2nd PBSS COLLOQUIUM
Helsinki, Finland 21-23 May 2007
B Longevity and Risk Sharing

**Moderator: Ken Buffin**

M. Ono: *Applying Sweden 'automatic balance mechanism' to Japanese population*

T. Igawa: *Public sector pension plans in Japan - Changes in plan design, financing and investment policies*

M. C. Boado: *A balance sheet for Pay-as-you-go finance: Solvency Indicators for Spain*
Applying Swedish Automatic Balance Mechanism to Japanese Population

2nd PBSS Colloquium- Helsinki, Finland
21-23 May 2007

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Certified Pension Actuary in Japan
Mizuho Pension Research Institute
Main Issue of the paper

- Does the Swedish Automatic Balance Mechanism work well under the severely decreasing population like Japan?
- If it doesn’t, which conditions would be required?

I have not yet find the appropriate answer to the second issue.
Contents

- Discussions in 2004 Pension Reform in Japan
- Review of “Automatic Balance Mechanism” in Swedish PAY-GO Pension Scheme
- Pension Scheme Projection Model for Japanese Population
- Projection Results and its Analysis
## Balance Sheet of Japanese PAY-GO State Pension Scheme (EPI)

### PV of Sources for Payment

<table>
<thead>
<tr>
<th>Component</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contributions</td>
<td>¥1,200 tril.</td>
</tr>
<tr>
<td>Buffer Fund</td>
<td>¥160 tril.</td>
</tr>
<tr>
<td>Past Service</td>
<td>¥150 tril.</td>
</tr>
<tr>
<td>Future Service</td>
<td>¥190 tril.</td>
</tr>
</tbody>
</table>

**Total**: ¥1,710 trillion

*Future appreciations of contribution rate are considered*

### PV of Future Benefits

<table>
<thead>
<tr>
<th>Component</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefits for Past Service</td>
<td>¥740 tril.</td>
</tr>
<tr>
<td>Benefits for Future Service</td>
<td>¥970 tril.</td>
</tr>
<tr>
<td>For retirees</td>
<td>¥350 tril.</td>
</tr>
</tbody>
</table>

**Total**: ¥1,710 trillion

Assumed interest rate(3.2%) is the expected rate of return on Buffer Fund.

Past Service - Past 2004  
Future Service - Future 2004
Automatic Balance Mechanism:
If the balance ratio goes down to less than 1, the indexation is automatically adjusted so that the ratio be recovered to 1.
Theoretical Background for the Balance Sheet
Assuming “Steady State”

\[ L_x = L_0 \cdot l_x \cdot e^{-\delta \cdot x} \]

- \( \delta \): Fertility driven population growth rate
- \( l_x \): Life table at age \( x \)
- \( L_x \): Population in age group \( x \)
- \( W \): Average wage
- \( W_x \): Average wage of age group \( x \)
- \( \rho \): Wage growth rate
- \( \varphi \): Adjustment factor for pension indexation
- \( A_x \): Participation rate in age group \( x \)
- \( R_x \): Rate of number pensioners to population in age group \( x \)
- \( m \): Minimum age
- \( r \): Retirement age
- \( \omega \): Limiting age

Review of “Automatic Balance Mechanism” in Swedish PAY-GO Pension Scheme
Theoretical Background for the Balance Sheet

Definition of “Turnover Duration”

\[
\bar{x}_a = \frac{\int_0^\omega x \cdot l_x \cdot e^{-\delta x} \cdot A_x \cdot W_x \, dx}{\int_0^\omega l_x \cdot e^{-\delta x} \cdot A_x \cdot W_x \, dx}
\]

\[
\bar{x}_p = \frac{\int_0^\omega x \cdot e^{-(\delta+\varphi)x} \cdot l_x \cdot R_x \, dx}{\int_0^\omega e^{-(\delta+\varphi)x} \cdot l_x \cdot R_x \, dx}
\]

money(wage) - weighted average age for active participants

money(pension) - weighted average age for pensioners

\[
TD = \bar{x}_p - \bar{x}_a
\]

Turnover Duration (32.04812)
Theoretical Background for the Balance Sheet

Actuarial Liability \( V = PV_{FB} - PV_{FC} \)

\[
V = \int_{0}^{\omega} L_0 \cdot l_x \cdot e^{-\delta x} \int_{x}^{\omega} p_x \cdot e^{-(\delta + \rho)(u-x)} \cdot \left[ R_u \cdot k \cdot W \cdot e^{\rho(u-x) - \phi(u-r)} - A_u \cdot c \cdot W \cdot W_u \cdot e^{\rho(u-x)} \right] du \cdot dx
\]

