Retirement benefits and pension’s funds

Principles

- Identification
- Contracts
- Pricing
References

- OECD
  *Prive pensions- classification and glossary, 2005*
## Risk identification

### Life expectancy: a rising trend

<table>
<thead>
<tr>
<th>Ulpien table (170 - 228)</th>
<th>Northampton table (1783)</th>
<th>1937 table</th>
<th>2005 table</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>Annuity</td>
<td>Age</td>
<td>Life expectancy</td>
</tr>
<tr>
<td>0-19</td>
<td>30 years</td>
<td>20</td>
<td>33</td>
</tr>
<tr>
<td>20-24</td>
<td>28 years</td>
<td>30</td>
<td>28</td>
</tr>
<tr>
<td>25-29</td>
<td>25 years</td>
<td>40</td>
<td>23</td>
</tr>
<tr>
<td>30-34</td>
<td>22 years</td>
<td>50</td>
<td>18</td>
</tr>
<tr>
<td>35-39</td>
<td>20 years</td>
<td>60</td>
<td>13</td>
</tr>
<tr>
<td>40-44</td>
<td>15 years</td>
<td>65</td>
<td>11</td>
</tr>
<tr>
<td>45-49</td>
<td>10 years</td>
<td>70</td>
<td>9</td>
</tr>
<tr>
<td>50 +</td>
<td>5 years</td>
<td>75</td>
<td>7</td>
</tr>
</tbody>
</table>
Ageing of the population

• **BISMARCK:**
  - Retirement age: 65 years
  - Life expectancy: 48 years

• In 1990
  - Life expectancy: 72.0 years
  - Retirement age: 97 years

• And today?
  - In 1990, 75 years is considered as old age (for men)
  - In 2040, old age will be 82 years (a gain of 1.5 month per year)
# Life expectancy at birth for a selection of industrialized countries

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Males</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Japan</td>
<td>69.3</td>
<td>71.7</td>
<td>73.4</td>
<td>74.8</td>
<td>75.9</td>
<td>76.4</td>
<td>77.7</td>
</tr>
<tr>
<td>Australia</td>
<td></td>
<td></td>
<td>71.0</td>
<td>72.4</td>
<td>73.9</td>
<td>75.0</td>
<td>76.6</td>
</tr>
<tr>
<td>Canada</td>
<td>69.3</td>
<td>70.1</td>
<td>71.7</td>
<td>73.1</td>
<td>74.3</td>
<td>75.2</td>
<td>76.6</td>
</tr>
<tr>
<td>Italy</td>
<td>68.7</td>
<td>69.5</td>
<td>70.6</td>
<td>72.3</td>
<td>73.6</td>
<td>74.8</td>
<td>76.6</td>
</tr>
<tr>
<td>United Kingdom</td>
<td></td>
<td></td>
<td>70.8</td>
<td>71.7</td>
<td>72.9</td>
<td>74.0</td>
<td>75.5</td>
</tr>
<tr>
<td>Germany</td>
<td>67.5</td>
<td>68.2</td>
<td>69.6</td>
<td>71.1</td>
<td>72.0</td>
<td>73.2</td>
<td>75.0</td>
</tr>
<tr>
<td>France</td>
<td>68.4</td>
<td>69.0</td>
<td>70.2</td>
<td>71.3</td>
<td>72.8</td>
<td>73.9</td>
<td>75.3</td>
</tr>
<tr>
<td>Europe 25</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>67.1</td>
<td>68.8</td>
<td>70.0</td>
<td>71.1</td>
<td>71.8</td>
<td>72.5</td>
<td>74.1</td>
</tr>
</tbody>
</table>

| Females        |      |      |      |      |      |      |      |
| Japan          | 74.7 | 76.9 | 78.8 | 80.5 | 81.9 | 82.9 | 84.6 |
| France         | 75.8 | 76.8 | 78.3 | 79.3 | 80.9 | 81.8 | 82.7 |
| Italy          | 74.4 | 75.7 | 77.2 | 78.6 | 80.1 | 81.3 | 82.5 |
| Australia      |      |      | 78.1 | 78.8 | 80.1 | 80.8 | 82.0 |
| Canada         | 76.3 | 77.3 | 78.9 | 79.9 | 80.7 | 81.1 | 81.9 |
| Germany        | 73.5 | 74.4 | 76.1 | 77.4 | 78.4 | 79.7 | 81.0 |
| Europe 25      |      |      |      |      |      |      |      |
| United Kingdom |      |      | 76.9 | 77.6 | 78.5 | 79.2 | 80.2 |
| United States  | 74.7 | 76.6 | 77.4 | 78.2 | 78.8 | 78.9 | 79.5 |

Source: Various statistical agencies, Sardon (2004) and Statistics Canada, Demography Division.
Life expectancy projected by national and provincial agencies, around 2030

<table>
<thead>
<tr>
<th>Country</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canada (2031)</td>
<td>81.9</td>
<td>86.0</td>
</tr>
<tr>
<td>Ontario (2031)</td>
<td>82.6</td>
<td>85.0</td>
</tr>
<tr>
<td>Quebec (2031)</td>
<td>81.8</td>
<td>86.4</td>
</tr>
<tr>
<td>British Columbia (2031)</td>
<td>79.8</td>
<td>84.4</td>
</tr>
<tr>
<td>Manitoba (2031)</td>
<td>77.4</td>
<td>82.2</td>
</tr>
<tr>
<td>United States (2025)</td>
<td>77.6</td>
<td>83.6</td>
</tr>
<tr>
<td>France (2030)</td>
<td>81.0</td>
<td>88.3</td>
</tr>
<tr>
<td>Japan (2030)</td>
<td>80.1</td>
<td>88.0</td>
</tr>
<tr>
<td>United Kingdom (2030)</td>
<td>79.7</td>
<td>83.9</td>
</tr>
</tbody>
</table>

