The Effects of Health, Wealth, and Wages on Labor Supply and Retirement Behavior

Eric French, Review of Economic Studies, 2005

By Mariacristina De Nardi
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• Estimates a life-cycle model of:
  • Labor supply and retirement
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• Uncertain health and wages
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• Social Security benefits and private pensions
Methodological contributions

Novelty of this framework, treat systematically

• Whole life cycle
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- Assets
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• Decisions of men ages 30-90
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- Decisions of men ages 30-90
- Structural estimation using Method of Simulated Moments
Economics contributions

- Better evaluate the effects of various changes in Social Security rules and benefits taxation
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- Better evaluate the effects of various changes in Social Security rules and benefits taxation
- Is it most effective to change retirement age or benefits taxation? What about cutting benefits?
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• Is it most effective to change retirement age or benefits taxation? What about cutting benefits?
• When will people change their behavior in response to policy? Will they work more and save more when young or retire later in response to changes in Social Security benefits?
Important background: Social Security rules

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    - Between ages 65 and 70, every additional year of work increases benefits by 3%, which is roughly unfair
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  - Major disincentive to work after age 65
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  - Accrual rates tend to be higher for those with higher wages
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  - Illiquid until 62

Use estimates of age-specific accrual rates from Gustman, Mitchell, Samwick, and Steinmaier (1998). Base it on AIME plus an age-dependent residual to account for different accrual rate by age. Thus, the residual is negative at younger ages and positive at older ages. Model regressivity of pensions as a function of AIME due to higher accrual rates for highest earners.
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Key findings

- Fixed costs make labor supply a discontinuous decision
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- Job exit (retirement) rates spike at ages 62 and 65
- Key determinants of retirement: Tax incentives generated by Social Security and pensions
  - Example: Removing the Social Security earnings test (tax) for individuals aged 65 and older ⇒ Workers delay job exit by one year
Key findings

• Less important:
  • Social Security benefit levels
  • Health
  • Borrowing constraints
  • Example: Reducing Social Security benefits by 20% delays exit from the labor force by only three months
Flow Utility

- Flow utility at age $t$

$$U(C_t; H_t; M_t) = \frac{1}{1 - \nu} \left[ C_t^\gamma L_t^{1-\gamma} \right]^{1-\nu}, \quad \gamma \in (0, 1), \nu > 0$$

$$L_t = L - H_t - \phi_P \cdot 1\{H_t > 0\} - \phi_M \cdot 1\{M_t = \text{bad}\}$$

where:

- $C_t$ consumption
- $H_t$ hours of work
- $M_t \in \{\text{bad, good}\}$ health
- $L_t = \text{leisure}$
- $\phi_P = \text{fixed cost of working}$
- $\phi_M = \text{time cost/disutility of bad health}$
Flow Utility

• The parameter $\nu$ controls:
  • Intertemporal substitution of consumption-leisure composite
  • Intratemporal substitutability of consumption and leisure:
    $\nu > 1 \Rightarrow$ leisure and consumption are substitutes
Fixed Costs of Working

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- This reflects fixed costs of work
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  - Elasticity is low when zero hours is not attractive: “prime-age” workers
Intertemporal elasticity of labor supply

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- Labor force participation declining sharply after age 55, especially at 62 and 65
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- Labor force participation declining sharply after age 55, especially at 62 and 65
- Ages at which Soc. Sec., pensions and declining wages provide incentives to leave labor force
### Distribution of Hours Worked (percentage shares) in the U.S. by Age and Gender (HRS data)

<table>
<thead>
<tr>
<th></th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>50-54</td>
<td>60-64</td>
</tr>
<tr>
<td>0 hours</td>
<td>16.8</td>
<td>44.7</td>
</tr>
<tr>
<td>1-500 hours</td>
<td>0.4</td>
<td>0.9</td>
</tr>
<tr>
<td>501-1000 hours</td>
<td>0.9</td>
<td>2.2</td>
</tr>
<tr>
<td>1001-1500 hours</td>
<td>1.7</td>
<td>2.4</td>
</tr>
<tr>
<td>1501-2000 hours</td>
<td>43.1</td>
<td>30.0</td>
</tr>
<tr>
<td>2001-2500 hours</td>
<td>21.1</td>
<td>12.4</td>
</tr>
<tr>
<td>2501-5000 hours</td>
<td>15.9</td>
<td>7.8</td>
</tr>
</tbody>
</table>

Source: French and Jones (Econometrica, 2011).
Sources of Uncertainty

• Health: $\pi_{ij,t+1} = \Pr(M_{t+1} = j \mid M_t = i)$ = age-dependent transition probabilities
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- **Mortality**: \( s_{M,t+1} = \text{age- and health-dependent survival probability} \)
  - \( s_{M,T+1} \equiv 0 \)
Sources of Uncertainty

