Are marriage-related taxes and Social Security benefits holding back female labor supply?

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U.S. marriage-related policies

• Taxes and old age Social Security benefits depend on marital status
  • Joint income tax
  • Social Security spousal benefit
  • Social Security survival benefit
U.S. marriage-related policies

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• Question: how do marriage-related policies affect
  • Labor supply of women
  • Labor supply of men
  • Savings
  • Welfare
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- Question: how do marriage-related policies affect
  - Labor supply of women
  - Labor supply of men
  - Savings
  - Welfare

- Labor supply of married women has been changing over time. Do the effects of these policies depend on the cohort?
  - Two cohorts (1945 cohort and 1955 birth cohorts)
Why might they matter? Marginal tax rate for women

Women’s marginal tax rates

Empirical cumulative distribution

Marginal tax rate

Women’s income

Cumulative probability

Non-working wives’ marginal tax rate
Why might they matter? Social Security benefits

![Social Security Benefit Graph](image1)

![Survivor Benefit Graph](image2)
Participation for women, 1945 and 1955 cohorts

![Labor Participation Chart]

- Single women, 1945
- Married women, 1945
- Single women, 1955
- Married women, 1955

Age:
- 25
- 30
- 35
- 40
- 45
- 50
- 55
- 60
- 65
Participation for men, 1945 and 1955 cohorts
Approach

• Partial equilibrium, cohort level analysis
Approach

- Partial equilibrium, cohort level analysis
- Data
  - Panel Study of Income Dynamics (PSID): working period
  - Health and Retirement Study (HRS): retirement period
Approach

• Partial equilibrium, cohort level analysis
• Data
  • Panel Study of Income Dynamics (PSID): working period
  • Health and Retirement Study (HRS): retirement period
• Estimate model on each cohort using the Method of Simulated moments (MSM)
• Counterfactuals: eliminate marriage-related provisions
Model’s key features

- Single and married people
- Endogenous human capital
- Risks during working period and retirement
- Self-insurance: saving and labor supply (hours)
Model’s key features

- Single and married people
- Endogenous human capital
- Risks during working period and retirement
- Self-insurance: saving and labor supply (hours)
- Government
  - Taxes married and single people + tax progressivity
  - Social Security payments (survival and spousal benefits)
  - Old-age means-tested transfer programs
Model’s key features

- Lifecycle model, period length: one year
- Working stage ($t_0=25$ to 61)
  - Alive for sure
  - Labor productivity shocks
  - Might get married if single
  - Risk divorce if married
  - Both spouses can work

- Early retirement stage (62 to 65)
  - Can retire and claim Social Security. Couples retire at the same time.
  - No marriage and divorce risk

- Retirement stage ($t=99$)
  - Health shocks
  - Medical costs
  - Exogenous probability of death
    → married people might lose their spouse
Model’s key features

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- Retirement stage (66 to $T=99$)
  - Health shocks
  - Medical costs
  - Exogenous probability of death $\rightarrow$ married people might lose their spouse
Wages

• Functions of
  • Human capital, measured as average past earnings
  • Wage shocks which follow an AR(1) that depends on gender
Marriage and divorce

• Marriage
  • Probability of marrying: function of age, gender, and wage shock
  • Conditional on getting married, probability of meeting with a partner with a certain wage shock depends on your wage shock
  • Conditional partner’s productivity, distribution of partner’s characteristics are assets and human capital

• Divorce probability: function of age and wage shocks of both spouses
Children

- Exogenous fertility
- Number and age structure of children depends on maternal age and marital status
- Time costs of raising children
- Monetary costs of raising children
Health risks (after age 66)

- Age, gender, marital status, and current health affect evolution of
  - Health
  - Medical expenses
  - Survival
Government

- Taxes income, progressive taxation of couples and singles
  \[ T(Y, i, j, t) = (1 - \lambda_t^{i,j} Y^{-\tau_t^{i,j}}) Y. \]
- Taxes labor income, up to Social Security cap \( \tilde{y}_t \), at rate \( \tau_t^{SS} \) to finance old-age Social Security
- Old age means-tested cons. floor \( c(j) \) (Medicaid and SSI)
Household preferences

- $\beta$ = discount factor, $i$ = gender, $j$ = marital status
- Time endowment: $L^{i,j}$
- Leisure $l_{t}^{i,j} = L^{i,j} - n_{t}^{i,j} - \phi_{t}^{i,j} l_{n_{t}^{i,j}}$
Household preferences