Source: Different statistical national and provincial agencies.
Ageing of the population (+80 years)

Source: OECD Health data (2004)
Changes in the age structure of the Canadian population by sex, 1956, 2006 and 2056

Deaths pyramids (in relative value) of the Canadian population 2009, 2035 and 2060
Financing retirement benefits

The 3 pillars

- **1st pillar** - State/social protection
- **2nd pillar** - Employees pension funds
- **3rd pillar** - private savings

The Four Pillars is a research programme set up in 1987 by the Geneva Association, also known as the International Association for the Study of Insurance Economics.

- **4th pillar** i.e. the future need for a flexible extension of work-life, mainly on a part-time basis, in order to supplement income from the three existing pillars
The Swiss Pension System

Three-Pillar System

Pillar 1
- State pension
- Securing a minimum standard of living
- AHV / AVS-IV / AI
- Supplementary benefits

Pillar 2
- Occupational pension
- Maintenance of current standard of living
- Mandatory BVG / LPP-UVG / LAA
- Extra-mandatory pension provision

Pillar 3
- Private pension
- Individual supplement
- Tied pension provision (Pillar 3a)
- Flexible pension provision (Pillar 3b)
## The Spanish pension system

<table>
<thead>
<tr>
<th></th>
<th>1st Pillar</th>
<th>2nd Pillar</th>
<th>3rd Pillar</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td>Mandatory</td>
<td>Mandatory/Voluntary</td>
<td>Voluntary</td>
</tr>
<tr>
<td><strong>Management</strong></td>
<td>Public</td>
<td>Public/Private</td>
<td>Private</td>
</tr>
<tr>
<td><strong>Form</strong></td>
<td>Non-contributory</td>
<td>Contributory/Occupational Plan</td>
<td>Personal savings Plan or occupational Plan</td>
</tr>
<tr>
<td><strong>Financing</strong></td>
<td>Tax-financed Pay-as-you-go (PAYG)</td>
<td>PAYG Contributions Funded</td>
<td>Funded</td>
</tr>
</tbody>
</table>

Social and Private Insurance
Classification of retirement systems

• Distribution system - « Pay-as-you-go »
• Capitalization system - « pension fund »
Pay-as-you-go

• Required equilibrium between income and benefits paid at any period of time: \( b \times I = tc \times w \times C \)
  
  – \( b = \) benefits paid
  – \( I = \) number of retirees
  – \( tc = \) contribution rate
  – \( w = \) average salary
  – \( C = \) Number of employees

**Fundamental variables in this relationship:**

• Economic dependency ratio \( = I / C \)
• Gross replacement rate \( = b / w. \)
The relevant factors

• Economic dependency ratio
  – I: retirement age, ageing population
  – C: economic growth, unemployment rate

• Gross replacement rate
  – Contribution rate (employer/employee), taxes
  – International economic environment (opened economies)
A Pension fund

• Required equilibrium between contributions paid today and benefits paid tomorrow:
  – Sum of “\(tc\cdot w\cdot C\)” during working period (t to \(t+r\))
  = Sum of “\(b\cdot I\)” over the period \(t+r+1\) to \(t+n\).

If \(I = C\) (employees contribute to their own pension), and
If there is no inflation over the period and interest rates = 0,….the problem is reduced to the gross replacement rate \(b/w\)
Graph of a pension fund mechanism
Classification of annuities

By Commencement of Income:
1. Immediate annuity.
2. Annuity fixed date
3. Deferred annuity.

By Number of Lives Covered:
2. Multiple life annuity (two heads)

By Mode of Payment of Premium:
1. Level premium annuities. (fixed or variable).
2. Single premium annuities.

By Disposition of Proceeds:
1. Life annuity.
2. Guaranteed premium (or period) annuity.
Determination of benefits: principles

- Defined contribution plan (DC)
- Defined benefits plans (DB)
Defined contributions plans

• Contributions as a % of salary
• Amount of funds before retirement is a function of:
  - rate of contribution
  - interest rates
• Benefits paid are function of funds accumulated
• Benefits amount unknown
• Retiree has the burden of risks
Defined benefits plan

- Contributions as a % of salary but determined by future benefits (regular actuarial evaluation needed)
- Amount of funds before retirement is a function of:
  - rate of contribution
  - interest rates
- Benefits paid are determined at the beginning of employment:
  - as a % of salary (last year or average)
  - as a function of the nb of years of contribution
- The employer (or state) has the burden of risks
Pension plans classification
OECD 2005
The relevant factors

- Retirement age
- Contribution rate (employer/employee)
- Gross replacement rate in a defined benefits plan
- Investments and return on investment
  - Market risks
  - Interest rate risks
Private pension plan: institutional perspective

- Private pension plan
  - Funded
  - Book reserves
  - Unfunded
    - Pension insurance contracts
    - Pension funds
      - Legal personality
        - Trust/Foundation
      - No legal personality
        - Corporate entity
        - Dedicated provider
        - Other financial institution