Ageing and Pensions in General Equilibrium: *Labor Market Imperfections Matter*

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1. Introduction

Background

Population Ageing
- ageing of baby boom generations
- decreasing fertility
- increasing longevity

Old-age dependency ratio, 1970-2050

Source: UN (2006)
Participation Rates (EU and US)

Source: OECD (2006)
Labour will become relatively scarcer

- increasing wages
- decreasing interest rates

Evaluation of pension reforms

must take price adjustments into account
→ use dynamic general equilibrium model

Ageing is a worldwide, asynchronized phenomenon

→ savings rates will evolve differently across countries
→ importance of international capital flows
→ use of multi-country models to determine equilibrium \( r \)
Pending questions

- **A most usual assumption:**
  perfectly competitive labour markets
  \(\rightarrow\) endogenizing labour supply has little impact

- **A well-known fact:**
  most changes in total hours of work are due to changes along the extensive margin…

- **In this paper,**
  (i) we introduce labour market frictions à DMP in an otherwise quite standard OLG model;
  (ii) we allow for early retirement effects.

- **Objectives:** *does introducing labour market frictions*
  - change price and quantity effects of ageing?
  - change fiscal effects of pension reforms?
  - connections between labour market and pension reforms?
**Rios-Rull (2001)**
emphasizes need to calibrate carefully the demographic variables

**Borsch-Supan, Ludwig & Winter (2006)**
multi-country; endogenous hours of work (lower « participation rate » of senior workers)

**Attanasio, Kitao & Violante (2007)**
two-country; participation rate negatively related to fertility; capital flows may have little effects on fiscal variables (because of counteracting forces); endogenous hours of work

**Krueger & Ludwig (2007)**
two-country; endogenous hours of work; focuses on distributional and welfare issues

**Heijdra & Romp (2009)**
small open-economy; focuses on effect of ageing and pension provisions on optimal (early) retirement decision; no unemployment nor individual heterogeneity.
2. The Model

- Demographics
- Labour Market Flows (MP + OLG)
- Life Cycle Household Behaviour
- Firms Behaviour
- Wage Bargaining
- Government (taxes, transfers)
- Intertemporal Equilibrium
Demographics

- max lifetime: 25-104 $\Rightarrow$ age $0 \leq a \leq 15$
- compulsory retirement age: $a = 8$ (65)
- exogenous participation $z_{a,t+a} = 1$ for $0 \leq a \leq 7$

- age-dependent survival probability $\beta_{a,t+a}$

- size of a cohort of age $a$ :

$$Z_{a,t+a} = \beta_{a,t+a} Z_{0,t} + X_{a,t+a}$$

- population of working age $P_{a,t+a}$ in 3 groups:

$$n_{a,t} + u_{a,t} + e_{a,t} = 1$$
Labour Market Flows I

- Matching: undirected search (no age discrimination)

\[ M_t = M(V_t, \Omega_t) \]

- Probability of finding a job

  - Unconditional: \[ p_t = \frac{M_t}{\Omega_t} \]
  
  - Conditional on age \( a \): \[ p_t \frac{\Omega_{a,t}}{P_{a,t}} \]
• Job destruction: exogenous job destruction rate $\chi$

• Employment (workers of age $a$)

\[
n_{a,t} = p_t \frac{\Omega_{a,t}}{P_{a,t}}, \quad \text{for } a = 0; \\
= (1 - \chi) n_{a-1,t-1} + p_t \frac{\Omega_{a,t}}{P_{a,t}}, \quad 1 \leq a \leq 5; \\
= (1 - \lambda_{a,t}) (1 - \chi) n_{a-1,t-1} + p_t \frac{\Omega_{a,t}}{P_{a,t}}, \quad 6 \leq a \leq 7
\]
Assumptions:
- no aggregate uncertainty;
- within a generation, perfect insurance against:
  - mortality risk
  - unemployment risk
  - early retirement (leisure) risk

→ one cohort behaves like one « household »

Motivation for last assumption

(ii) similar to representation of leisure choice of senior workers in perfect competition models
● Household « a »’s instantaneous utility

\[ \Psi_{a,t+a} = \Psi(c_{a,t+a}, n_{a,t+a}, e_{a,t+a}) , \]

\[ = \mathcal{U}(c_{a,t+a}) - d^n n_{a,t+a} z_{a,t+a} \]

\[ + d^e_a \frac{(e_{a,t+a})^{1-\phi}}{1 - \phi} z_{a,t+a} \]

● participation rate \( z_{a,t+a} \)
  either 1 (workers) or 0 (pensioners)

● decision variables: \( c_{a,t+a} , e_{a,t+a} \)
● « Household » objective:

\[
W^H_t = \max \sum_{a=0}^{15} \beta^a \beta_{a,t+a} \left\{ \Psi_{a,t+a} \right\} Z_{0,t}
\]