- $\beta =$ discount factor, $i =$ gender, $j =$ marital status
- Time endowment: $L^{i,j}$
- Leisure $l^{i,j}_t = L^{i,j} - n^{i,j}_t - \phi^{i,j}_t L^{i,j}\omega$  
- Singles

$$v(c_t, l_t) = \frac{(c_t/\eta^{i,j}_t)^{\omega} l^{1-\omega}_t}{1-\gamma} - 1$$
Household preferences

- $\beta =$ discount factor, $i =$ gender, $j =$ marital status
- Time endowment: $L_{i,j}$
- Leisure $l_{i,j}^t = L_{i,j} - n_{i,j}^t - \phi_{i,j}^t l_{n_{i,j}}^t$
- Singles
  
  $$v(c_t, l_t) = \frac{((c_t/\eta_{i,j}^t)^{\omega} l_t^{1-\omega})^{1-\gamma} - 1}{1 - \gamma}$$

- Couples
  
  $$w(c_t, l_1^t, l_2^t) = \frac{((c_t/\eta_{i,j}^t)^{\omega} (l_1^t)^{1-\omega})^{1-\gamma} - 1}{1 - \gamma} + \frac{((c_t/\eta_{i,j}^t)^{\omega} (l_2^t)^{1-\omega})^{1-\gamma} - 1}{1 - \gamma}$$
Value functions for couples and people in couples

- Working period
- Early retirement
- Retirement
- People in couples
Value functions for singles

- Working period
- Early retirement
- Retirement
Two-step estimation strategy

• First step inputs for each cohort
  • Estimate from data directly (taxes, demographics, wage risk, health risk, human capital accumulation function...)
  • Fix some parameters to calibrated or estimated values (externally to model)
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  - Estimate from data directly (taxes, demographics, wage risk, health risk, human capital accumulation function...)
  - Fix some parameters to calibrated or estimated values (externally to model)
- Second step, 1945 cohort
  - Estimate other parameters matching data targets for 1945 cohort
Two-step estimation strategy

- First step inputs for each cohort
  - Estimate from data directly (taxes, demographics, wage risk, health risk, human capital accumulation function...)
  - Fix some parameters to calibrated or estimated values (externally to model)
- Second step, 1945 cohort
  - Estimate other parameters matching data targets for 1945 cohort
- Second step, 1955 cohort
  - Fix preference parameters and use rest of parameters to match data targets for 1955 cohort
PSID: Wage profiles, 1945 and 1955 cohorts

![Hourly wage charts for different gender and marital status groups.](image-url)
### Other first-step inputs

- Marriage
- Divorce
- Children
- Health transitions
- Health cost
- Survival
- Calibrated parameters
### Estimated parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>1945 cohort</th>
<th>1955 cohort</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$: Discount factor</td>
<td>0.990</td>
<td>0.990</td>
</tr>
<tr>
<td>$\omega$: Consumption weight</td>
<td>0.406</td>
<td>0.406</td>
</tr>
<tr>
<td>$L^{2,1}_t$: Time endowment (weekly hours), single women</td>
<td>107</td>
<td>112</td>
</tr>
<tr>
<td>$L^{1,2}_t$: Time endowment (weekly hours), married men</td>
<td>107</td>
<td>101</td>
</tr>
<tr>
<td>$L^{2,2}_t$: Time endowment (weekly hours), married women</td>
<td>88</td>
<td>88</td>
</tr>
<tr>
<td>$\tau_c^{0,5}_t$: Prop. child care cost for children age 0-5</td>
<td>30%</td>
<td>25%</td>
</tr>
<tr>
<td>$\tau_c^{6,11}_t$: Prop. child care cost for children age 6-11</td>
<td>7%</td>
<td>19%</td>
</tr>
<tr>
<td>$\Phi_{i,j}^t$: Partic. cost</td>
<td>Fig. 27</td>
<td>Fig. 27</td>
</tr>
</tbody>
</table>

**Table:** Second-step estimated model parameters
Hours, 1945 cohort

- Married women
- Married men
- Single women
- Single men

<table>
<thead>
<tr>
<th>Age</th>
<th>Hours among workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>500</td>
</tr>
<tr>
<td>30</td>
<td>1000</td>
</tr>
<tr>
<td>35</td>
<td>1500</td>
</tr>
<tr>
<td>40</td>
<td>2000</td>
</tr>
<tr>
<td>45</td>
<td>2500</td>
</tr>
<tr>
<td>50</td>
<td>500</td>
</tr>
<tr>
<td>55</td>
<td>1000</td>
</tr>
<tr>
<td>60</td>
<td>1500</td>
</tr>
<tr>
<td>65</td>
<td>2000</td>
</tr>
</tbody>
</table>