\( \delta + \rho \) : assumed interest rate
\( k \) : constant representing benefit level

Annual Contributions (C)

\[
C = \int_{0}^{\omega} L_0 \cdot l_x \cdot e^{-\delta x} \cdot A_x \cdot c \cdot W \cdot W_x \cdot dx
\]

\[
\frac{V}{C} = \bar{x}_p - \bar{x}_a = TD
\]

Rate of Contributions (c)

\[
c = \frac{k \cdot \int_{0}^{\omega} l_x \cdot e^{-\delta x} \cdot A_x \cdot W \cdot W_x \cdot dx}{\int_{0}^{\omega} l_x \cdot e^{-\delta x} \cdot A_x \cdot W \cdot W_x \cdot dx}
\]

\[
\frac{V}{C} = TD
\]

It may be assumed that the scheme can expect future contributions as an inter-generational wealth transfer insofar to “Steady State Pension Liability”. Steady State Pension Liability can be easily calculated by using the above equation.
Present Population Structures

There seems to be no big difference.

Swedish Population (2005)


Pension Scheme Projection Model for Japanese Population
Population Projection in Japan

Generation Y will not create any baby boom.
Population Projection in Japan

Difference from “Steady State Population”
Assumptions for the Projection

- Fertility and Mortality rates: NIPSSR* 2002 Projection (moderate)
  - the total fertility rate will converge to 1.39
- Labor Force Participation Rates: MHLW** Projection for 2004 Reform (moderate)
  - Labor Force = Participants of the Scheme
- Benefits Formula: Career Average (reevaluated)
- Rate of Benefit Accrual: 1% per annum
- Pensionable Age: 65
- Indexation in retirement: CPI
- Wage Profile: MHLW**
- Inflation, Wage Increase, Return on Assets: 1.0%, 2.1%, 3.2%

*National Institute of Population and Social Security Research
**Ministry of Health, Labor, and Welfare
Selected Assumptions

Figure 3: Labor Force Participation Rate

Figure 4: Wage Profiles by Age
Projection Results and its Analysis

Projection Results

Initial Fund: 5 times annual outlays
Real Rate of Return on the fund: 1.1%
Without Automatic Balance Mechanism

Net of Wage Increase

Figure 5
Projection of Financial Position without the activation of the Balance Mechanism
(Initial Fund: 5 times annual outlays, Real Rate of Return on the fund: 1.1%)
Projection Results and its Analysis

**Figure 8**
Effect of Automatic Balance Mechanism

<table>
<thead>
<tr>
<th>Benefit Level</th>
<th>60%</th>
<th>70%</th>
<th>80%</th>
<th>90%</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2010</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td></td>
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<td></td>
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<tr>
<td>2030</td>
<td></td>
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<td></td>
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<tr>
<td>2040</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>2050</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ABM will activate in 2039

**Figure 7**
Analysis of Actuarial Gains and Losses

Net CA will decrease severely from 2030s
If there is no initial fund, the automatic balance mechanism will not be able to avoid the fund exhaustion for 50 years.
Projection Results

Considering the fertility driven population decreasing rate or the net total wage decreasing rate might generate a better result.

Considering those factors has not given the pleasant result.
Public Sector Pension Plans in Japan
- Changes in Plan Design, Financing and Investment Policies -

Takayuki Igawa
F.I.A.J., Certified Pension Actuary of Japan
Introduction

1. System of Japanese public sector pension plans

2. What happened to these plans?

3. 2 Examples

4. Consideration and Conclusion
Categories of the Japanese public sector pension plans

I define here the Japanese public sector pension plans as the below two categories:

1. **Non-profit organizations’ pension plans** related to the public plans

2. **Occupational Additional Pension (OAP)** which Mutual Aid Pensions (government officials’ pension fund and private school teachers’ pension fund) provide as public plans
Non-profit organizations’ pension plans

1. Some of them are related to the public plans and here I treat them as one category of the public sector plans.

2. These plans were NOT regulated by the law.

3. Various types of plans, various funding method and investment policies
3 representative non-profit organization plans related to the public plans

Fig. 1 The system of Japanese pension and non-profit organization plans

(A) Plans for government officials

(B) Plans for private school teachers and employees

(C) Plans for welfare institution personnel

1. System of Japanese public sector pension plans

Private plan
Public plan

Corporate pension plans
Employees’ Pension Insurance (EPI)
Mutual Aid Pensions (MAP)
Occupational Additional Pensions

National Pension (Basic Pension)
Occupational Additional Pension (OAP)

1. There are 3 Mutual Aid Pensions (MAP) and 2 MAP are for national and local government officials and 1 MAP is for private school teachers and employees.

