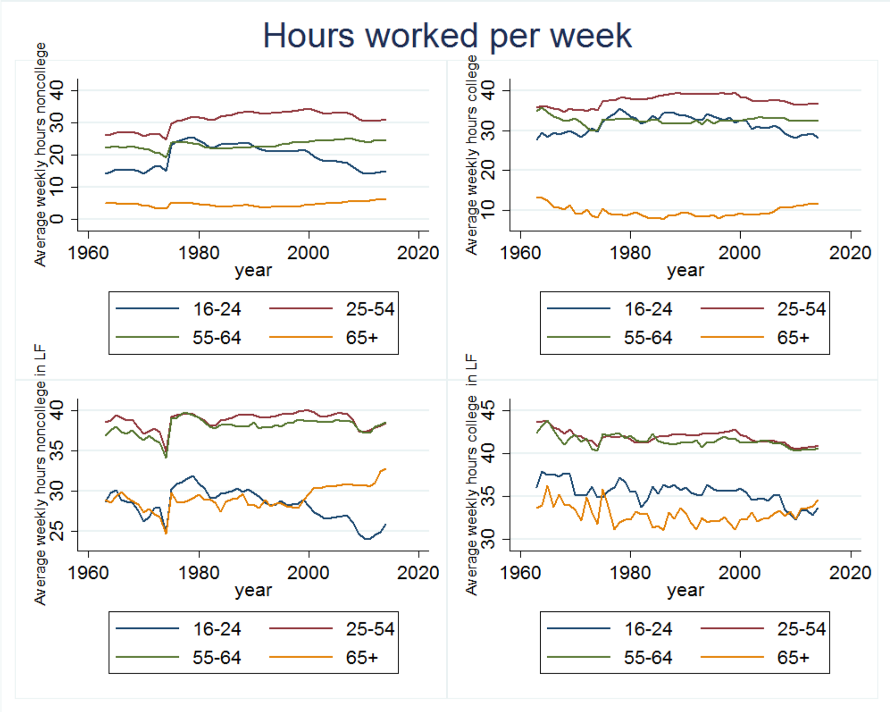


Figure 3: Weekly working hours.

of females is has been increasing. The more surprising then comes the fact that for older individuals the patterns are quite the same: for both males and females aged 55+ their labor supply diminishes until roughly mid-eighties, and then comes up. This can be a mere coincidence, but also can be a sign of some deep process beyond this behavior, that differs from the processes that rule the labor supply of prime-age individuals.

Education matters. The increase in LFP of elderly is the more pronounced the higher is level of educational attainment of individual. The figures in the appendix demonstrate this fact. Furthermore, given that the individuals with at least college education constitute now more than 30% of the total labor force, the clear conclusion is that more educated tend to stay in labor force longer. A number of things can lead to this fact. First, college educated got paid more, which gives them an incentive to stay longe in labor force. Second, they are more healthy. Third, the type of jobs college educated do are as a rule not physically demanding, hence they can perform it without significant decrease in productivity until older age. Fourth, the self selection into college assumes higher levels of productivity and self selection into later retirement. Fifth, the rise in assortative mating grants that the spouses of college educated individuals are often also college educated, and couples tend to coordinate retirement (however, Schirle (2008[15]) didn't find much of a result with her empirical specifications).

Changes in retirement patterns. Rupert and Zanell [14] introduce novel set of facts about the retirement behavior of youngest cohorts approaching the traditional retirement age. These facts stay in contrast to retirement patterns documented in previous literature. First, more and more individuals currently choose to retire gradually, passing through the period of part-time job. This contradicts the commonly accepted viewpoint of abrupt retirement. Second, the earnings of individuals aged 55+ go down, whereas hourly wage tend to grow for some time after the hours start to decline. Burtless (2013) documents this fact as well.

5 MODEL

This is a partial equilibrium life-cycle model. Individuals are heterogenous in several aspects: they differ by educational attainment (at this point college/non-college), which is exogenous and given at "birth"; the agents are of different sexes. The hetrogeneity affects their survival hazard and wage schedule. Earnings, health and medical expenditures of an agent are subject to idiosyncratic uncertainty; the details of these processes are described further in text.

5.1 Demography

An individual live for maximum of $J = 75$ periods, which means that at age 100 person dies with certainty.