Model:
- Model
- Data
- Data, upper bound
- Data, lower bound

Data:
- Data
- Data, upper bound
- Data, lower bound
Savings. 1945 cohort

**Couples**

- Model
- Data
- Data, upper bound
- Data, lower bound

**Single women**

- Model
- Data
- Data, upper bound
- Data, lower bound

**Single men**

- Model
- Data
- Data, upper bound
- Data, lower bound
### Labor supply elasticity, temporary wage change

<table>
<thead>
<tr>
<th></th>
<th>Participation</th>
<th>Hours among workers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Married</td>
<td>Single</td>
</tr>
<tr>
<td></td>
<td>W  M</td>
<td>W  M</td>
</tr>
<tr>
<td>30</td>
<td>1.0 0.0</td>
<td>0.2 0.3</td>
</tr>
<tr>
<td>40</td>
<td>0.7 0.1</td>
<td>0.3 0.5</td>
</tr>
<tr>
<td>50</td>
<td>0.6 0.2</td>
<td>0.5 0.5</td>
</tr>
<tr>
<td>60</td>
<td>1.1 0.8</td>
<td>0.4 0.2</td>
</tr>
</tbody>
</table>

|        | Married       | Single              |
|        | W  M          | W  M                |
| 30     | 0.5 0.2       | 0.4 0.3             |
| 40     | 0.4 0.2       | 0.5 0.5             |
| 50     | 0.4 0.5       | 0.8 0.5             |
| 60     | 1.4 2.0       | 0.5 0.3             |

**Table:** Labor supply elasticity, temporary wage change, 1945 cohort
Labor supply elasticity, permanent wage change, 1945 cohort

Elasticity in participation
Raise wages of married women by: 5%

Change in participation
Raise wages of married women by: 5%
What is the effect of marriage-related policies?

In all cases, adjust the proportional component of the income tax to maintain revenue neutrality

- Eliminating Social Security marital benefits, 1945 cohort
- Taxing everyone as singles, 1945 cohort
- Eliminating Social Security marital benefits and taxing everyone as singles, 1945 cohort
- Eliminating Social Security marital benefits and taxing everyone as singles, 1955 cohort
## Welfare, 1945 cohort

<table>
<thead>
<tr>
<th>Policy Change</th>
<th>All Couples</th>
<th>SW</th>
<th>SM</th>
<th>All Winners Couples</th>
<th>SW</th>
<th>SM</th>
<th>All Losers Couples</th>
<th>SW</th>
<th>SM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remove Social Security spousal benefits, unbalanced budget</td>
<td>Avg</td>
<td>-0.25</td>
<td>-0.23</td>
<td>0.31</td>
<td>0.00</td>
<td>0.00</td>
<td>0.31</td>
<td>-0.25</td>
<td>-0.23</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>0.0</td>
<td>0.0</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
<td>0.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>Remove Social Security spousal benefits, balanced budget</td>
<td>Avg</td>
<td>0.71</td>
<td>0.20</td>
<td>1.30</td>
<td>0.71</td>
<td>0.22</td>
<td>1.30</td>
<td>0.00</td>
<td>-0.04</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>100.0</td>
<td>93.4</td>
<td>100.0</td>
<td>0.0</td>
<td>6.6</td>
<td>0.0</td>
<td>100.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Remove joint income taxation, balanced budget</td>
<td>Avg</td>
<td>0.33</td>
<td>-0.10</td>
<td>1.25</td>
<td>0.45</td>
<td>0.11</td>
<td>1.25</td>
<td>-0.09</td>
<td>-0.15</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>78.5</td>
<td>17.9</td>
<td>100.0</td>
<td>21.5</td>
<td>82.1</td>
<td>0.0</td>
<td>100.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Remove all marital related polices, balanced budget</td>
<td>Avg</td>
<td>0.83</td>
<td>0.03</td>
<td>2.24</td>
<td>0.84</td>
<td>0.31</td>
<td>2.24</td>
<td>-0.04</td>
<td>-0.13</td>
</tr>
<tr>
<td></td>
<td>%</td>
<td>98.9</td>
<td>35.8</td>
<td>100.0</td>
<td>1.1</td>
<td>64.2</td>
<td>0.0</td>
<td>100.0</td>
<td>0.0</td>
</tr>
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</table>
Welfare, remove all marital related polices, balanced budget, 1945 and 1955 cohorts