2. In 1985, the difference in benefit between Employees’ pension insurance (EPI) and MAP was arranged as the Occupational Additional Pension (OAP).

3. The OAP is treated as a public plan incorporated within MAP.

4. A partial funding method is adopted.
OAP for government officials and private school teachers and employees

Fig.2 The system of Japanese pension and OAP

1. System of Japanese public sector pension plans

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Helsinki, Finland 21-23 May 2007
Investment policies of Government officials’ pension plans

Table 1 Policy Portfolios of Public Pension Plans

<table>
<thead>
<tr>
<th>Policy Portfolios</th>
<th>Expected Return</th>
<th>Domestic Bond etc.*</th>
<th>Domestic Equity</th>
<th>Foreign Equity</th>
<th>Foreign Bond</th>
<th>Cash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employees’ Pension Insurance</td>
<td>3.37%</td>
<td>67%</td>
<td>11%</td>
<td>9%</td>
<td>8%</td>
<td>5%</td>
</tr>
<tr>
<td>Mutual Aid Pension for National Government Officials</td>
<td>2.5%</td>
<td>87%</td>
<td>5%</td>
<td>5%</td>
<td>0%</td>
<td>3%</td>
</tr>
<tr>
<td>Mutual Aid Pension for Local Government Officials**</td>
<td>3.21%</td>
<td>64%</td>
<td>14%</td>
<td>11%</td>
<td>10%</td>
<td>1%</td>
</tr>
<tr>
<td>Mutual Aid Pension for Private School Teachers</td>
<td>2.8%</td>
<td>65%</td>
<td>10%</td>
<td>10%</td>
<td>10%</td>
<td>5%</td>
</tr>
</tbody>
</table>

Note *: Including loans, real estate
Note **: Pension fund association for local government officials
Source: Author’s tabulations from each public pension’s disclosure

Table 2 Average Portfolio of Corporate Pension Plans

<table>
<thead>
<tr>
<th>Policy Portfolios</th>
<th>Domestic Bond etc.*</th>
<th>Domestic Equity</th>
<th>Foreign Equity</th>
<th>Foreign Bond</th>
<th>Hedge Fund</th>
<th>Cash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employees’ Pension Fund and Defined Benefit Corporate Pension</td>
<td>31.56%</td>
<td>30.81%</td>
<td>18.32%</td>
<td>11.67%</td>
<td>4.18%</td>
<td>3.47%</td>
</tr>
</tbody>
</table>

Note *: Including general account of insurance company, loans, real estate and convertible bond etc.
Source: Author’s tabulations from the investigation of the investment results in FY2005 by Pension Fund Association

Public pension plans adopt lower risk portfolios than corporate pension plans.
The revision of the insurance law

1. In April 2006, the new insurance law was enforced and the definition of the insurance business was changed.

2. Consequently, some non-profit organization plans became to be regulated by the insurance law.
Public corporation reform

1. Public corporation means a corporate juridical person or foundation. It is one of the representative non-profit organizations. Many public corporations provide mutual aid pension plans related to the public plans.

2. The new accounting standard for public corporations was introduced in April 2006.

3. The new law of the new public corporation was approved in the Diet in May 2006 as a revision, following almost a century-long lapse.

4. The tax law will be revised in 2007-2008.
Occupational Additional Pension (OAP) reform

1. The OAP will probably be abolished and a new system will probably be established in 2010.

2. The kind of plans (DC, Hybrid plans etc.) to be introduced as a new system remain undecided.
Examples of non-profit organization plans

1. 2 examples for considering on what the public sector plans should be and the regulation should be

2. There is no official data about non-profit organization plans because of no regulation, but some types of plans can be found in them.
Example 1 Hybrid plans

1. The benefit is revised based on the result of the investment.

2. The financial management is similar to the insurance company’s way, but it is difficult to comply with the insurance law.

3. This type is not available in the corporate pension plans.
Example 2 Prescribed benefit types

1. The benefit amount is prescribed in advance.

2. Various funding method, various expected rate of return and investment portfolio

3. Some plans have insufficient funds.
Comparison to corporate pension plans for consideration

Table 3 Comparison of non-profit organization plans to corporate pension plans

<table>
<thead>
<tr>
<th></th>
<th>Non-profit organization plans</th>
<th>Corporate pension plans</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hybrid plan</td>
<td>Any type is available.</td>
<td>Only Cash Balance type (CB) is available.</td>
</tr>
<tr>
<td>Employees’ Contribution</td>
<td>Not regulated</td>
<td>Regulated</td>
</tr>
<tr>
<td>Funding Method</td>
<td>Not regulated</td>
<td>Advance funding method</td>
</tr>
<tr>
<td>Investment Risk Sharing</td>
<td>Possible by various types of hybrid plans</td>
<td>Possible by CB</td>
</tr>
</tbody>
</table>
### Comparison to corporate pension plans for consideration