Agents start their lives at the age of 25, which corresponds to $t = 1$. The initial distribution of wages for the agents of different genders and educational levels is exogenously given and to be calibrated to the data.

There is a survival hazard rate $s_t = s(t, e, g, h_t)$ every period that depends on individuals age $t < J$, education, gender and current health status h (see DeNardi et al (2010)[4]).

5.2 Health status

I model the health of individual following DeNardi et al. (2010) [4]. Every period of life agent face two possible health statuses: healthy ($h = 1$) and unhealthy ($h = 0$), which affects agent's contemporaneous utility. Health is one of the sources of idiosyncratic uncertainty in the model, with current status being dependent on previous health, gender, age and education, with transition probabilities given by:

$$\pi_{j,k}^{t,e,g} = Pr(h_{t+1} = k | h_t = j, t, e, g), \ j, k \in \{0, 1\}$$

5.3 Utility

Each period an agent has to make a choice over allocation of time unit it owns between leisure and labor. In order to model the retirement, there is a lower bound $\bar{l} \geqslant 0$ to the possible amount of working time supplied, below which an individual is considered out of labor force. Retirement is a form of non-participation (see French (2005) [6]). Note that agents can re-enter labor force.

Individuals enjoy contemporaneous utility from consumption, leisure and health $u(c, l, h)$. Upon death, an individual derives utility from leaving a bequest described by function $B(a, \tau)$ of assets at the time of death and taxes.

$$\max_{c_t, l_t, h_t} E_{P,H,M} \sum_{t=1}^{J} \beta^{t-1} \prod_{k=0}^{t-1} s_{k,e,g} \left(s_{t,e,g} u(c_t, l_t, h_t) + (1 - s_{t,e,g}) B(a_t, \tau) \right) \tag{1}$$

The expectation is taken with respect to agent's productivity, health status, and medical expenditure shock. Future is discounted by common discount factor β.

Bequest function $B(a)$ takes form that is common in the literature (see Fench (2005) [6], De Nardi (2010) [4]):

$$B(a) = \eta \frac{(a+d)^{1-\sigma}}{1-\sigma}, \tag{2}$$

where η is the magnitude of the bequest motivation, and d is curvature of bequest function.

The particular functional form of contemporaneous utility function is a combination of (Kitao (2015)[11] and DeNardi et al. (2010)[4]):

$$u(c, l, h) = \delta(h) \frac{[c^{\gamma}(1 - l - I(l > \bar{l}) \cdot \kappa_{e,g})^{1-\gamma}]^{1-\sigma}}{1-\sigma},$$

where $I(l > \bar{l})$ is an indicator that takes value of 1 if an individual participates in the labor market, and 0 oterwise, and $\kappa_{e,g}$ is the cost of participation in the labor market, that depends on gender and education level. Note that κ does not depend on age for purposes of identification. The dependence of utility on health status $\delta(h)$ is modelled following DeNardi et al. (2010)[4] and Palumbo (1999)[13]:

$$\delta(h) = 1 + \delta h,$$

so that when health is good ($h = 1$) agent gains boost to utility.

5.4 Earnings and productivity

The earnings of the agent follow:

$$\ln y_t = \ln w^{t,e,g} + \alpha \ln l_t + \ln z_t$$
$$\ln z_t = \rho_z \ln z_{t-1} + \varepsilon_t^z, \ \varepsilon_t^z \sim \mathcal{N}(0, \sigma_\varepsilon)$$

Agents get paid according to exogenously given wage schedule $w^{t,e,g}$ which depends on combination of agent's education (college/noncollege), gender (male/female) and age (25 to a max of 100).

Coefficient α penalizes earnings of the agents who work part-time.

Productivity shock z_t consists of persistent and transitory components. The error ε_t^z is iid across individuals (the differences between groups by age/gender/education/cohort are captured by different wage profiles).

Problem: how to estimate productivity process from MEPS data. Possibly, need to use PSID for this.

