Abstract
1 INTRODUCTION
2 DESCRIPTION OF THE ECONOMY
2.1 Population dynamics and employment opportunities

2.1.1 Population dynamics
2.1.2 Employment opportunities and intergenerational opportunities

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\[ \text{ERA} = 5 \]
\[ \pi(e') = Pr\{e_{t+1} = e' | e_t = e\} \]

2.2 The household’s decision: retirement choice, consumption and wealth

2.2.1 Preferences

\[ \sum_{t=0}^{\infty} \beta^t \left\{ \sum_{s_t \in S} \pi(s_t | s_{t-1}) u(C_t, l_t) + \varrho \Phi \beta \sum_{s_{t+1} \in S} \pi(s_{t+1} | s_t) V(A_{t+1}, s_{t+1}) \right\} \]

\[ \pi(s'|s) = Pr\{s_{t+1} = s' | s_t = s\} \]

\[ u(c) = \frac{(c^{1-\eta}(1-\lambda)^{\eta})^{1-\sigma}}{1-\sigma} \]

\[ A_{t+1} \geq 0 \]
2.2.2 The steady state
(i) \[ a' = g(a, s), \psi = \Psi(a, s) \]

\[
\Psi(a, s) = \begin{cases} 
1 & v(a, \{s, k\}) \geq v(a, \{R, k\}) \\
0 & \text{otherwise}
\end{cases}
\]

(ii) \[ s = e, u \]

\[ \lambda(a, s) = \sum_{s'} \lambda(a', s') \]

(iii) \[ R = D \]

\[ 
\lambda(a', s') = \sum_{s} \sum_{\{a, a' = A(a, s)\}} \lambda(a, s) \pi(s'|s')
\]
\[ A = \sum_s \sum_a \lambda(a,s)g(a,s) \]

3 SOCIAL SECURITY REFORMS

3.1 The French reform: A defined pension plan

3.1.1 The pre-reform system (post-Balladur system, 1993):
$$P(k) = P_{\text{basic}}(k) + P_{\text{ARRCO}}(k)$$

$$P_{\text{basic}}(k) = \min \left(1, \frac{d}{25}\right) \times \frac{1}{25} \sum_{t=1}^{25} \min(w_t, \text{cap}_t)$$

$$P_{\text{ARRCO}}(k) = \text{points}(k) \times v_d \times \text{penalty}(k)$$

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**Notes:**

- $w_t$: Weight of the $t$-th item
- $\text{cap}_t$: Capacity of the $t$-th container
- $d$: Total demand
- $v_d$: Value of the demand
- $\phi$: Parameter for the penalty function
- $\text{points}(k)$: Points assigned to the $k$-th solution
- $\text{penalty}(k)$: Penalty function for the $k$-th solution

---

**Algorithm:**

1. **Initialization:**
   - Set $P_{\text{basic}}(k) = \min \left(1, \frac{d}{25}\right)$
   - Set $P_{\text{ARRCO}}(k) = 0$
   - Set $\phi = 0.5$
   - Set $v_d = \text{value of demand}$
   - Set $\text{points}(k) = \text{initial points}$
   - Set $\text{penalty}(k) = \text{initial penalty}$

2. **Iteration:**
   - For each item $t$ in the set of items $T$
     - Determine the best container $c_t$ for item $t$ based on $w_t$ and $\text{cap}_t$
     - Update $P_{\text{basic}}(k)$ using the formula above
     - Update $P_{\text{ARRCO}}(k)$ using the formula above

3. **Finalization:**
   - After iterating over all items, calculate the total $P(k)$
   - Adjust the value of $\phi$ based on the results
   - Update $v_d$ based on the final solution
   - Calculate the final $\text{points}(k)$ and $\text{penalty}(k)$

---

**Summary:**

The presented algorithm combines a basic heuristic with a penalty function to allocate items to containers, optimizing the total value while respecting capacity constraints.
### 3.1.2 The post reform system (Raffarin Reform, 2003)