**Table 4 Comparison of OAP to corporate pension plans**

<table>
<thead>
<tr>
<th></th>
<th>Occupational Additional Pension (OAP)</th>
<th>Corporate pension plans</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hybrid plan</strong></td>
<td>No type is available.</td>
<td>Only Cash Balance type (CB) is available.</td>
</tr>
<tr>
<td><strong>Employees’ Contribution</strong></td>
<td>Prescribed</td>
<td>Regulated</td>
</tr>
<tr>
<td><strong>Funding Method</strong></td>
<td>Partial funding method</td>
<td>Advance funding method</td>
</tr>
<tr>
<td><strong>Investment Risk Sharing</strong></td>
<td>Impossible with hybrid plans</td>
<td>Possible by CB</td>
</tr>
</tbody>
</table>
Conclusion

1. The pension plan should be regulated by the pension law – not by the insurance law. The new pension law is necessary for Japanese government officials.

2. Arrangement of non-profit organization plans and the OAP is necessary.

3. Some kinds of hybrid plans seem to be an effective way for the financial stability and should also be introduced to corporate pension plans.
Thank you very much.
2nd PBSS COLLOQUIUM
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AN ACTUARIAL BALANCE SHEET FOR PAY-AS-YOU-GO FINANCE:
SOLVENCY INDICATORS FOR SPAIN

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Salvador VALDÉS-PRIETO, PUC University (Chile)
Carlos VIDAL-MELIÁ, University of Valencia (Spain)
AIM of this paper

✓ To show the usefulness of the actuarial balance sheet as an indicator of solvency, sustainability or financial solidity of any pay-as-you-go financed pension system.

✓ To offer the first estimate, based on official data, of the actuarial balance sheet of the Spanish contributory pension system.
1) Introduction.

2) Actuarial balance sheet of a pay-as-you-go pension system.
   - Overview on the Contribution Asset
   - Overview on the Hidden Asset

3) The Swedish experience with the actuarial balance sheet.

4) Balance sheet of the Spanish pension system.

5) Concluding remarks.

6) Bibliography.

7) Appendixes (7.1.-Contribution Asset, 7.2.-Hidden Asset, 7.3.-Sensitivity Analysis, 7.4.-Spanish Data).
1.- Introduction.

✓ Three important issues in pension finance:

1) Transparency in the management of the finances of public systems.
2) Immunising the pay-as-you-go system against the political risk.
3) To gain credibility among participants.

✓ The actuarial balance sheet provides response to these three issues.

✓ The actuarial balance sheet may also help neutralise and/or minimise populism with regard to pensions.

✓ The actuarial balance sheet has been developed and applied by Sweden since 2001. In USA, BOT (2006) has been compiling elements to build an actuarial balance sheet since 1965.
2.- Actuarial balance sheet of a pay-as-you-go system.

Main entries on the balance sheet of a pay-as-you-go system.

<table>
<thead>
<tr>
<th>ASSETS</th>
<th>LIABILITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial and Real Assets</td>
<td>Liability to Pensioners</td>
</tr>
<tr>
<td>Contribution Asset/Hidden Asset</td>
<td>Liability to Contributors</td>
</tr>
<tr>
<td>Accumulated Deficit</td>
<td>Accumulated Surplus</td>
</tr>
<tr>
<td><strong>TOTAL ASSETS</strong></td>
<td><strong>TOTAL LIABILITIES</strong></td>
</tr>
</tbody>
</table>

Financial and Real Assets + Contribution Asset or Hidden Asset \( \geq \) Liability to Pensioners + Liability to contributors

Financial and Real Assets + Contribution Asset or Hidden Asset \( < \) Liability to Pensioners + Liability to contributors

Solvent

Partially solvent
2.- Actuarial balance sheet of a pay-as-you-go system.

- The presence of the Contribution/Hidden Asset in the balance sheet counters those who discredit pure and partial pay-as-you-go finance by claiming that it is always “bankrupt” or insolvent.

- These concepts are different.

**Contribution Asset**
- Settergren & Mikula (2005)

**Hidden Asset**

**Maximum liability** that can be financed in that steady state by the current contribution rate without supplements from the sponsor.