<table>
<thead>
<tr>
<th></th>
<th>All Couples</th>
<th>All SW</th>
<th>All SM</th>
<th>Winners Couples</th>
<th>Winners SW</th>
<th>Winners SM</th>
<th>Losers Couples</th>
<th>Losers SW</th>
<th>Losers SM</th>
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<tr>
<td>1945 cohort</td>
<td></td>
<td></td>
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<td>64.2</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1955 cohort</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Avg</td>
<td>0.75</td>
<td>0.21</td>
<td>1.31</td>
<td>0.77</td>
<td>0.31</td>
<td>1.31</td>
<td>-0.05</td>
<td>-0.05</td>
<td>-0.02</td>
</tr>
<tr>
<td>%</td>
<td>97.2</td>
<td>70.9</td>
<td>100.0</td>
<td>2.8</td>
<td>29.1</td>
<td>0.0</td>
<td></td>
<td></td>
<td></td>
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Conclusions

• Estimate a rich life-cycle model of couples and singles with marriage-related policies:
  • Marital income tax,
  • Social Security spousal benefits
  • Social Security survival benefits

• Removal of marriage-related provisions
  • Increases participation of married women over their life cycle
  • Reduces participation of married men after age 55
  • Increases savings of couples

• Is welfare improving for most

• Effects are also large for the 1955 cohort, who had much higher labor market participation of married women to start with
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Contributions

- First estimated structural model of couples and singles with participation and hours decisions (both men and women) and savings
- Study all marriage-related taxes and benefits in a unified framework
- Study two different cohorts
- Rich framework
  - Labor market experience can affect wages
  - Survival, health, and medical expenses in old age, heterogeneous by marital status and gender
  - Fit data for participation, hours worked, savings, and labor supply elasticities
Hours for women, 1945 and 1955 cohorts

Average Working Hours (Workers)

Age

25 30 35 40 45 50 55 60 65

1300 1400 1500 1600 1700 1800 1900 2000

Single women, 1945
Married women, 1945
Single women, 1955
Married women, 1955
Hours for men, 1945 and 1955 cohorts

Average Working Hours (Workers)

- Single men, 1945
- Married men, 1945
- Single men, 1955
- Married men, 1955
Recursive problem for working-age singles

\[ W^s(t, i, a_t^i, \epsilon_t^i, \bar{y}_t^i) = \max_{c_t, a_{t+1}, n_t^i} \left( v(c_t, l_t^{i,j}) + \beta(1 - \nu_{t+1}() E_t W^s(t + 1, i, a_{t+1}^i, \epsilon_{t+1}^i, \bar{y}_{t+1}^i) + \beta \nu_{t+1}() E_t \xi_{t+1}() \theta_{t+1}() \hat{W}^c(t + 1, i, a_{t+1}^i + a_{t+1}^p, \epsilon_{t+1}^i, \epsilon_{t+1}^p, \bar{y}_{t+1}^i, \bar{y}_{t+1}^p) \right) \]

- \( t \): Age
- \( i \): Gender
- \( a_t \): Net worth from previous period
- \( \epsilon_t^i \): Current productivity shock
- \( \bar{y}_t^i \): Annual accumulated Social Security earnings
Recursive problem for working-age singles

\[ Y_t^i = e_t^i \bar{y}_t^i e_t^i n_t^i \]

\[ T(\cdot) = \tau (r_a + Y_t^i \cdot j) \]
Recursive problem for working-age singles

\[ Y_t^i = e_t^i \bar{y}_t^i \epsilon_t^i n_t^i \]
\[ T(\cdot) = \tau(r_{at} + Y_t^i, j) \]

\[ \tau_c(i, j, t) = \tau_c^{0.5} f^{0.5}(i, j, t) + \tau_c^{6,11} f^{6,11}(i, j, t) \]
\[ c_t + a_{t+1} = (1 + r)a_t^i + Y_t^i(1 - \tau_c(i, j, t)) - \tau_t^{SS} \min(Y_t^i, \tilde{y}_t^i) - T(\cdot) \]
\[ \bar{y}_{t+1}^i = (\bar{y}_t^i(t - t_0) + (\min(Y_t^i, \tilde{y}_t^i)))/(t + 1 - t_0), \]
\[ a_t \geq 0, \quad n_t \geq 0, \quad \forall t \]
Early retirement stage, singles

- Single individuals don’t get married anymore.
- Decide whether to retire or not.

$$V^s(t, i, a^i_t, c^i_t, \bar{y}^i_t) = \max_{D^i_t} \left( (1 - D^i_t) N^s(t, i, a^i_t, c^i_t, \bar{y}^i_t) + D^i_t S^s(t, i, a^i_t, \bar{y}^i_t, t) \right)$$

