Optimal Design and Regulation of Funded Pension Schemes

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Introduction (1/4)

- Literature points out that pension funds may enhance welfare by facilitating risk sharing between non-overlapping generations
  - Social Security Trust Funds in the United States
  - Japanese Government Pension Investment Fund
  - Canada Pension Plan
  - Provident Funds in Singapore and Malaysia
  - occupational pension funds in Iceland and the Netherlands
- Sovereign wealth funds (e.g., in Norway) face similar issues of intergenerational risk sharing in deciding on their dividend policies
- Several countries have established a mandatory funded social security tier with individual retirement accounts in which it is not possible to share risks between non-overlapping generations
  - Australia
  - various Latin American and Eastern European countries
Article reviews the literature on design and regulation of funded pension schemes (forthcoming in ARE, vol 6.)

- Section 1: introduction
- Section 2: saving and investing over individual’s life-cycle
  - main intuition explained in framework of Merton (1971)
  - discussion of extensions: additional risk factors, stochastic human capital, more elaborate individual preferences
- Section 3: intergenerational risk sharing
  - incompleteness: no trade between non-overlapping generations
  - characterization of efficient risk sharing solution
  - commitment problems and discontinuity risk
  - raises concerns w.r.t **intergenerational fairness** and sustainability
  - role for solvency regulation in addressing these concerns
Focus of today’s presentation: **intergenerational fairness**

- Social planner can enhance ex-ante welfare if markets incomplete
- In this paper: ”biological trading constraint”
- Ex-ante Pareto-efficient solution is not unique: welfare gain from risk sharing can be distributed across generations in different ways
- Two alternative fairness criteria for allocating the welfare gain across generations in which all generations are treated equally in terms of:
  1. ex-ante utility value (e.g. Gollier, 2008)
  2. ex-ante market value (e.g. Teulings and de Vries, 2006)
- These two alternative fairness criteria
  - are different from each other due to market incompleteness
  - and hence result in distinct solvency requirements for the buffers that must be transferred to future generations
Introduction (4/4)

- All possible risk-sharing solutions
- Efficient risk-sharing solutions
- Pareto-efficient risk-sharing solutions
- Utility-based fairness criterion
- Market-value based fairness criterion

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Model (1/4)

Stylized framework with transfers between non-overlapping generations:

- Model abstracts from life-cycle pattern
- Generations live during a single period and only a single generation is alive at each point in time
- Each generation $t \geq 1$ maximizes expected utility from consumption:
  \[
  U_t = E_{t=0}\left[\frac{1}{1-\theta}C_t^{1-\theta}\right]
  \]
- Labor earnings $Y_t$ are deterministic
- Define: $\eta_t \equiv \frac{1}{Y_t} \frac{Y_{t+1}}{1+r}$ as the discounted value of the labor earnings of generation $t + 1$ relative to the income of the currently-living generation $t$, and is assumed constant over time: $\eta_t = \eta$
- The economy is dynamically efficient so that $\eta < 1$
Model includes a single source of risk

Financial markets offer two investment opportunities:

- The riskfree asset yields a deterministic and time-invariant return $r$ in each period $t$.
- Risky asset with excess return (in excess of the riskfree rate) denoted by $\tilde{x}_t$ ($t \geq 1$) and i.i.d. distributed with a time-invariant mean $\bar{\mu}$ and standard deviation $\sigma$.
- Sharpe ratio $\lambda \equiv \frac{\bar{\mu}}{\sigma}$ represents excess return per unit of risk.

Consumption $C_t$ given by:

$$C_t = \begin{cases} 
(1 + r) + f_t \tilde{x}_t \ Y_t - \tilde{\tau}_t & \text{for } t = 1 \\
(1 + r) + f_t \tilde{x}_t \ Y_t - \tilde{\tau}_t + (1 + r) \tilde{\tau}_{t-1} & \text{for } t > 1 
\end{cases}$$

where $f_t$ denotes the fraction of gross (before intergenerational transfers) wealth of generation $t$ that is invested in the risky asset.
$\tilde{\tau}_t$ ($t \geq 1$) represents the transfer that is passed onto generation $t+1$ by generation $t$.

In general, the transfer $\tilde{\tau}_t$ can be conditioned upon all shocks that occurred up to period $t$.

Our benchmark model is restricted to the case in which the intergenerational transfer $\tilde{\tau}_t$ depends on period-$t$ risk only.