**Present discounted value** of the hidden taxes and hidden subsidies that will be applied by the pension system to its participants in the future, under legislated parameters.
The Contribution Asset is derived from linking the assets and liabilities of the pension system.

\[ \text{Liabilities} = \text{Assets} \Rightarrow V_t = f(\text{benefit parameters}, \gamma, g, d) \cdot C_t \]

\[ V_t = CA_t = TD \cdot C_t \Rightarrow TD = \frac{V_t}{C_t} \]

\[ d = g, \gamma = 0 \Rightarrow TD = (pt_r + pt_c) \Rightarrow TD = A_r - A_c \]

\[ V_t : \text{Accrued liabilities at date } t \]
\[ C_t : \text{Contribution revenue in year } t \]
\[ \gamma : \text{Fertility-driven population growth rate} \]
\[ g : \text{Growth rate of average covered earnings in real terms} \]
\[ d : \text{Discount rate} \]
3. - Balance sheet of the Swedish pension system.

Main assumptions:

- Both assets and liabilities are valued on the basis of verifiable cross-section facts, i.e. no projections are made.

- The Liability to Contributors is calculated as the notional capital accumulated in the participants' accounts.

- The Liability to Pensioners is the “nominal” value of benefits expected to be paid, and it is calculated by multiplying the annual pension by the economic annuity divisor for each cohort.

- The system’s solvency does not depend on the amount of the assets and liabilities separately, but on the relation between them via the solvency ratio: \( \frac{\text{Total assets}}{\text{total liabilities}} \)

- If the solvency ratio is less than one, the Swedish system imposes an “automatic balance mechanism”, that modifies the notional interest rate credited and the indexation rate for pensions.
### Balance Sheet of the Swedish Pension System

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ASSETS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial Asset</td>
<td>28.8</td>
<td>25.1</td>
<td>23.5</td>
<td>20.6</td>
<td>24.7</td>
</tr>
<tr>
<td>Contribution Asset</td>
<td>214.0</td>
<td>217.9</td>
<td>222.2</td>
<td>223.2</td>
<td>222.2</td>
</tr>
<tr>
<td><strong>Total Assets</strong></td>
<td>242.8</td>
<td>243.0</td>
<td>245.7</td>
<td>243.7</td>
<td>246.9</td>
</tr>
<tr>
<td><strong>LIABILITIES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liability to Contributors</td>
<td>172.6</td>
<td>174.3</td>
<td>175.4</td>
<td>175.3</td>
<td>172.3</td>
</tr>
<tr>
<td>Liability to Pensioners</td>
<td>69.2</td>
<td>68.3</td>
<td>67.9</td>
<td>66.3</td>
<td>65.1</td>
</tr>
<tr>
<td>Accumulated surplus</td>
<td>0.3</td>
<td>2.2</td>
<td>2.1</td>
<td>9.2</td>
<td>9.5</td>
</tr>
<tr>
<td>&quot;Losses or benefits&quot;</td>
<td>0.7</td>
<td>-1.9</td>
<td>-1.9</td>
<td>0.3</td>
<td>-7.0</td>
</tr>
<tr>
<td><strong>Total Liabilities</strong></td>
<td>242.8</td>
<td>243.0</td>
<td>245.7</td>
<td>243.7</td>
<td>246.9</td>
</tr>
<tr>
<td><strong>FUNDING AND SOLVENCY INDICATORS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solvency ratio (Total Assets/Liabilities)</td>
<td>1.0044</td>
<td>1.0014</td>
<td>1.0097</td>
<td>1.0090</td>
<td>1.0402</td>
</tr>
<tr>
<td>Degree of funding (Financial Asset/Liabilities)</td>
<td>11.90%</td>
<td>10.35%</td>
<td>9.64%</td>
<td>8.51%</td>
<td>10.40%</td>
</tr>
<tr>
<td>Liabilities to Contributors/Liabilities</td>
<td>71.4%</td>
<td>71.8%</td>
<td>72.1%</td>
<td>72.6%</td>
<td>72.6%</td>
</tr>
</tbody>
</table>

4. - Balance sheet of the Spanish pension system.

- Main assumptions:
  - Information relating to the commitments acquired with current workers and pensioners for the retirement contingency.
  - Social security regimes considered: general, agrarian workers, self-employed workers, coal mining, domestic employees, sea workers and SOVI.
  - The philosophy used to compile the balance sheet in Sweden will be followed as far as possible when valuing the Spanish system's assets and liabilities.
  - Spanish current benefit formula: constant pensions, pension base is calculated by taking into account the 15 years before retirement.