- If retire, no longer able to work.
Early retirement stage, singles who decided not to claim SS

\[ N^s(t, i, a_t^i, \epsilon_t^i, \bar{y}_t^i) = \max_{c_t, a_{t+1}, n_t^i} \left( v^i(c_t, l_t^i) + \beta E_t V^s(t+1, i, a_{t+1}^i, \epsilon_{t+1}^i, \bar{y}_{t+1}^i) \right) \]

\[ Y_t = e_t^i j(\bar{y}_t^i) e_t^i n_t^i, \]

\[ T(\cdot) = T(Y_t + r a_t, j) \]

\[ \bar{y}_{t+1}^i = (\bar{y}_t^i(t - t_0) + (\min(Y_t^i, \bar{y}_t))) / (t + 1 - t_0), \]

\[ c_t + a_{t+1} = (1 + r) a_t^i + Y_t^i - \tau_t^{SS} \min(Y_t, \bar{y}_t) - T(\cdot), \]

\[ a_{t+1} \geq 0. \]
Early retirement stage, singles who have claimed SS

\[ S^s(t, i, a_t^i, \bar{y}_r^i, tr) = \max_{c_t, a_{t+1}} \left( v^i(c_t, L^ij) + \beta E_t S^s(t + 1, i, a_{t+1}^i, \bar{y}_r^i, tr) \right) \]

\[ Y_t = SS(\bar{y}_r^i, tr) \]

\[ T(\cdot) = T(Y_t + ra_t, j) \]

\[ c_t + a_{t+1} = (1 + r)a_t + Y_t - T(\cdot) \]

\[ a_{t+1} \geq 0. \]
Recursive problem for retired singles

$$R^s(t, i, a_t, \psi_t^i, \bar{y}_r^i, tr) = \max_{c_t, a_{t+1}} \left( v(c_t, L_t^{i,j}) + \beta s_t^{i,j}(\psi_t^i) E_t R^s(t + 1, i, a_{t+1}, \psi_{t+1}^i, \bar{y}_r^i, tr) \right)$$

- $t$ : Age
- $i$ : Gender
- $a_t$ : Net worth from previous period
- $\bar{y}_r^i$ : Annual accumulated social security earnings (PI)
- $\psi_t^i$ : Health status (good or bad)
- $tr$ : Retirement age
Recursive problem for retired singles

\[ Y^i_t = SS(\bar{y}^i_r) \]

\[ T(\cdot) = \tau \left( Y^i_t + r a_t, j \right) \]

\[ B(a_t, Y_t, \psi^i_t, c(j)) = \max \left\{ 0, c(j) - \left\{ (1 + r) a_t + Y_t - m^{i,j}_t (\psi^i_t) - T(\cdot) \right\} \right\} \]

\[ c_t + a_{t+1} = (1 + r) a_t + Y_t + B(a_t, Y^i_t, \psi^i_t, c(j)) - m^{i,j}_t (\psi^i_t) - T(\cdot) \]

\[ a_{t+1} \geq 0, \quad \forall t \]
### PSID: Marriage, 1945 and 1955 cohorts

<table>
<thead>
<tr>
<th>Age</th>
<th>Prob. of marriage</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>0.25</td>
<td>Lowest</td>
<td>Lowest</td>
</tr>
<tr>
<td>40</td>
<td>0.2</td>
<td>2nd</td>
<td>2nd</td>
</tr>
<tr>
<td>50</td>
<td>0.15</td>
<td>3rd</td>
<td>3rd</td>
</tr>
<tr>
<td>60</td>
<td>0.1</td>
<td>4th</td>
<td>4th</td>
</tr>
</tbody>
</table>

#### Borella, De Nardi, Yang

Marriage-related policies
PSID: Divorce, 1945 and 1955 cohorts

Borella, De Nardi, Yang

Marriage-related policies
PSID: number of children, 1945 and 1955 cohorts
Recursive problem for working-age couples

\[
W^c(t, a_t, \epsilon^1_t, \epsilon^2_t, \bar{y}^1_t, \bar{y}^2_t) = \max_{c_t, a_{t+1}, n_t^1, n_t^2} \left( w(c_t, l^1_{t+1}, l^2_{t+1}) \right. \\
+ (1 - \zeta_{t+1}(\cdot)) \beta E_t W^c(t + 1, a_{t+1}, \epsilon^1_{t+1}, \epsilon^2_{t+1}, \bar{y}^1_{t+1}, \bar{y}^2_{t+1}) \\
+ \zeta_{t+1}(\cdot) \beta \sum_{i=1}^2 \left( E_t W^s(t + 1, i, a_{t+1}/2, \epsilon^i_{t+1}, \bar{y}^i_{t+1}) \right) 
\]