- Health: $\pi_{ij,t+1} = \Pr(M_{t+1} = j | M_t = i) = \text{age-dependent transition probabilities}$
- Mortality: $s_{M,t+1} = \text{age- and health-dependent survival probability}$
  - $s_{M,T+1} \equiv 0$
- Wages:

$$\ln W_t = \alpha \ln H_t + W(M_t, t) + AR_t,$$

$W(M_t, t) = \text{age- and health-dependent component},$

$\alpha \ln H_t = \text{effect of employer-side fixed costs},$

$AR_t = \rho AR_{t-1} + \eta_t,$

$\eta_t \sim N(0, \sigma_\eta^2),$

$= \text{idiosyncratic shock}.$
Budget Constraints

• Asset accumulation equation:

\[ A_{t+1} = A_t + Y(rA_t + W_t H_t + y_s t + p_b t + \varepsilon_t, \tau) + B_t s_s t - C_t, \]

where:

- \( Y(l, \tau) \) = net income, function of total income \( l \) and tax parameter vector \( \tau \)
- \( y_s t \) = spousal (non-family head) income
- \( p_b t \) = pension benefits, calculated as function of Social Security benefits
- \( \varepsilon_t \) = pension accrual residual
- \( s_s t \) = Social Security benefits
- \( B_t = 1 \) if agent is receiving Social Security, = 0 otherwise

Borrowing constraint

\[ A_{t+1} \geq 0. \] (BC)
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Social Security

- Benefits based on $AIME = \text{average earnings in 35 best years}$
  - Formula converting AIME to benefits increasing and concave
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- Benefits based on $AIME = \text{average earnings in 35 best years}$
  - Formula converting AIME to benefits increasing and concave
- First eligible for benefits at age 62
  - Delaying benefits actuarially fair for average person prior to age 65
  - Receive “full” benefit at normal retirement age $= 65$
  - Delaying benefits actuarially unfair after age 65
Social Security

- Social Security provides 3 retirement incentives
  - Borrowing against Social Security is illegal ⇒ Some workers wait to retire to receive benefits
  - After 35 years of work, earnings increase benefits only if they raise worker's average earnings
  - Social Security beneficiaries have labor income taxed through the earnings test
Pension Wealth

- Illiquid until age 62
- Pension wealth/benefits are modelled as a function of \( AIME \)
  - Reduces dimension of state space when finding decision rules
- Pension **accrual** (accumulation) explicitly modelled as a function of age and earnings
  - When pension accrual deviates from \( AIME \) accrual, use the residual \( \varepsilon_t \) to compensate
Recursive Formulation

- State vector: \( X_t = (A_t, AR_t, B_t, M_t, AIME_t) \)
- Social Security receipt is permanent: \( B_{t-1} = 1 \Rightarrow B_t = 1 \)
- Bellman equation:

\[
V_t(X_t) = \max_{\{C_t, H_t, B_t\}} \frac{1}{1 - \nu} \left[ C_t^\gamma L_t^{1-\gamma} \right]^{1-\nu} \\
+ \beta s_{M,t+1} \int V_{t+1}(X_{t+1})dF(X_{t+1}|X_t, C_t, H_t, B_t) \\
+ \beta (1 - s_{M,t+1}) \theta_B \frac{1}{1 - \nu} (A_{t+1} + \kappa)^{1-\nu}
\]

subject to (AA), (BC), and laws of motion for Social Security, pensions and net income
Recursive Formulation

- $\theta_B \frac{1}{1-\nu} (A_{t+1} + \kappa)^{1-\nu}$: utility from bequests
- $\theta_B > 0$ controls intensity
- $\kappa \geq 0$ controls curvature
Estimation and calibration

• Split parameter vector into

\[ \chi = \left( r, \{ \pi_{ij,t+1}\}_t, \{ s_{M,t+1}\}_t, \rho, \sigma_{\eta}^2, \alpha, \{ W(M_t, t)\}_t, \{ y_{st}(W_t)\}_t, \right. \]

\[ \left. Y(l, \tau), \text{Social Security rules, pension rules} \right) \]

\[ = \text{first-stage parameters}, \]

\[ \theta = (\gamma, \nu, \phi_P, \phi_M, \theta_B, \kappa, L, \beta) = \]

\[ = \text{second-stage parameters (preference parameters)} \]
Data

- Labor supply data: Male heads of households
- Asset data: Household-level
Calibration and estimation of first-step parameters

- Part-time wage penalty coefficient: chosen so that part-time workers earn 25% less than full time workers
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- Spousal earnings: polynomial in age and log wage
Estimation of profiles