<table>
<thead>
<tr>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>ASSETS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial Asset</td>
<td>3.00</td>
<td>2.30</td>
<td>1.54</td>
<td>0.85</td>
<td>0.36</td>
</tr>
<tr>
<td>Contribution Asset</td>
<td>188.74</td>
<td>188.74</td>
<td>194.18</td>
<td>196.21</td>
<td>203.75</td>
</tr>
<tr>
<td>Accumulated Deficit</td>
<td>101.39</td>
<td>96.16</td>
<td>94.56</td>
<td>87.29</td>
<td>93.51</td>
</tr>
<tr>
<td>&quot;Losses for the period&quot;</td>
<td>7.32</td>
<td>13.12</td>
<td>8.67</td>
<td>14.19</td>
<td>0.00</td>
</tr>
<tr>
<td>Total Assets</td>
<td>300.45</td>
<td>300.32</td>
<td>298.95</td>
<td>298.53</td>
<td>297.62</td>
</tr>
<tr>
<td><strong>LIABILITIES</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liability to Pensioners</td>
<td>60.82</td>
<td>60.75</td>
<td>61.62</td>
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<td>62.10</td>
</tr>
<tr>
<td>Liability to Contributors</td>
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</tr>
<tr>
<td>Total Liabilities</td>
<td>300.45</td>
<td>300.32</td>
<td>298.95</td>
<td>298.53</td>
<td>297.62</td>
</tr>
<tr>
<td><strong>FUNDING AND SOLVENCY INDICATORS</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solvency ratio</td>
<td>0.638</td>
<td>0.636</td>
<td>0.655</td>
<td>0.660</td>
<td>0.686</td>
</tr>
<tr>
<td>Degree of funding</td>
<td>1.00%</td>
<td>0.77%</td>
<td>0.51%</td>
<td>0.28%</td>
<td>0.12%</td>
</tr>
<tr>
<td>Liabilities to Contrib./Liabilities</td>
<td>79.8%</td>
<td>79.8%</td>
<td>79.4%</td>
<td>78.8%</td>
<td>79.1%</td>
</tr>
</tbody>
</table>

% of GDP. Source: Authors
4. - Balance sheet of the Spanish pension system.

- Different values of “d” considered.
- Comparation to Sweden results.
- Results for different Spanish regimes.
- Causes of insolvency in the Spanish case.
4.- Balance sheet of the Spanish pension system. Different values of “d”.

<table>
<thead>
<tr>
<th>ASSETS</th>
<th>d=0%</th>
<th>d=1.5%</th>
<th>d=3%</th>
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<tr>
<td>Financial Asset</td>
<td>3.00</td>
<td>3.00</td>
<td>3.00</td>
</tr>
<tr>
<td>Contribution Asset</td>
<td>188.74</td>
<td>121.57</td>
<td>77.70</td>
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<tr>
<td>Accumulated Deficit</td>
<td>101.39</td>
<td>69.15</td>
<td>46.21</td>
</tr>
<tr>
<td>&quot;Losses for the period&quot;</td>
<td>7.32</td>
<td>2.90</td>
<td>1.64</td>
</tr>
<tr>
<td>Total Assets</td>
<td>300.45</td>
<td>196.62</td>
<td>128.45</td>
</tr>
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<table>
<thead>
<tr>
<th>LIABILITIES</th>
<th></th>
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<tr>
<td>Liability to Pensioners</td>
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<td>Total Liabilities</td>
<td>300.45</td>
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<tr>
<th>FUNDING AND SOLVENCY INDICATORS</th>
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<th></th>
<th></th>
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<tbody>
<tr>
<td>Solvency ratio</td>
<td>0.638</td>
<td>0.634</td>
<td>0.628</td>
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<tr>
<td>Degree of funding</td>
<td>1.00%</td>
<td>1.53%</td>
<td>2.34%</td>
</tr>
<tr>
<td>Liabilities to Contrib./Liabilities</td>
<td>79.8%</td>
<td>72.8%</td>
<td>64.0%</td>
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</table>

% of GPD. Year 2005. Source: Authors
4.- Balance sheet of the Spanish pension system. Comparison to Swedish results.

<table>
<thead>
<tr>
<th>ASSETS</th>
<th>Spain</th>
<th>Sweden</th>
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</thead>
<tbody>
<tr>
<td>Financial Asset</td>
<td>3.00</td>
<td>28.8</td>
</tr>
<tr>
<td>Contribution Asset</td>
<td>188.74</td>
<td>214.0</td>
</tr>
<tr>
<td>Accumulated Deficit</td>
<td>101.39</td>
<td></td>
</tr>
<tr>
<td>&quot;Losses for the period&quot;</td>
<td>7.32</td>
<td></td>
</tr>
<tr>
<td>Total Assets</td>
<td>300.45</td>
<td>242.8</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>LIABILITIES</th>
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</thead>
<tbody>
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<td>Liability to Pensioners</td>
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<td>Liability to Contributors</td>
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<td>Accumulated surplus</td>
<td>0.3</td>
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<tr>
<td>“Benefits for the period”</td>
<td>0.7</td>
<td></td>
</tr>
<tr>
<td>Total Liabilities</td>
<td>300.45</td>
<td>242.8</td>
</tr>
</tbody>
</table>

| FUNDING AND SOLVENCY INDICATORS |        |        |
| Solvency ratio                 | 0.638  | 1.0044 |
| Degree of funding              | 1.00%  | 11.90% |
| Liabilities to Contrib./Liabilities | 79.8% | 71.4% |

% of GPD. Year 2005. Source: Authors
4.- Balance sheet of the Spanish pension system. Comparation to Sweden
## Balance sheet of the Spanish pension system. Results for different Spanish regimes.