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<th>$P(T)$</th>
<th>$P(k)$</th>
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<tr>
<td>$P(T) = \left( \frac{1}{5} \sum_{t=1}^{5} w_{age-t} \right) \times \text{Max} (T, 40) \times \tau$</td>
<td>$P(k) = c \times \sum_{t=1}^{R} 0.33 \times w_{t} (1 + \gamma)^{k-t}$</td>
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<td>$\gamma = 5 \cdot \frac{w_{t}}{\sum_{t=1}^{R} w_{t}}$</td>
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3.2 The Italian reform : Switching to a contributive system

#### 3.2.1 The pre-reform system (before 1992)

#### 3.2.2 The post-reform system (after 1997)
4 DOES THE MODEL FIT THE DATA?
5 WELFARE EFFECTS OF SOCIAL SECURITY REFORMS

\[ W = \int a V(\cdot, J) \lambda(\cdot, J) da \]

5.1 France

\[ W = \int a V(\cdot, J) \lambda(\cdot, J) da = \frac{1}{(1 - \beta)(1 - \sigma)} \tilde{C}^{1 - \sigma} \]

\[ \tilde{C} = \frac{\tilde{C} - \tilde{C}' \bar{C}}{\tilde{C}' \bar{C} - \tilde{C'^2}} \]
5.2 Italy
6 CONCLUSION
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![Graph](image-url)
A Optimizing programs

Choice when young \((s \in J^z)\) with \(x = E\) (Employed) or \(U\) (unemployed) :  

\[
\begin{align*}
\max_{a, J^E} & u(c, l) + \beta \left\{ \pi_{JJ} [\pi_{\pi_{E,E}} v(a', J^E) + (1 - \pi_{\pi_{E,E}}) v(a', J^U)] + (1 - \pi_{JJ}) [\pi_{\pi_{E,A}} v(a', A^E) + (1 - \pi_{\pi_{E,A}}) v(a', A^U)] \right\} \\
(1 + g)a' & = (1 + r)a + w(J) - \Theta(w(J)) - c \\
& \geq 0
\end{align*}
\]
Choice when adult \((s \in A^x)\) with \(x = E\) or \(U\):

\[
v(a, A^E) = \max_{c \geq 0} u(c, l)
\]

\[
+ \beta \left\{ \begin{array}{l}
\pi_{A} \left[ \pi_{ee,A} v(a', A^E) + (1 - \pi_{ee,A}) v(a', A^U) \right] \\
\pi_{ee,59} v(a', 59^E) + (1 - \pi_{ee,59}) v(a', 59^U)
\end{array} \right\}
\]

\[
(1 + g) a' = (1 + r) a + w(A^E) - \Theta(w(A^E)) - c
\]

\[
a' \geq 0
\]

Choice when mature \((s \in M)\):

\[
v(a, k^E) = \max_{c \geq 0} u(c, l)
\]

\[
+ \beta \left\{ \begin{array}{l}
(1 - \pi_{kk'}) \Phi_{kk'} v(a', J^U)
\end{array} \right\}
\]

\[
+ \pi_{kk'} \max \left[ \pi_{ee,k'} v(a', k^E) \right] + (1 - \pi_{ee,k'}) v(a', k^E)
\]

\[
(1 + g) a' = (1 + r) a + w(k^E) - \Theta(w(k^E)) - c
\]

\[
a' \geq 0
\]

If the individual is employed at age \(k\):

\[
v(a, k^U) = \max_{c \geq 0} u(c, l)
\]

\[
+ \beta \left\{ \begin{array}{l}
(1 - \pi_{kk'}) \Phi_{kk'} v(a', J^U)
\end{array} \right\}
\]

\[
+ \pi_{kk'} \max \left[ \pi_{uu,k'} v(a', k^U) \right] + (1 - \pi_{uu,k'}) v(a', k^U)
\]

\[
(1 + g) a' = (1 + r) a + \theta^u w(k) - c
\]

\[
a' \geq 0
\]
If retiree at age $k$:

$$v(a, k^{Rx}) = \max_{c \geq 0} u(c, l) + \beta \left\{ (1 - \pi_{kk'}) \Phi_q v(a', J^U) + \pi_{kk'} v(a', k^{Rx}) \right\}$$

$$(1 + g)a' = (1 + r)a + \omega(k) - c$$

$$a' \geq 0$$

If retiree at age $k^{Rx}$ in $3^{nd}$ period $x = E \left( \max_{U} U \right)$ such that $x_{k^{Rx}} \geq k_{kk'}$ and $x_{k_{kk'}}$ is the optimal value of $k_{kk'}$.