- \( t \): Age
- \( a_t \): Net worth from previous period
- \( \epsilon^i_t \): Current productivity shock for each spouse
- \( \bar{y}^i_t \): Annual accumulated SS earnings for each spouse
- Divorce probability \( \zeta_t(\cdot) = \zeta_t(\epsilon^1_t, \epsilon^2_t) \)
Recursive problem for working-age couples

\[ Y_t^i = e_t^i (\tilde{y}_t^i) c_t^i n_t^i, \]

\[ T(\cdot) = \tau (r a_t + Y_t^1 + Y_t^2, j) \]
Recursive problem for working-age couples

\[ Y_t^i = e_t^i(\bar{y}_t^i)c_t^i n_t^i, \]
\[ T(\cdot) = \tau(ra_t + Y_t^1 + Y_t^2, j) \]
\[ \tau_c(i, j, t) = \tau_c^{0.5} f^{0.5}(i, j, t) + \tau_c^{6,11} f^{6,11}(i, j, t), \]
\[ c_t + a_{t+1} = (1 + r)a_t + Y_t^1 + Y_t^2 (1 - \tau_c(2, 2, t)) \]
\[ -\tau^{SS} (\min(Y_t, \bar{y}_t) + \min(Y_t, \bar{y}_t)) - T(\cdot) \]
\[ a_t \geq 0, \quad n_t^1, n_t^2 \geq 0, \quad \forall t \]
Early retirement stage, couples

- Couples don’t get divorced anymore.
- Decide whether to retire or not at the same time.
- If retire, no longer able to work.

\[
V^c(t, a_t, \epsilon^1_t, \epsilon^2_t, \bar{y}^1_t, \bar{y}^2_t) = \max_{D_t} \left( (1 - D_t) N^c(t, a_t, \epsilon^1_t, \epsilon^2_t, \bar{y}^1_t, \bar{y}^2_t) + D_t S^c(t, a_t, \bar{y}^1_t, \bar{y}^2_t, t) \right)
\]
Early retirement stage, couples who decided not to claim SS

\[
N^c(t, a_t, \epsilon^1_t, \epsilon^2_t, \bar{y}^1_t, \bar{y}^2_t) = \max_{c_t, a_{t+1}, n^1_t, n^2_t} \left( w(c_t, l^1_t, l^2_t) \right) \\
+ \beta E_t V^c(t + 1, a_{t+1}, \epsilon^1_{t+1}, \epsilon^2_{t+1}, \bar{y}^1_{t+1}, \bar{y}^2_{t+1}) \\
l^i_{t} = L^i - n^i_t - \Phi^i_t l^i_t, \\
Y^i_t = e^i_t (\bar{y}^i_t) \epsilon_t n^i_t, \\
T(\cdot) = T(ra_t + Y^1_t + Y^2_t, i, j, t) \\
c_t + a_{t+1} = (1 + r)a_t + Y^1_t + Y^2_t - \tau^{SS}_t (\min(Y^1_t, \bar{y}_t) + \min(Y^2_t, \bar{y}_t)) - T(\cdot) \\
\bar{y}^i_{t+1} = (\bar{y}^i_t (t - t_0) + (\min(Y^i_t, \bar{y}_t)))/(t + 1 - t_0), \\
a_t \geq 0, \quad n^1_t, n^2_t \geq 0
\]
Early retirement stage, couples who decided to claim SS

\[
S^c(t, a_t, \bar{y}_r^1, \bar{y}_r^2, tr) = \max_{c_t, a_{t+1}} \left( w(c_t, L^1_j, L^2_j) + \beta E_t S^c(t + 1, a_{t+1}, \bar{y}_r^1, \bar{y}_r^2, tr) \right),
\]

\[
Y_t = \max\left\{ (SS(\bar{y}_r^1, tr) + SS(\bar{y}_r^2, tr), \frac{3}{2} \max(SS(\bar{y}_r^1, tr), SS(\bar{y}_r^2, tr)) \right\}
\]

\[
T(\cdot) = T(Y_t + ra_t, i, j, t)
\]

\[
c_t + a_{t+1} = (1 + r)a_t + Y_t - T(\cdot)
\]