<table>
<thead>
<tr>
<th>Regime</th>
<th>All regimes</th>
<th>General 80%</th>
<th>Self-employed</th>
<th>Domestic employees</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ASSETS</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Financial Asset</td>
<td>3.00</td>
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<td>0.31</td>
<td>0.03</td>
</tr>
<tr>
<td>Contribution Asset</td>
<td>188.74</td>
<td>160.40</td>
<td>19.26</td>
<td>1.90</td>
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<tr>
<td>Accumulated Deficit</td>
<td>108.71</td>
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<td>20.36</td>
<td>1.59</td>
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<td>Total Assets</td>
<td>300.45</td>
<td>235.50</td>
<td>39.92</td>
<td>3.52</td>
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<tr>
<td><strong>LIABILITIES</strong></td>
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<td></td>
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<td>Liability to Pensioners</td>
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<td>43.14</td>
<td>5.39</td>
<td>1.20</td>
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<td>Liability to Contributors</td>
<td>239.63</td>
<td>192.36</td>
<td>34.53</td>
<td>2.32</td>
</tr>
<tr>
<td>Total Liabilities</td>
<td>300.45</td>
<td>235.50</td>
<td>39.92</td>
<td>3.52</td>
</tr>
<tr>
<td><strong>SOLVENCY INDICATOR</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solvency ratio</td>
<td>0.638</td>
<td>0.692</td>
<td>0.490</td>
<td>0.549</td>
</tr>
</tbody>
</table>

% of GDP. Year: 2005. Source: Authors
4.- Balance sheet of the Spanish pension system. Results for different Spanish regimes.

![Graph showing solvency ratio for different regimes from 2001 to 2005.](image)

**Solvency ratio**

- **All regimes**
- **Self-employed**
- **General**
- **Domestic employees**

<table>
<thead>
<tr>
<th>Year</th>
<th>Solvency ratio</th>
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<tbody>
<tr>
<td>2001</td>
<td>0.80</td>
</tr>
<tr>
<td>2002</td>
<td>0.75</td>
</tr>
<tr>
<td>2003</td>
<td>0.70</td>
</tr>
<tr>
<td>2004</td>
<td>0.65</td>
</tr>
<tr>
<td>2005</td>
<td>0.60</td>
</tr>
</tbody>
</table>


✓ The cost of selling (commitments) > the selling price (contributions).
 Paradox: “The more sold, the more positive the net cash flow observed, but greater the degree of insolvency of the system as a whole”.

✓ In the Spanish defined-benefit design, the current evolution will continue until new legislation is adopted.

Swedish system has the automatic balance mechanism

✓ Restoring solvency to the Spanish system would demand a package of far-reaching measures to reduce the speed of growth of the liabilities.
5. - Concluding remarks.

✓ The existence of the Contribution Asset shows that there is no basis for the arguments put forward by those who discredit pure and partial pay-as-you-go finance systems by saying that they are always "bankrupt" or insolvent.

✓ The balance sheet for the Spanish contributory retirement pension system as of 2005 shows a weak position of solvency (solvency ratio equal to 0.638, the assets deficit was 36.2 % of liabilities).

✓ The Spanish system shows signs of a structural actuarial imbalance: the relation between the expected contributions and pension benefits “yields” too high an implicit IRR for the average participant.

✓ The absence of a actuarial balance, in the case for Spain, produces a “MIRAGE EFFECT”; by hiding the presence of a capital deficit, it relativises future cash deficits because there is still time before they occur and still time meanwhile for “something to save the system".
AN ACTUARIAL BALANCE SHEET FOR PAY-AS-YOU-GO FINANCE:
SOLVENCY INDICATORS FOR SPAIN

KIITOS

END
B Longevity and Risk Sharing

Moderator: Ken Buffin

R. Brown: Actuarial issues in the design of an optimal social security system

K. Lundberg: Balancing distribution of surpluses, and the role of bookkeeping and the balance sheet in the Swedish public pay-as-you-go pension scheme
ACTUARIAL ISSUES IN THE DESIGN OF AN OPTIMAL SOCIAL SECURITY SYSTEM