Life cycle profiles of assets, hours, participation and wages: estimated from PSID
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Take $Z_{it}$ to be one of our profiles

$$
Z_{it} = f_{it} + \sum_{k=1}^{T} \prod_{g} I\{age_{it} = k\} \text{prob}(M_{it} = \text{good}|M_{it})
$$

$$
+ \sum_{k=1}^{T} \prod_{b} I\{age_{it} = k\} \text{prob}(M_{it} = \text{bad}|M_{it})
$$

$$
+ \sum_{j=1}^{F} \prod_{f} famsize_{it} + \prod_{U} U_{t} + u_{it}
$$

Assets are assumed not to depend on health

Keep age and health effect profiles for model

Family size = 3

Unemployment = 6.5%

Mean individual fixed effect of 1940 cohort
Estimation of profiles

Life cycle profiles of assets, hours, participation and wages: estimated from PSID

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Method of Simulated Moments, match data and model generated data for life cycle profile of:

- Mean labor force participation, conditional on health
Moment Conditions

Method of Simulated Moments, match data and model generated data for life cycle profile of:

- Mean labor force participation, conditional on health
- Mean hours worked, conditional on health
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- Mean labor force participation, conditional on health
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- Median and mean assets, unconditional of health
Moment Conditions

Method of Simulated Moments, match data and model generated data for life cycle profile of:

- Mean labor force participation, conditional on health
- Mean hours worked, conditional on health
- Median and mean assets, unconditional of health
- Assume that individuals do not work after age 70 and do not match any moments after that
Moment Conditions

- Let $\overline{Z}_t = E(Z_t)$
- For $t = 31, 32, \ldots, 70$, $M \in \{\text{good, bad}\}$:
  
  $$
  E \left( 1 \left\{ A_{it} \leq A_t^{\text{median}}(X; \theta, \chi) \right\} - 1/2 \right) = 0, \\
  E \left( A_{it} - \overline{A}_t(X; \theta, \chi) \right) = 0, \\
  E \left( \left[ \ln H_{it} - \ln H_t(X, M; \theta, \chi) \right] \cdot 1\{H_{it} > 0\} \cdot 1\{M_{it} = M\} \right) = 0, \\
  E \left( \left[ 1\{H_{it} > 0\} - \overline{P}_t(X, M; \theta, \chi) \right] \cdot 1\{M_{it} = M\} \right) = 0
  $$
Wage selection, even with fixed-effect estimators

- Use wages for workers but do not use potential wages of non-workers
Wage selection, even with fixed-effect estimators

- Use wages for workers but do not use potential wages of non-workers
- Demeans average level of wages for people in sample ⇒ identifies growth rate of wages while working

• Not a problem if they have the same wage growth rate
• But: If individuals drop because of a sudden wage drop, such as wage loss, ⇒ Growth rate for wage workers is higher than for non-workers
• Composition bias: low wage growth people drop out of labor market
• Not accounting for selection biases estimated wage growth upward
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- Demeans average level of wages for people in sample ⇒ identifies growth rate of wages while working.
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Wage selection: Toward a solution

Consider three important objects

- Unobserved wage profile for individual. This is what we need
Wage selection: Toward a solution

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Wage selection: Toward a solution

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- Assume that the data wage profile and the model wage profile are biased in the same way
- True if simulated individuals face same wage generating process, same state variables, and same preferences as people in data
French’s wage selection adjustment

1. Feed estimated (and biased) fixed-effect wage profile in model. Solve and simulate model
2. Estimate fixed-effect wage profiles for both simulated workers and all simulated individuals
3. Compute difference between the two profiles in 2 to evaluate wage growth overestimation by age
4. Use estimated difference to correct wage-profiles that are fed into the model
5. Repeat until convergence
6. Repeat for every set of preference parameters we are estimating until GMM criterion function is satisfied
Results, data

- LHS: healthy, RHS: unhealthy
- Health has a large effect on hours. Hours are lower and decline earlier
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- Health has a large effect on participation after age 40. Participation of unhealthy declines much earlier and fast
- Participation of the healthy is very high until past age 50
Results
Results, model fit

• LHS: healthy, RHS: unhealthy
• Unhealthy: Model misses gradual decline in HOURS until age 58 and fast decline after that
• Unhealthy: Model misses decline in PARTICIPATION during working life
• Some serious issues for modeling the unhealthy. Perhaps health measure is not good enough. Perhaps modeling disability is important
• Healthy: model misses hours and participation after age 62
Results
# Estimates