5.5 Medical expenditures

Agent's out-of-pocket expenses (part of the total expenses not covered by Medicare, Medicaid or personal insurance, plus insurance premium paid by the agent) m_t depend on health status, age, gender and education in the following way (see DeNardi et al. (2010) [4]):

$$\ln m_t = m(t, e, g, h, c) + \sigma(t, e, g, h, c) \times \psi_t$$

Idiosyncratic component ψ_t is assumed to be decomposed as in French and Jones (2004) [7].

$$\psi_t = \zeta_t + \xi_t, \ \xi_t \sim N(0, \sigma_\xi^2)$$
$$\zeta_t = \rho_m \zeta_{t-1} + \epsilon_t, \ \epsilon_t \sim N(0, \sigma_\epsilon^2)$$

Problem: MEPS data is a collection of short 2-year-long panels. Is it enough for identification?

5.6 Agent's budget constraint

$$c_t + a_{t+1} + m_t = a_t + Y(ra_t + y_t + b_t, \tau)$$
$$a_{t+1} \geqslant 0$$

Here, y_t is labor income, a_t is agent's assets at period t, r is risk-free rate of return, b_t is composite of different kinds of benefits, social security and pensions (described in details below) and τ is a tax schedule (to be described more carefully). Y is a function mapping sum of agent's labor income, asset return, government transfers (including social security) and pensions into a disposable income given current tax schedule.

5.7 Benefits

Benefits b_t is a complex object. It includes a government-provided "consumption floor" (see [4]), Social Security payments for eligible individuals, employer-provided pensions.

$$b_t = b_t^{Ma} + b_t^{ss} \times S_t + b_t^{pb}$$

5.7.1 *Consumption floor*

A way to think of the "consumption floor" b_t^{Ma} is as of Medicaid insurance for low-income agents. It is necessary to make it consistent with public transfer programs.

$$b_t^{Ma} = \max\{0, \underline{c} + m_t - [a_t(1 + r(1 - \tau_a)) + y_t]\}$$
$$c_t = \underline{c} \text{ if } b_t^{Ma} > 0$$
$$a_{t+1} = 0 \text{ if } b_t^{Ma} > 0$$

5.7.2 *Social Security*

Once individual achieved Early Retirement Age at the age of 62 ($t \geqslant 37$) he/she becomes eligible and can apply for retirement social security benefits, that are going to be paid to her/him throughout the rest of his/her life. Benefit application $S_t \in \{0, 1\}$ is yet another decision individual makes on top of consumption, leisure and amount of assets. Note that this decision irreversible: once an agent started to receive benefits, an individual can't withdraw it. The exact amount of Social Security payments agent receives will depend on *individual history* of earnings througout the carreer before retirment (Average Indexed Monthly Earnings, to be exact; see French (2005) [6]). In fact, a person can work and receive Social Security benefits simultaneously. However, for beneficiaries of Social Security earnings test taxes labor income and benefits at very high level.

The base for calculation of Social Security benefits is Average Indexed Monthly Earnings of individual, an average earnings in the 35 highest earning years in the labor market. For the person who starts his working life at the age of 25 this means that Social Security benefits will grow fastest until the age of 60. Moreover, to increase the amount of benefits received, agent has to earn a lot after the age of 60 and before the application to benefits.

At the age of 62 agents become eigible to Social Security payments. However, for each year before Normal Retirement Age (that are higher for more recent cohorts of retirees) that a person applies for benefits they are reduced by 6.7%. On the other hand, for each year on top of NRA benefits increase by additional 3%.

Earnings test currently applies to individuals who receive Social Security benefits and work. For those who didn't yet attain NRA there is an exempt amount of earnings, over which earnings are taxed at 50% rate on top of all other taxes, until all benefits are taxed away. For individuals of NRA and older, higher exempt amounts were established prior to 2000, when earnings test was eliminated for these individuals. However, it is important to know that taxed benefits currently are just withholding until an individual reaches NRA, when monthly benefit is increased permanently to account for the time during which they were withheld.

5.7.3 *Pension Benefits*

Pension benefits are different from social security in that they are provided by empoyer. Like Social Security, pensions are illiquid until certain age (depending on particular pension plan) and depend on individuals earning history (typically, on years of service at the particular firm). I can borrow the ideas on how to construct pension from French (2005) [6].

