Macroeconomic and welfare implications of different pension benefit arrangements

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Pension benefit arrangements

**Focus of the paper:** the link between pension contributions and pension benefits in pay-as-you-go (PAYG) pension systems

**Examples:**
- **Flat benefit (FL) systems:** pension contributions are proportional to earnings, but benefits are constant across agents: UK, Netherlands
- **Notional Defined Contribution (NDC) and points pension systems:** one-to-one relation between life-time earnings and pension benefits: very popular in the past 25 years, implemented in Italy, Germany, Sweden, many eastern European countries
This paper

- points out the trade-off among labor supply distortions, insurance against idiosyncratic earnings shocks, and capital crowding out arising in the arrangement of pension benefits
- shows how this trade-off impacts on welfare (ex-ante utility of agents)

Compared to flat benefit systems, NDC pensions systems:
- distort labor supply less, so individuals work more hours and longer - higher welfare

but
- offer no insurance against idiosyncratic earnings shocks, so consumption inequality is higher - lower welfare
- reduce the capital to labor ratio - lower welfare in a dynamically efficient economy in general equilibrium
Stylized facts

Contrasting pension reforms implemented in the past 25 years:

▶ Some pension systems switched to a NDC or points system (Italy, Sweden, Germany, eastern European countries):
  ▶ main aim was to restore labor supply incentives of agents close to retirement
  ▶ pension systems with large contributions
▶ Some pension systems switched to a FL system (UK)
  ▶ pension system with no separate contribution
Preview of results

The NDC system brings a higher welfare than the FL system only when:

- the pension system is large: welfare gains from low labor supply distortions dominate the welfare losses from less insurance against idiosyncratic earnings shocks and
- the size of the idiosyncratic risk is low.

General equilibrium effects:

- favor the FL pension system;
- have a sizable impact on the relative welfare: in an economy with no idiosyncratic shocks, the NDC pension system brings a higher welfare than the FL pension system only for contribution rates above 10%.
Related literature

- **Nishiyama and Smetters (2007)** - a 50% privatization of the US pension system is welfare improving only if it is accompanied by an increase in the progressivity of pension benefits (more insurance against idiosyncratic productivity shocks)

- **Huggett and Parra (2010)** - the optimal pension benefit function for the US entails more progressivity than the one currently in place

- **Fehr and Habermann (2008) and Fehr et al. (2013)** - reforming the German pension benefit system towards more progressivity (combination of flat benefit and points system) is welfare improving
The intuition in a stylized model (1)

- T=2 overlapping generations - *young* and *old*
- *young agents*: are *homogeneous*, supply labor inelastically, choose how much to consume and save;
- *old agents* are hit by an *idiosyncratic earnings shocks* at the beginning of the period, choose how much to work.

Closed form solution of the model indicates that, compared to a FL system, under the NDC system:

- labor supply is higher - no distortions on labor supply
- consumption inequality is higher - no insurance against idiosyncratic shocks
- capital to labor ratio is lower as long as the level of idiosyncratic risk is not very high
Why is the capital to labor ratio \((k)\) lower under the NDC pension system?

- labor supply is higher due to lack of distortions - lower \(k\)
- agents work more when they are old so they need to make lower savings when young in order to achieve the same consumption level when old - lower \(k\)
- agents make more precautionary savings than under the FL system because the NDC system offers no insurance - higher \(k\)

First two effects dominate the third as long as the size of idiosyncratic risk is not too high.
The intuition in a stylized model (3)

In a partial equilibrium framework, the FL pension system brings a higher welfare at low levels of pension contributions.

**Figure 1:** Partial equilibrium

**Figure 2:** General equilibrium

General equilibrium effects favor FL systems.
Large scale model (1)

Population:
- 80 overlapping generations, agents start working at 20, live until at most 100 years
- probability to survive from age $j$ to $j + 1$ is $s_{j+1}$
- population grows at rate $n$

Households of age $j$ maximize expected utility:

$$V(x) = \max_{c,l,a'} u(c, l) + \beta s_{j+1} V(x')$$

$$c(1 + \tau_c) + a' = a(1 + r(1 - \tau_k)) + y(x)$$

where $x = (j, z, pa, a)$ is the state of the agent, $z$ is a persistent idiosyncratic earnings shock, $pa$ is pension assets, $a$ is savings in capital, $y(x)$ is the net labor income, $\tau_c$ is the consumption tax and $\tau_k$ is the tax on the return on capital.
Large scale model (2)

Environment:
- markets are incomplete - agents can only self-insure
- assume tight borrowing constraint, i.e. $a \geq 0$

Preferences:

\[
\begin{align*}
    u(c, l) &= \frac{(c^n(1 - l - \theta_P P)^{1-\eta})^{1-\sigma}}{1 - \sigma} \\
\end{align*}
\]

- disutility from participating to the labor market increasing with age $\theta_P$: $P = 1$ if $l > 0$
Net labor income:

\[ y(x) = wl(x)k_jz_j(1 - \tau - \tau_l) + TL \]
\[ log z_j = \rho log z_{j-1} + \epsilon_j, \epsilon_j \sim N(0, \sigma^2_\epsilon) \]

where \( w \) is the average wage, \( z_j \) is the idiosyncratic earnings shock, \( k_j \) is a deterministic age-specific part of the productivity process, \( \tau_l \) is the tax on labor income, \( \tau \) is the social security contribution rate and \( TL \) is a lump sum transfer.
Large scale model (4)