\[
a_{t+1} \geq 0.
\]
Recursive problem for retired couples

\[ R^c(t, a_t, \psi_1^t, \psi_2^t, \bar{y}_r^1, \bar{y}_r^2) = \max_{c_t, a_{t+1}} \left( w(c_t, L_1^1, L_2^2) + \beta s_t^1 \left( \psi_1^t \right) s_t^2 \left( \psi_2^t \right) E_t R^c(t + 1, a_{t+1}, \psi_{t+1}^1, \psi_{t+1}^2, \bar{y}_r^{t+1}, \bar{y}_r^{t+2}) + \beta s_t^1 \left( \psi_1^t \right) (1 - s_t^2 \left( \psi_2^t \right)) E_t R^s(t + 1, 1, a_{t+1}, \psi_{t+1}^1, \bar{y}_r^{t+1}) + \beta s_t^2 \left( \psi_2^t \right) (1 - s_t^1 \left( \psi_1^t \right)) E_t R^s(t + 1, 2, a_{t+1}, \psi_{t+1}^2, \bar{y}_r^{t+2} \right) \]

- \( t \): Age.
- \( a_t \): Net worth from previous period.
- \( \bar{y}_r^1 \): PI for men.
- \( \bar{y}_r^2 \): PI women.
- \( \psi_{t}^i \): Health status (good or bad) for each spouse.
Recursive problem for retired couples

\[
\tilde{y}_r^i = \max(\tilde{y}_r^1, \tilde{y}_r^2),
\]

\[
Y_t = \max \left\{ (SS(\tilde{y}_r^1) + SS(\tilde{y}_r^2), \frac{3}{2} \max(SS(\tilde{y}_r^1), SS(\tilde{y}_r^2)) \right\}
\]

\[
T(\cdot) = \tau(Y_t + r a_t, j)
\]

\[
B(a_t, Y_t, \psi_t^1, \psi_t^2, c(j)) = \max \left\{ 0, c(j) - \left[ (1 + r)a_t + Y_t - m_t^1j(\psi_t^1) - m_t^2j(\psi_t^2) - T(\cdot) \right] \right\}
\]

\[
c_t + a_{t+1} = (1 + r)a_t + Y_t + B(\cdot) - m_t^1j(\psi_t^1) - m_t^2j(\psi_t^2) - T(\cdot)
\]

\[a_{t+1} \geq 0, \forall t\]
Individual’s Discounted Present Value of Being in a Marriage

Evaluated under optimal policies

$$\hat{W}^c(t, i, a_t, \epsilon_t^1, \epsilon_t^2, \bar{y}_t^1, \bar{y}_t^2) = \nu(\hat{c}_t(\cdot)/\eta_t^{i,j}, \hat{l}_t^{i,j}) + \beta(1 - \zeta(\cdot))E_t \hat{W}^c(t + 1, i, \hat{a}_{t+1}(\cdot), \epsilon_{t+1}^1, \epsilon_{t+1}^2, \bar{y}_{t+1}^1, \bar{y}_{t+1}^2) + \beta\zeta(\cdot)E_t W^s(t + 1, i, \hat{a}_{t+1}(\cdot)/2, \epsilon_{t+1}^i, \bar{y}_{t+1}^i)$$

$$\hat{R}^c(t, i, a_t, \psi_t^1, \psi_t^2, \bar{y}_r^1, \bar{y}_r^2) = \nu(\hat{c}_t(\cdot)/\eta_t^{i,j}, L_t^{i,j}) + \beta s_t^{i,j}(\psi_t^i)s_t^{p,j}(\psi_t^p)E_t \hat{R}^c(t + 1, i, \hat{a}_{t+1}(\cdot), \psi_{t+1}^1, \psi_{t+1}^2, \bar{y}_{t+1}^1, \bar{y}_{t+1}^2) + \beta s_t^{i,j}(\psi_t^i)(1 - s_t^{p,j}(\psi_t^p))E_t R^s(t + 1, i, \hat{a}_{t+1}(\cdot), \psi_{t+1}^i, \bar{y}_r^i)$$
Individual’s Discounted Present Value of Being in a Marriage

