The impact of reducing pension generosity on schooling and inequality

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Motivation:
Expected reductions in the generosity of pension systems

Figure 1: Old-age dependency ratio across OECD countries
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Expected reductions in the generosity of pension systems

Figure 1: Old-age dependency ratio across OECD countries
Motivation: Increasing longevity gap across socio-economic groups

Figure 2: Life expectancy at age 65, US males

Source: Own calculations.
• **Research interest:**
  What is the impact of reducing the generosity of the pension system on inequality and schooling when individuals differ by longevity?

• **Model:**
  To study this problem, we propose an extension of Pestieau and Ponthiere (2016) by introducing heterogeneity in schooling effort.
Individuals’ budget constraint

- First period:
  - stay unskilled \((e_u)\) or become skilled worker \((e_s)\) \(\rightarrow y(e_s) > y(e_u)\)
  - pay social security contributions \(\tau y(e_i)\)
  - consumption \(c\)
  - save for retirement \(s\)

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c + s = (1 - \tau)y(e_i)
\] (1)
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- Second period:
  - For \(e_i \rightarrow \pi(e_i)\)
  - consumption \(d\)

\[
d = \frac{s}{R\pi(e_i)} + f(e_i, \theta)y(e_i) \tag{2}\]

where \(f(e_i, \theta)\) is the pension replacement rate

\[
f(e_i, \theta) = \begin{cases} \psi & \text{if } e_i = e_u, \\ \psi[1 - \theta \alpha(e_s)] & \text{if } e_i = e_s, \end{cases} \tag{3}\]

where \(\alpha(e_s) = \frac{y(e_s) - y(e_u)}{y(e_s)}\) is the relative income advantage of a skilled worker and \(\theta\) represents the degree of progressivity.
Replacement rate

\[ \theta = 1 \]

\[ \theta > 0 \]

\[ \psi \]

Labor income

Figure 3: Stylized replacement rate function
The preferences of an individual of type \( \phi \) are described by the following utility function:

\[
V(e_i; \phi) = u(c) - \phi e_i + \beta \pi(e_i) u(d),
\]

where \( \phi \in \mathbb{R} \) is the effort of attending school and differs across individuals (Oreopolous, 2007; Restuccia and Vandenbroucke, 2013; Le Garrec, 2015; Sánchez-Romero, d’Albis and Prskawetz, 2016).
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Assumptions 1 and 2 guarantee that a marginal increase in the longevity gap leads to a marginal increase in the benefit of continued schooling.
The optimal schooling decision satisfies

$$e_i^* = \begin{cases} e_u & \text{if } \phi \leq \phi, \\ e_s & \text{if } \phi > \phi, \end{cases}$$

(5)

where the parameter $\phi$ denotes the threshold utility cost of schooling for which an individual is indifferent between continuing unskilled and becoming a skilled worker — i.e,

$$V(e_u; \phi) = V(e_s; \phi),$$

$$\phi = u(c^*(e_s)) - u(c^*(e_u)) + \beta[\pi(e_s)u(d^*(e_s)) - \pi(e_u)u(d^*(e_u))].$$

(6)
The optimal schooling decision satisfies

\[ e_i^* = \begin{cases} e_u & \text{if } \bar{\phi} \leq \phi, \\ e_s & \text{if } \bar{\phi} > \phi, \end{cases} \quad (5) \]

where the parameter \( \bar{\phi} \) denotes the threshold utility cost of schooling for which an individual is indifferent between continuing unskilled and becoming a skilled worker — i.e,

\[ V(e_u; \bar{\phi}) = V(e_s; \bar{\phi}), \]

\[ \bar{\phi} = u(c^*(e_s)) - u(c^*(e_u)) + \beta[\pi(e_s)u(d^*(e_s)) - \pi(e_u)u(d^*(e_u))]. \quad (6) \]

**Figure 4:** Stylized probability density function of the utility cost of schooling
The impact of pensions on inequality
Combining (1) and (2), the intertemporal budget constraint is

\[ c + R\pi(e_i)d = (1 - \tau_E(e_i))y(e_i) \]

(7)
**The implicit tax on work**

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Implicit tax on work
the effective social security tax/subsidy rate on work, \( \tau_E(e_i) \), is given by:

\[ \tau_E(e_i) = \tau - f(e_i, \theta)R\pi(e_i) \] (8)
The implicit tax on work

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Individuals with different educational attainment face different \( \tau_E(e_i) \)!!
The implicit tax on work

The difference in the effective social security tax rate between unskilled and skilled workers, $\Delta_\tau(\theta) = \tau_E(e_u) - \tau_E(e_s)$, is

$$\Delta_\tau(\theta) = \psi \pi(e_s) [\varepsilon(e_s) - \theta \alpha(e_s)] R.$$  \hspace{1cm} (9)

with $\varepsilon(e_s) = \frac{\pi(e_s) - \pi(e_u)}{\pi(e_s)}$. 