## TABLE 2

*Preference parameter estimates*

<table>
<thead>
<tr>
<th>Parameter and definition</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>( \gamma ) Consumption weight</td>
<td>0.578 (0.003)</td>
</tr>
<tr>
<td>( \nu ) Coefficient of relative risk aversion, utility</td>
<td>3.34 (0.07)</td>
</tr>
<tr>
<td>( \beta ) Time discount factor</td>
<td>0.992 (0.002)</td>
</tr>
<tr>
<td>( L ) Leisure endowment</td>
<td>4466 (30)</td>
</tr>
<tr>
<td>( \phi ) Hours of leisure lost, bad health</td>
<td>318 (9)</td>
</tr>
<tr>
<td>( \theta_p ) Fixed cost of work, in hours</td>
<td>1313 (14)</td>
</tr>
<tr>
<td>( \theta_B ) Bequest weight</td>
<td>1.69 (0.05)</td>
</tr>
<tr>
<td>( \chi^2 ) Statistic: (233 degrees of freedom)</td>
<td>856</td>
</tr>
<tr>
<td>( \epsilon_{14}, \mu (40) ) Labour supply elasticity, age 40</td>
<td>0.37</td>
</tr>
<tr>
<td>( \epsilon_{14}, \mu (60) ) Labour supply elasticity, age 60</td>
<td>1.24</td>
</tr>
<tr>
<td>Reservation hours level, age 62</td>
<td>885</td>
</tr>
<tr>
<td>Coefficient of relative risk aversion</td>
<td>2.35</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

Specifications described below:

1. Does not account for selection or tied wage-hours offers
2. Accounts for selection but not tied wage-hours offers
3. Accounts for tied wage-hours offers but not selection
4. Accounts for selection and tied wage-hours offers
Estimates, discussion

- Labor supply elasticity increases by age
  Age 40: 0.2-0.4. Age 60: 1.0-1.3
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• Fixed cost of working $\Rightarrow$ minimum numbers of hours worked, between 885 to 1072

• It is identified by the profile of hours over the life cycle. If there is no fixed cost of working, hours decline smoothly
Estimates, discussion

- Risk aversion identified by
  - Amount of assets held when young to self-insure against wage shocks
  - Labor supply when young, to help earn and save
Estimates, the effects of selection and tied-wage offers

- Correcting for selection due to participation implies that
  - At ages 62 and 65 wages are respectively 7% and 11% lower than implied by the fixed effects wage regression
  - Health reduces wages by an additional 2% than implied by the fixed effects wage regressions
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- There is evidence that the drop in wages after age 60 is linked to a drop in hours. Failure to account for tied wage-hours offers may lead to a downward bias in productivity growth after age 60
  - The fixed cost of working is very sensitive on whether wages and hours are linked. This is because part-time work pays less and is thus less desirable
  - A large fixed cost of working is needed if wages and hours are not tied
What causes the high job exit rate at 62?

- People are assumed to start drawing benefits at 62. They are taxed and, due to progressive taxation, the marginal tax rate increases. This causes about half of the decline in labor supply at 62.
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- Borrowing constraints are not important.
- The effect of SS actuarial accrual between 62 and 65 depends a bit on the interest rate assumed, but is overall minor.
Model generates consumption drop at retirement

Because consumption and leisure are substitutes
Policy experiments

- Shift early retirement from age 62 to age 63: Almost no effect on labor supply
- Reduce Social Security benefits by 20%: delay exit from labor market by 3 months
- Eliminate Soc. Security earnings test: Work one more year
<table>
<thead>
<tr>
<th>Policy Experiments</th>
<th>Years Worked (1)</th>
<th>Hours per Year (2)</th>
<th>PDV of Labor Income (3)</th>
<th>PDV of Cons. (4)</th>
<th>Assets at Age 62 (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1987 Results</td>
<td>32.60</td>
<td>2,097</td>
<td>1,781</td>
<td>1,583</td>
<td>190</td>
</tr>
<tr>
<td>↓ 20%</td>
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<td>200</td>
</tr>
<tr>
<td>↓ benefits &amp; taxes</td>
<td>33.00</td>
<td>2,115</td>
<td>1,803</td>
<td>1,586</td>
<td>203</td>
</tr>
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<td>32.62</td>
<td>2,096</td>
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<tr>
<td>No earnings test, age 65+</td>
<td>33.62</td>
<td>2,085</td>
<td>1,799</td>
<td>1,594</td>
<td>188</td>
</tr>
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</table>

Columns (3)-(5) are measured in thousands of 1987 dollars.
Results discussion

- Model: reasonable preference parameters
- Captures drops in labor force participation
- To fit both participation an hours worked, estimate a large fixed cost of work ⇒ high labor supply substitutability at the labor force participation margin
- Because of Soc. Sec. and pension incentives to leave lab. force, those in their 60s are near the lab. force partic. margin
- ⇒ labor supply elasticities rise from .3 at age 40 to 1.1 at age 60
Paper’s limitations

- No medical expenses (French and Jones, Econometrica 2011)
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- No pension choice. No role for pension defaults and “nudges”