If retiree at age 69:

$$v(a, 69^{x}) = \max_{c \geq 0} u(c, l) + \beta \left\{ (1 - \pi_{kk'}) \Phi_q v(a', J) + \pi_{kk'} v(a', 69^{x}) \right\}$$

$$(1 + g)a' = (1 + r)a + w(69) - \Theta(w(69)) - c$$

$$a' \geq 0$$

If retiree at age $x = E(U) = w(69) - \Theta(w(69))$ in $3^{rd}$ period $x = E \left( \max_{U} \theta^u w(69) \right)$.

**B Data**

France:

Italy:

C
C  Calibration

C.1  Demographics, technology, real interest rate and preferences

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| \( l \) | \( 1-l \) | \( BA \) |

| \( r \) | \( F \) |
| \( \sigma \) | \( - \) |

| \( \eta \) | \( \text{connection} \) |
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C.2 Wages, employment risks and social mobility

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**Notes:**

```
K   6 4K 6KJD
K   4 6KJD 6D6K
6KJD 666 664A>
6KJD 666 664A>
6? KD 6 6KJD 6KJD
6>AR A=K6 4KJD
```

|                | $\Rightarrow$64 & $\Rightarrow$4K & $\Rightarrow$6KJD |
|----------------|-----|-----|-----|
| $\Rightarrow$64 | $\Rightarrow$4K & $\Rightarrow$6KJD |
| $\Rightarrow$4K | $\Rightarrow$6KJD |
| $\Rightarrow$6KJD | $\Rightarrow$4K |
| $\Rightarrow$4K | $\Rightarrow$6KJD |

|                | $\Rightarrow$64 & $\Rightarrow$4K & $\Rightarrow$6KJD |
|----------------|-----|-----|-----|
| $\Rightarrow$64 | $\Rightarrow$4K & $\Rightarrow$6KJD |
| $\Rightarrow$4K | $\Rightarrow$6KJD |
| $\Rightarrow$6KJD | $\Rightarrow$4K |
| $\Rightarrow$4K | $\Rightarrow$6KJD |

**Notes:**

```
K   6 4K 6KJD
K   4 6KJD 6D6K
6KJD 666 664A>
6KJD 666 664A>
6? KD 6 6KJD 6KJD
6>AR A=K6 4KJD
```

**Notes:**

```
K
```
\[
\Pi_{k,i} = \begin{pmatrix}
\pi_{ee,ki} & \pi_{eu,ki} \\
\pi_{ue,ki} & \pi_{uu,ki}
\end{pmatrix} = \begin{pmatrix}
1 - \pi_{ee,ki} & \pi_{eu,ki} \\
\pi_{ue,ki} & 1 - \pi_{ue,ki}
\end{pmatrix}
\]

\[
D_{ki} = \frac{1}{\pi_{eu,ki}}
\]

\[
E_{ki} = \frac{1}{\pi_{eu,ki}} = \frac{1}{\pi_{eu,ki}}
\]

\[
U_{ki} = \frac{D_{ki}}{E_{ki} + D_{ki}}
\]

\[
\pi_{eu,ki} = \frac{U_{ki}}{D_{ki}(1 - U_{ki})}
\]

C.3 Social Security
N | 6KDA | 6Dh64 | 6Dh4 | 6h4 | 6h4 >
keva

French Complementary Schemes

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| 6\text{h4} | 6\text{h4} > |

6\text{h4} | 6\text{h4} > |

penalty(k)

| $k$ | K | ? | D | > | K | K6 | K4 | KA | K4 |

penalty(k) | $\text{K4A}$ | $\text{D}$ | ? | $\text{K4}$ | $\text{K}6$ | $\text{K}4$ | $\text{K}4$ | $\text{K}4$ | $\text{K}4$ |

Italian post-1997 system

$\text{g} = 1.5\%$. 
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