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with \( \varepsilon(e_s) = \frac{\pi(e_s) - \pi(e_u)}{\pi(e_s)} \)

**Proposition 1:** Assuming a constant longevity across skill groups, \( \pi(e_s) = \pi(e_u) \), a pension system with

(a) a flat replacement \( (\theta = 0) \) does not redistribute resources among skill groups

(b) a progressive replacement rate \( (\theta > 0) \) redistributes resources from skilled workers to unskilled workers
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\Delta_{\tau}(\theta) = \psi \pi(e_s) \alpha(e_s) [p - \theta] R \tag{9}
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**Proposition 2:** Assuming that \( \pi(e_s) > \pi(e_u) \) and defining \( p = \frac{\varepsilon(e_s)}{\alpha(e_s)} \) as the ratio of the relative mortality to the relative income advantage of skilled workers, a pension system with

(a) a flat replacement rate \((\theta = 0)\) transfers resources from short-lived and unskilled workers to long-lived and skilled workers

(b) a progressive replacement rate \((\theta > 0)\) redistributes income (i) from skilled workers to unskilled workers when \( \theta > p \) and (ii) from unskilled workers to skilled workers when \( \theta < p \)
The implicit tax on work

Figure 5: Effective social security tax/subsidy rate ($\tau_E$) for each educational group by degree of progressivity ($\theta$)
Impact of reducing the pension replacement rate on pension inequality

To study the effect of a decrease in the replacement rate ($\psi$) on pension inequality, we calculate the sign of the derivative of Eq. (9) with respect to $\psi$

$$\frac{-\partial \Delta \tau}{\partial \psi} = \pi(e_s)\alpha(e_s)(\theta - p) R \begin{cases} > 0 & \text{if } \theta > p \\ < 0 & \text{if } \theta < p \end{cases}$$ (10)
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> 0 \text{ if } \theta > p \\
< 0 \text{ if } \theta < p 
\end{cases}
$$

(10)

Figure 6: Impact of a fall in the replacement rate ($\psi^1 > \psi^2$) on the effective social security tax/subsidy rate ($\tau E$) for each educational group by degree of progressivity ($\theta$)
Impact of reducing the pension replacement rate on pension inequality

Figure 7: Empirical values of $p = \varepsilon(e_s)/\alpha(e_s)$ and $\theta$ for 21 selected OECD countries

Source: Values obtained from OECD (2017), Murtin (2017), and authors’ calculations.
To study the impact of a decrease in $\psi$ on education, we differentiate the proportion of skilled workers, $q$, with respect to $\psi$

$$\frac{-\partial q}{\partial \psi} = g(\phi)u'(c^*(e_s))y(e_s) \left[ \frac{-\partial \Delta \tau}{\partial \psi} + (\Phi - 1) \frac{-\partial \tau E(e_u)}{\partial \psi} \right],$$  

(11)

with $\Phi = \frac{u'(c^*(e_u))y(e_u)}{u'(c^*(e_s))y(e_s)}$.
To study the impact of a decrease in $\psi$ on education, we differentiate the proportion of skilled workers, $q$, with respect to $\psi$

$$\frac{-\partial q}{\partial \psi} = g(\bar{\phi})u'(c^*(e_s))y(e_s) \left[ \frac{-\partial \Delta \tau}{\partial \psi} + (\Phi - 1) \frac{-\partial \tau_E(e_u)}{\partial \psi} \right],$$

with $\Phi = \frac{u'(c^*(e_u))y(e_u)}{u'(c^*(e_s))y(e_s)}$

**Figure 8**: Impact of a reduction in the replacement rate on the proportion of skilled workers by degree of progressivity of the pension system ($\theta$)
Figure 9: Impact of a reduction in the replacement rate on the proportion of skilled workers by degree of progressivity of the pension system ($\theta$) in 21 selected OECD countries

Source: OECD (2017), Murtin (2017), and authors' calculations. Calculations done assuming each period lasts forty years, a power marginal utility function $u'(x) = x^{-\gamma}$, where $\gamma$ is the relative risk aversion coefficient, a constant annual real interest rate of 3 percent, a productivity growth rate of 1.5 percent, and a subjective discount factor of 1 percent.
The combined effect of a reduction in pension generosity

Figure 10: Impact of a reduction in the replacement rate ($\psi$) on the proportion of skilled workers ($q$) and on pension inequality ($\Delta \tau$) by degree of progressivity of the pension system ($\theta$)
The combined effect of a reduction in the pension generosity

More skilled workers & lower pension inequality

Less skilled workers & lower pension inequality

More skilled workers & higher pension inequality

Less skilled workers & higher pension inequality

Figure 10: Impact of a reduction in the replacement rate ($\psi$) on the proportion of skilled workers ($q$) and on pension inequality ($\Delta\tau$) by degree of progressivity of the pension system ($\theta$)

- If we pursue avoiding pension inequality, then a reduction in the generosity of the pension system will lead to an ambiguous result on the number of skilled workers
The combined effect of a reduction in pension generosity

Impact of a fall in the replacement rate
Less skilled workers and lower inequality
More skilled workers and lower inequality
More skilled workers and higher inequality

(a) Relative risk aversion = 0.5 ⇒ Φ < 1
(b) Relative risk aversion = 1.5 ⇒ Φ > 1

Figure 11: Impact of a reduction in the replacement rate ($\psi$) on the proportion of skilled workers ($q$) and on pension inequality ($\Delta \tau$) by degree of progressivity of the pension system ($\theta$) in 21 selected OECD countries

Source: See figs. 7 and 9.
Conclusions

- We have developed a model for analyzing the impact of a reduction in the generosity of the pension system on inequality and schooling.

- Within this framework we study the impact of a reduction in the generosity of the pension system on schooling and inequality when there exists differential mortality across groups.

- We show that when there exists ex ante mortality differences, it is necessary to introduce a progressive pension system to avoid that pension system becomes regressive.
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Thank you!

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US OAI pension system (DB-II)

Figure 12: Old-Age Insurance replacement rate in the US

Note: AIME is calculated as $1/12$ of the mean of the 35 highest labor incomes over the working life, measured in real terms.
The impact of an increase in $\Delta \pi$ and in $\alpha e$ on the implicit tax on work

Figure 13: Effective social security tax/subsidy rate ($\tau_E$) for each educational group by degree of progressivity ($\theta$)