5.8 Modelling behavioral changes: exogenous data

So far, the model described above is static in the sense that many primitivs of the model supposed to be taken from the data (e.g. survival hazards, wage profiles, benefit rules). However, in order to model behavioral changes, I need to add certain dynamics to it. In order to do that, there going to be several cohorts in the model, which are indexed by $n < N_g$. For every particular cohort, I'm going to construct the following exogenous profiles from the data.

- *Medical expenditures.* The cost of medicial services was growing rapidly in US in the last few decades. Despite the increase in Medicare and Medicaid coverage, it is highly probable that out-of-pocket expenditures constitue larger ang larger parts of medical expenses of consequent generations.
- *Survival hazard.* Take a person born, say, in 1920. It is clear that survival hazard for the person is quite different than the one for the person born in 1950, but not that much different for the persons born in 1915 or 1925. So what I will try to do is to construct a few cohorts, with a mean birth years separated by 15-20 years, and construct survival profiles for them. I should take into account gender differences and the fact that more educated persons on average earn more, ang in general more healthy, as well as advances in medical science and changes in consciousness about healthy lifestyle.
- *Wage profiles.* Again, wage profile for a person born in 1920 is quite different that for the person born in 1950 (e.g. rise in returns to education, job polarization etc.). So I will try to construct those too.
- *Benefits.* Each of three parts of b_t changed over the years. For example, Medicare coverage grow over the years.

- *Earnings test.* In year 2000, the earnings test was eliminated for those who work after normal retirement age. This may present a strong incentive to work after normal retirement age.

Upon constructing these profiles, I can solve the model and simulate labor supply choices of individuals under different regimes, as well as conduct counterfactual experiments.

5.9 Dynamic programming problem

The problem of indvidual in recursive formulation is presented below. Here I suppress the indices, which only characterize exogenously given structures:

- gender index g;
- education index e;
- cohort index c.

These characteristics are static in the sense that they only affect agents givens, such as mean wage profile, government benefits, survival hazards. Given these objects, agent's state consists of its current age t, current level of assets a, idiosyncratic productivity z, health status h, medical expenditure m, level of accumulated labor income $\bar{y}$. Given the current state, agent chooses level of consumption, labor supply and assets to save:

$$V(t, a, z, h, m, \bar{y}, S, y_{min}) = \max_{c,l,a',S'} \{u(c, l, h) + \beta s_t E_{P,H,M} V(t+1, a', z', h', m', \bar{y}', y'_{min})\} \tag{3}$$

subject to

$$\begin{aligned} c + a' + m = a + Y(ra + y + b + \upsilon, \tau) \\ a' \geqslant 0 \\ \ln y = \ln w + \alpha \ln l + \ln z \\ \bar{y}' = f(\bar{y}, y) \\ b_t = b_t^{Ma} + b_t^{ss} \times S_t + b_t^{pb} \\ S' = \max\{S', S\} \end{aligned}$$

Here, $f(\bar{y}, y)$ is a function that describes $AIME_t$ (Average Indexed Monthly Earnings), which is average over 35 highest earning years. For $0 \leqslant t \leqslant 35$, function just calculates average earnings. For $t > 35$ it checks if current level of income is higher than the lowest level of annual income in one of the previous years y_{min}, and recalculates $AIME$ accordingly.

6 CALIBRATION AND ESTIMATION

This section outlines assumptions in the current paper and describes approach to calibration and estimation of the model. The main assumptions are:

1. Preferences parameters of the agents in the model are similar for the different cohorts. This means in terms of preferences agents who are aged 55+ in, say, 1985, are similar to those aged 55+ in 2005.

2. The source of change in agent's behavior are changes in exogenous processes: survival hazard, medical expenditures, earnings, benefits provision, social security policies, tax regime.

6.1 General approach

The problem at hand is to model the labor supply behavior of 55+ year old individuals on intensive (hours worked per week) and extensive (participation decision) margins under different conditions with regard to differences in multiple processes mentioned above (survival hazard, medical expenditures etc). I am approaching the problem in several steps.

1. Fully calibrate model to fit the labor force participation behavior of individuals in year 1996 (the first year available at MEPS-HC dataset). In particular, this includes the estimation of individual preference parameters, that will be used in further calculatons. This is going to be done by Method of Simulated Moments (as it customary in the literature). The details of the procedure will be described further.