● Flow budget constraint

\[
\left[ \left( 1 - \tau^w_{t+a} \right) w_{a,t+a} \cdot n_{a,t+a} + b^u_{a,t+a} \cdot u_{a,t+a} + b^e_{a,t+a} \cdot e_{a,t+a} + b^i_{a,t+a} \cdot i_{a,t+a} \right] \cdot z_{a,t+a} \\
+ \frac{\beta_{a-1,t+a-1}}{\beta_{a,t+a}} R_{t+a} s_{a-1,t+a-1} = \left( 1 + \tau^c_{t+a} \right) c_{a,t+a} + s_{a,t+a}
\]
Optimal early retirement rate (60-64, $a=7$):

$$\frac{b_{7,t+7}^e}{(1 + \tau_{t+7}^c) c_{7,t+7}} + d_{7}^e (e_{7,t+7})^{-\phi} =$$

$$\pi_{7,t+7} \left[ \frac{(1 - \tau_{t+7}^w) w_{7,t+7}}{(1 + \tau_{t+7}^c) c_{7,t+7}} - d^n \right]$$

$$+ (1 - \pi_{7,t+7}) \left[ \frac{b_{7,t+7}^u}{(1 + \tau_{t+7}^c) c_{7,t+7}} \right]$$
Objective of the representative firm

\[ W_t^F = \max_{K_t, V_t} \Pi_t + R_{t+1}^{-1} W_{t+1}^F \]

where:

\[ \Pi_t = F(K_t, H_t) - \nu_t K_t \]

\[ - \sum_{a=0}^{7} (1 + \zeta_t) w_{a,t} N_{a,t} - a V_t \]

\[ H_t = \sum_{a=0}^{7} h_{a,t} \cdot N_{a,t} \]
Factor demands

- capital
  \[ v_t = F_{K_t} \]

- labour
  \[ a = q_t \sum_{a=0}^{7} \frac{\Omega_{a,t}}{\Omega_t} \frac{\partial W_t^F}{\partial N_{a,t}} \]

where:

\[
\frac{\partial W_t^F}{\partial N_{a,t}} = \sum_{j=0}^{7-a} \frac{\beta_{a+j,t+j}}{\beta_{a,t}} R_{t,t+j}^{-1} (1 - \lambda_{a+j-1,t+j-1}) (1 - \lambda_{a+j,t+j}) (1 - \chi)^j \\ 
\cdot \left\{ h_{a+j,t+j} F_{H_{t+j}} - (1 + \zeta_{t+j}) w_{a+j,t+j} \right\}
\]
- Government transfers

\[ b_{a,t}^u = \rho_t^u w_{a,t} \quad 0 \leq a \leq 7; \]

\[ b_{a,t}^e = \rho_t^e w_{a,t} \quad 6 \leq a \leq 7; \]

\[ b_{a,t}^i = \rho_t^i \sum_{i=0}^{3} \frac{w_{a-i,t-i}}{4} \quad 8 \leq a \leq 15. \]

- Balanced budget constraint (adjusting variable: \( \tau_t^c \))

\[ \tau_t^c C_t + (\tau_t^w + \zeta_t) \left( \sum_a w_{a,t} n_{a,t} P_{a,t} \right) = G_t + T_t \]
- Wage bargaining: Nash sharing rule

\[
(1 - \eta) \frac{1}{u'_{ca,t}} \frac{\partial W_t^H}{\partial N_{a,t}} = \eta \frac{1 - \tau_t^w}{(1 + \zeta_t)(1 + \tau_t^c)} \frac{\partial W_t^F}{\partial N_{a,t}}
\]
Equilibrium

- Capital Market Equilibrium (closed economy)

\[ K_{t+1} + Q_t = \sum_{a=0}^{14} s_{a,t} Z_{a,t} \]

- Intertemporal equilibrium
  given initial conditions, exogenous demographic processes, exogenous pension schemes, etc...
  - an IGE with perfect foresight and frictions...
  - an IGE with perfect foresight and perfect competition...
3. Calibration

Demographics:

Based on French data/projections, 1900-2050, extrapolated till 2100;

Migration shocks such that one reproduces exactly latest demographic projections.
leisure utility

the \( d^e_a \) and \( \phi \) parameters are set at values such that early retirement rates are

- in 1970 (with much less generous compensations)
  - 6% for workers aged 55-59
  - 17% for workers aged 60-64

- in 2000
  - 15% for workers aged 55-59
  - 50% for workers aged 60-64

(back to 7.4% and 19% at final steady state)

(\( \phi = 0.20; \ \phi = 0 \) is linear case)
Policy variables

- payroll taxes, public consumption, 2000 values of gross replacement rates

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(ρ<sub>i</sub> values after 2000 include anticipated effects of changes in entitlement rules)
4. Simulations

- We focus on the transition period 2000-2100
  
  - initial steady state: year 1900;
  
  - final steady state: reached after 2100.
Frictional vs competitive economies

Frictional vs competitive economy

Consumption (% of GDP)

Frictional vs competitive economies

similar price effects

Yearly Interest Rate

Wage (% change since 2000)
Frictional vs competitive economies

- **quantity effects are quite different**

![Graph showing average unemployment rate and activity rate](image)

- **fiscal effects of pension reform are quite different**

![Graph showing cost of public pensions](image)
Closed vs small open economy

Activity rate 55-64 (%)

Unemployment rate 25-54 (%)

Cost of Public Pensions (% of GDP)

Consumption (% of GDP)
6. Conclusions

**Labour market imperfections matter**

1. **Price effects are similar, quantity effects not**
   a. ageing reduces equilibrium unemployment through its effects on equilibrium interest rate.
   b. The reduced unemployment risk affects early retirement which reinforces initial effects.

2. Adjustments along extensive margin change the fiscal effects of pension reforms

3. Capital flows of course matter.
   a. As long as the net effect is a lower interest rate, the qualitative results will remain.
   b. Fiscal variables can be affected by capital flows.