Evaluated under optimal policies

\[
\hat{N}^c(t, i, a_t, \epsilon^1_t, \epsilon^2_t, \bar{y}^1_t, \bar{y}^2_t) = v^i(\hat{c}_t(\cdot), \hat{\bar{N}}^i_j) \\
+ \beta E_t \hat{V}^c(t + 1, i, \hat{a}_{t+1}(\cdot), \epsilon^1_{t+1}, \epsilon^2_{t+1}, \bar{y}^1_{t+1}, \bar{y}^2_{t+1})
\]

\[
\hat{S}^c(t, i, a_t, \bar{y}^1_r, \bar{y}^2_r, tr) = v^i(\hat{c}_t(\cdot), L^{i,j}) + \beta E_t S^c(t + 1, i, \hat{a}_{t+1}(\cdot), \bar{y}^1_r, \bar{y}^2_r, tr)
\]

\[
\hat{V}^c(t, i, a_t, \epsilon^1_t, \epsilon^2_t, \bar{y}^1_t, \bar{y}^2_t) = (1 - \hat{D}_t(\cdot))\hat{N}^c(t, i, a_t, \epsilon^1_t, \epsilon^2_t, \bar{y}^1_t, \bar{y}^2_t) + \\
\hat{D}_t(\cdot)\hat{S}^c(t, i, a_t, \bar{y}^1_r, \bar{y}^2_r, t)
\]
PSID: Wage profiles, 1945 cohort

![Graph showing wage profiles for men and women by age.](image)
## PSID: Wage processes

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Men</th>
<th>Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Persistence</td>
<td>0.941</td>
<td>0.946</td>
</tr>
<tr>
<td>Variance prod. shock</td>
<td>0.026</td>
<td>0.015</td>
</tr>
<tr>
<td>Initial variance</td>
<td>0.114</td>
<td>0.095</td>
</tr>
</tbody>
</table>

**Table**: Estimated processes for the wage shocks for men and women, PSID data
HRS: Health transition probabilities

Singles

Couples

Prob. of staying in the same health

Men bad health

Men good health

Women bad health

Women good health

Age

Singles

Couples

Prob. of staying in the same health

Men bad health

Men good health

Women bad health

Women good health

Age
HRS: Survival rates

Singles

Couples

Survival probability vs age for singles and couples, categorized by gender and health status.
HRS: Health costs

**Singles**

- Men bad health
- Men good health
- Women bad health
- Women good health

**Couples**

- Men bad health
- Men good health
- Women bad health
- Women good health

Borella, De Nardi, Yang
Second-step participation cost estimates

Borella, De Nardi, Yang
### Fixed parameters

<table>
<thead>
<tr>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preferences and returns</td>
</tr>
<tr>
<td>$\gamma$ Utility curvature parameter</td>
</tr>
<tr>
<td>$\eta_t$ Equivalence scales</td>
</tr>
<tr>
<td>Government policy</td>
</tr>
<tr>
<td>$\lambda_{ij}^t, \tau_{ij}^t$ Income tax</td>
</tr>
<tr>
<td>$SS(\tilde{y}_t^i)$ Social Security benefit</td>
</tr>
<tr>
<td>$\tau_{SS}^t$ Social Security tax rate</td>
</tr>
<tr>
<td>$\tilde{y}_t$ Social Security cap</td>
</tr>
<tr>
<td>$c(1)$ Minimum consumption, singles</td>
</tr>
<tr>
<td>$c(2)$ Minimum consumption, couples</td>
</tr>
</tbody>
</table>
Remove both Social Security benefits, 1945 cohort

<table>
<thead>
<tr>
<th>Percentage asset change</th>
<th>Couples</th>
<th>Single men</th>
<th>Single women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Balanced government budget</td>
<td>14.9%</td>
<td>7.8%</td>
<td>11.2%</td>
</tr>
</tbody>
</table>
Taxing everyone as singles, 1945 cohort

No marital differential tax

Change in participation

Age

No marital differential tax

Single Men

Single Women

Married Men

Married Women
Remove Social Security benefits + joint tax, 1945 cohort

All policies change

<table>
<thead>
<tr>
<th>Change in participation</th>
<th>Single Men</th>
<th>Single Women</th>
<th>Married Men</th>
<th>Married Women</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>25</td>
<td>30</td>
<td>35</td>
<td>40</td>
</tr>
</tbody>
</table>

Percentage asset change

<table>
<thead>
<tr>
<th>Balanced government budget</th>
<th>Couples</th>
<th>Single women</th>
<th>Single men</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20.3%</td>
<td>14.8%</td>
<td>8.8%</td>
</tr>
</tbody>
</table>

Changing marriage and divorce pattern
Remove Social Security benefits + joint tax, 1955 cohort

% asset change
Balanced government budget | Couples | Single women | Single men
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>19.7%</td>
<td>14.9%</td>
<td>8.4%</td>
<td></td>
</tr>
</tbody>
</table>

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Marriage-related policies
Remove Social Security benefits + joint tax, 1945 cohort

- Left: $\downarrow$ the marriage prob. and $\uparrow$ the divorce rate by 20%
- Middle: benchmark
- Right: $\uparrow$ the marriage prob. and $\downarrow$ the divorce rate by 20%