2. Once preference parameters are calibrated, for each year of observation available in the data I will recalibrate all exogenous processes in the model (survival hazards, medical expenditures etc.). Upon finishng the calibration, I will simulate a large number of households for each available data year, and compare the behavior of model households to the real ones. I will be able to see which part of the change in labor force participation decisions can be explained by these exogenous factors.

3. I can also conduct counterfactual experiments, shutting down certain channels of influence and comparing the results. For example, in year 2000 I can recalibrate all exogenous processes except survivl hazard, keeping that one similar to 1996, thus observing the relative importance of changes in expected longevity on labor supply decisions.

6.2 Details of Estimation Procedure

I will follow he procedure of DeNardi (2010) et al [4], French (2005) [6] and use a two-step method of simulated moments. But first, I list the parameters I need to estimate and exogenous profiles that I'm going to feed to a model to be able to solve it (that I'm going to get from the data).

- **Preference parameters** to be calibrated *once*: $\{\delta, \gamma, \bar{l}, \kappa_{e,g}, \sigma, \eta, d\}$.
- **Earnings process**: wage profiles $w^{t,e,g}$, $\{\alpha, \rho_z, \sigma_\varepsilon\}$.
- **Medical Expenditures**: profiles $m(t, e, g, h)$, $\sigma(t, e, g, h)$, $\{\rho_m, \sigma_\xi, \sigma_\epsilon\}$.
- **Survival hazard**: $s_{t,e,g,h}$.
- **Health transition probability matrix** π.
- **Tax schedule** τ to be taken from the data.
- **Consumpton floor** $\underline{c}$.
- **Lower bound on hours** $\bar{l}$.

Once these objects are estimated for each separate model date, they can be fed to te model as inputs. Then I can simulate large number of individuals to observe the following outputs, which are going to be affected by individual's gender, education, health and age.

- Labor supply and participation decisions.
- Decisions about savings.
- Timing of benefits application decision.

Given these outputs, shutting down different incentive channels, I'll be able to assess relative importance of these channels.

6.3 Data

The data I plan to use for the estimation of the model is Household Component of Medical Expenditures Panal Survey (MEPS-HC) data. MEPS bagan in 1996 and is a nationally representative survey of the U.S. civilian noninstitutionalized population. The design of survey is two-year-long overlapping panel: every year, a panel of households is selected, and data for them is collected for two years. The survey has a very detailed individual level information, including data on income, education, health, and very thorough information about health insurance and expenditures. The informaion on medical expenditures is a primary reason for choosing this particular data set.

6.4 Moment Conditions

The set of moment conditions I'm going to use in MSM approach is presented below. Assumption is that distribution of state varables is the same in the data and in the simulations.

$$m(t, e, g, h)^{year} = \tag{4}$$

7 CONSTRUCTION OF PROFILES

I need several life-cycle profiles to use as the inputs to model: wage profile, medical expenditures and survival hazards. This section is intended for the discussion of these profiles in details. I need to track the changes in labor force supply of individuals over years. An example of suitable profile would be a wage of a college educated female who is 55 in 1996. This means she was born in 1941 and tured 25 in 1966. Thus I need the average wages of college-educated females, born in 1941, from 1966 to 1996. However, MEPS-HC only started in 1996. This means I don't have ANY histories of individuals' wages prior to 1996.

8 APPENDIX A. NOTATION.

Variable	Meaning
t	Age
J	Maximum age
$s_{t,e,g}$	Survival hazard
a_t	Asset level
e	Education level
g	Gender
h_t	Health status
π	Health transition probability
$\bar{l}$	Lower bound on hours worked
B	Bequest function
η	Magnitude of bequest motivation
d	Curvature of bequest function
$\delta(h)$	Health modulator of utility
κ	Fixed cost of work
z_t	Idiosyncratic productivity
$w_{t,e,g}$	Wage profile
ρ_z	Persistence parameter of idiosyncratic productivity
α	Penalty for part-timers
ε_t	Transitory component of idiosyncratic productivity
m_t	Out-of-pocket medical expenditures
ρ_m	Persistence parameter of medical expenditures
σ	Intensity of AR1 process of medical expenditures
τ_x	Various tax rates
b_x	Various benefits
$\underline{c}$	Consumption floor
S	Benefit application choice

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