Linear transfers between generations then take the form:

$$\tilde{\tau}_t = \alpha_t + \beta_t \tilde{x}_t,$$

where $\alpha_t$ represents the deterministic component of the transfer and where $\beta_t$ represents the exposure of the transfer to period-$t$ risk.
Model (4/4)

\begin{align*}
\text{transfer } \tilde{\tau}_1 \\
\text{from agent 1} \\
\text{to agent 2}
\end{align*}

\begin{align*}
\text{transfer } \tilde{\tau}_2 \\
\text{from agent 2} \\
\text{to agent 3}
\end{align*}

\begin{align*}
\text{transfer } \tilde{\tau}_3 \\
\text{from agent 3} \\
\text{to agent 4}
\end{align*}

\begin{align*}
\text{etc.}
\end{align*}
Pareto-efficiency (1/3)

Pareto-efficient risk sharing solution:

- Perfect smoothing of consumption across generations:

\[
\frac{dC_{t+1}}{d\tilde{x}_t} = \frac{dC_t}{d\tilde{x}_t} = \frac{C_{t+1}}{C_t}
\]

- Increase in the demand for the transferrable risk $\tilde{x}_t$ determined by relative wealth $\eta$ of unborn generation:

\[
f_t - \{f_t\}_{\tilde{r}_t=0} = \eta \frac{\bar{\mu}}{\theta \sigma^2}
\]

- Welfare gain associated with transfer $\tau_t$:

\[
\frac{1}{2} \frac{\lambda^2}{\theta}.
\]
Pareto-efficiency (2/3)

- Solution for efficiency obtained from maximization of aggregate certainty equivalent consumption
- If larger than zero, then there exists a solution that improves laissez-faire economy
- Approach similar to the *Lump-Sum Redistribution Authority* in Auerbach and Kotlikoff (1987), but now applied in a stochastic environment
- Unaffected by deterministic redistributive transfers (in our model: $\alpha_t$).
- Pareto-efficient solution puts limits on $\alpha_t$.
- Pareto-efficient solution is not unique: welfare gain from risk sharing can be distributed across generations in various alternative ways.
Pareto efficiency (3/3)

- All possible risk-sharing solutions (any $f_t$, $\alpha_t$, $\beta_t$)
- Efficient risk-sharing solutions (solves $f_t$ and $\beta_t$)
- Pareto-efficient risk-sharing solutions (interval for $\alpha_t$)
- Utility-based based fairness criterion (solves $\alpha_t$)
- Market-value based fairness criterion (solves $\alpha_t$)
We explore two intergenerational fairness criteria yielding a unique solution for $\alpha_t$.

Criteria require all generations to be treated equally in terms of:

1. ex-ante utility value (e.g. Gollier (2008))
2. ex-ante market value (e.g. Teulings and de Vries (2006))

The reason why criteria based on utility and market value yield different solutions has to do with the biological trading constraint.

The associated market incompleteness causes a gap between the market prices of risk and unborn generations’ marginal rate of substitution between various contingencies.
The first, utility-based, fairness criterion:

- implies that the welfare gain from sharing risk between generation $t$ and $t+1$ fully accrues to the older generation $t$.

- The younger generation $t+1$ gains nothing from sharing risk with the older generation $t$ but enjoys the full benefit from sharing risk (through the stochastic transfer $\tilde{\tau}_{t+1}$) with generation $t+2$.

![Diagram showing welfare gains associated with $\tilde{\tau}_1$, $\tilde{\tau}_2$, $\tilde{\tau}_3$, etc.](image)
The second fairness criterion, based on ex-ante market value, implies:

- Intergenerational transfers take the form of a multiple of the excess return on risky asset ($\alpha_t = 0$ for all $t$)

- Each transfer includes the full risk compensation. Future generations experience welfare gain while the first-born generation $t = 1$ gains nothing.
Comparison:

- Utility-value based fairness criterion transfers the welfare gain associated with the stochastic transfer $\tilde{\tau}_t$ ($t \geq 1$) to the older generation $t$
  - future generations have to share the welfare gain with the generation that is alive when scheme is introduced.

- Market-value based fairness criterion transfers this welfare gain to the younger generation $t + 1$
  - larger welfare gain for future generations (i.e. $\frac{1}{2} \frac{\lambda^2}{\theta} > \frac{1}{2} \frac{\lambda^2}{\theta} \eta$) because it provides them with the full benefit from risk sharing (first-born generation gains nothing)

- Market-value based criterion implies tighter requirements for minimum buffers $\tilde{\tau}_t$ that must be transferred to future generations
Discussion

Market value often used (e.g. value-based generational accounting)
  ▶ based on observed prices in financial markets
  ▶ requires no subjective assumptions w.r.t preferences of individuals.

Paradox: pension schemes that complete markets are difficult to value objectively and may thus give rise to intergenerational conflicts and political risks.

▶ Trading between non-overlapping generations:
  ▶ in a "general equilibrium" framework current generations can trade with future generations and market prices would adjust (see Ball and Mankiw (JPE,2007)).

▶ Trading untraded risk factors
  ▶ no objective market prices available