Government:

- revenues: labor income tax ($\tau_l l$), consumption taxes ($\tau_c C$), tax on the return on capital ($\tau_k rK$), accidental bequests ($Bq$)
- expenditures: wasteful government spending ($G$), lump sum transfers ($TL$)
- budget balanced by lump sum transfers

$$\tau_l l + \tau_c C + \tau_k rK + Bq = G + TL$$ (2)
Pension system:

- contribution rate $\tau$
- benefits modeled according to 3 different systems:
  1. US system: earnings related system with progressive replacement rates:
     $$b(j, z, a, pa) = \text{rep}(pa)pa$$
  2. Flat benefit (FL):
     $$b(j, z, a, pa) = b$$
  3. NDC:
     $$b(j, z, a, pa) = \frac{pa}{sp} \quad (3)$$

where $sp$ represents the expected survival period (in years) at retirement, $\text{rep}$ is the replacement ratio (depends on life-time earnings in the US system)
Large scale model (6)

Pension system:
- system balances in the steady state
- pensions are paid starting with the early retirement age of 62.

Pension assets:
1. US system: average of life-time earnings
   \[ pa(j) = \frac{(pa(j-1) + wlz)}{j} \]
2. FL system: no pension assets
3. NDC system: contributions are accrued at rate \( rp = n \)
   \[ pa(j) = pa(j-1)(1 + rp) + \tau wlz \]
## Calibration (1)

<table>
<thead>
<tr>
<th>Param.</th>
<th>Description</th>
<th>Value</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha$</td>
<td>Capital share in output</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>$\rho$</td>
<td>Autoregressivity of earnings process</td>
<td>0.97</td>
<td></td>
</tr>
<tr>
<td>$\sigma_{\epsilon}^2$</td>
<td>Variance of earnings process</td>
<td>0.02</td>
<td></td>
</tr>
<tr>
<td>$G/Y$</td>
<td>Government expenditure to GDP</td>
<td>0.18</td>
<td></td>
</tr>
<tr>
<td>$\tau_c$</td>
<td>Consumption tax</td>
<td>0.05</td>
<td></td>
</tr>
<tr>
<td>$\tau_k$</td>
<td>Return on capital tax</td>
<td>0.36</td>
<td></td>
</tr>
<tr>
<td>$\tau_l$</td>
<td>Labor income tax</td>
<td>0.17</td>
<td></td>
</tr>
<tr>
<td>$\delta$</td>
<td>Depreciation rate</td>
<td>0.06</td>
<td>I/Y=0.21</td>
</tr>
<tr>
<td>$\beta$</td>
<td>Time preference</td>
<td>0.998</td>
<td>K/Y=3</td>
</tr>
<tr>
<td>$\sigma$</td>
<td>Consumption share</td>
<td>4</td>
<td>$\sigma_c = 2$</td>
</tr>
<tr>
<td>$\eta$</td>
<td>Consumption share</td>
<td>0.55</td>
<td>Hours worked across lifecycle</td>
</tr>
<tr>
<td>$\theta_P(j)$</td>
<td>Disutility of labor participation</td>
<td>$0.1 + 0.2j^2$</td>
<td>Participation rate across lifecycle</td>
</tr>
<tr>
<td>$\tau$</td>
<td>Contribution to PAYG pensions</td>
<td>0.108</td>
<td>Balanced budget</td>
</tr>
</tbody>
</table>
Calibration (2)

Labor force participation and hours worked: match the lifecycle profile from the data (March CPS 1962-2016, men, not self-employed and with completed high-school)

Figure 3: Participation rate

Figure 4: Hours worked
Results (1)

Figure 5: Participation rate

Figure 6: Hours worked
Results (2)

Figure 7: Consumption inequality
The results obtained with the small model hold. Compared to the FL pension system, the NDC system promotes:

- higher labor supply
- higher consumption inequality
- lower savings

Overall, the NDC system brings a lower welfare than both the US and FL system.
An economy with no idiosyncratic shocks: general equilibrium effects ensure that the FL system brings a higher welfare for contribution rates below 10%.

<table>
<thead>
<tr>
<th>Contribution rate</th>
<th>1%</th>
<th>5%</th>
<th>8%</th>
<th>10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consumption equivalent</td>
<td>-0.3</td>
<td>-0.23</td>
<td>-0.2</td>
<td>0.05</td>
</tr>
</tbody>
</table>
Conclusions

The arrangement of pension benefits involves a trade-off among labor supply distortions, insurance against idiosyncratic earnings shocks and capital crowding out.

The NDC system brings a higher welfare than the FL system when:

- the pension system is large
- the size of the idiosyncratic risk is low.

General equilibrium effects:

- favor the FL pension system;
- have a sizable impact on the relative welfare of the two pension systems → the FL system can bring a higher welfare than the NDC system even in the absence of idiosyncratic earnings shocks.
Thank you!