ROBERT L. BROWN
DIRECTOR
THE INSTITUTE OF INSURANCE AND PENSION RESEARCH
UNIVERSITY OF WATERLOO

IAA / PBSS    Helsinki

May 22, 2007
What Is An Optimal System

Criteria used
- Poverty Alleviation
- Income Adequacy
- Income Equality
- Wealth Distribution
- Sustainability
Only look at Retirement Income Security

Not: Health care
Workers Compensation

Focus on Canada and United States (U.S.)
Economist’s View of Social Security

Social Security normally designed by economists not actuaries 😞

Economists’ priorities
- Individual equity
- Minimal labor force distortions (contributions; age of retirement)
- National savings
- Strong financial institutions
- Wealth creation

Creates a bias toward D.C. plans
Actuaries tend to focus on:

- Insurance and Risk Sharing
  (based on Law of Large Numbers)
- Annuitzation for the Longevity Risk
- Low expenses per unit
- A long-term view of stability and sustainability
  (vs. annual balancing)
- Predictable benefits
- Improvement in societal utility (of wealth)
- Transparency and understandability

Creates a bias toward D.B. plans
Aside (but important)

New Notional Defined Contribution Plans (Sweden, Poland, Italy) are mathematically equivalent to career average D.B. Plans
Actuarial Concerns with Individual Accounts

- All major risks transferred to worker
- Investment risk
- Interest - rate risk (annuity price)
- Longevity risk
- Inflation risk

- Ignores advantages of risk sharing
- Larger expense ratios for small accounts (regressive)
- Total expenses higher than most government-administered systems
Financing Extremes: Paygo vs. Fully-Funded

Paygo: Required contribution, $C$:

\[ C = \frac{P_t}{A_t} \cdot \frac{B_t}{AIW_t} \]

- \( P_t \equiv \) # of pensioners
- \( A_t \equiv \) # of active workers
- \( B_t \equiv \) average pension benefit
- \( AIW_t \equiv \) average wage on which contributions are made
Demographic Ratio

\[ \frac{Pt}{At} \equiv \]

Financial Ratio

\[ \frac{B_t}{AIW_t} \equiv \]

e.g. U.S.

\[ \frac{Pt}{At} \approx \frac{1}{3} \]

\[ \frac{B_t}{AIW_t} \approx 39\% \]

\[ \Rightarrow C \approx 13\% \]
Another View:

Paygo:

\[
C = \int_{65}^{\infty} \frac{e^{-rx}}{\int_{65}^{20} e^{-rx}} Lx \, dx \\
\]

\(Lx\equiv\) Real People Alive Aged \(x\)

\(rx\equiv\) Growth Rate in Covered Earnings (= \(\Delta\) Labor Force + \(\Delta\) Real Wages)
Fully-Funded:

\[ C = \frac{\int_{65}^{\infty} e^{-\delta x} \ell x \, dx}{\int_{20}^{65} e^{-\delta x} \ell x \, dx} \]

\( \delta \equiv \) Investment Rate of Return

\( \ell x \equiv \) Life Table Survivorship Probabilities
Financing basis is not remarkably important

- Both dependent on active workers
- Neither is inherently stable ($\delta$ vs demographic ratio)
- Both face political risk

(If fully-funded, local dictator can abscond with assets.)
(If paygo, local dictator can only abscond with liabilities!)
Priorities for Well-Designed Social Security

1. Mitigation / alleviation of poverty amongst elderly (requires wealth transfer to those in poverty)
   - Be wary of easily-attained minimum benefits

2. Sustained standard of living in retirement (replacement ratio)
   - In partnership with employer plans and individual plans (may be tax incented)

3. Solidarity
   - Contributors want the social security system to succeed
   - Requires benefits for as many workers as administratively feasible (even the wealthy)
Other Preferred Design Features

Do not create perverse economic incentives

- If contribution rate too high:
  
  Workers go to cash economy (aided by employers)
  • Employers prefer overtime to hiring (especially if ceiling on contributory earnings)
  • Employers outsource work

- Disincentives to private saving
  • Benefits “too large”
  • Clawbacks too steep
- Incentives to retire too early
  • Max benefits after $n$ years of contributions
  • Early age retirement does not result in full actuarial discount

- Incentives for absence from labor force
  • Exempt periods
  • Better than short qualifying period ($n$)

- Can't get it perfect
CPP **Automatic** Stabilizer (excellent feature)

If 75-year projection indicates 9.9% cannot support

Benefits:

- Contribution rate is raised to satisfy half of the deficit
- Benefits are de-indexed until the other half of the deficit disappears

(i.e., Risk sharing between workers and retirees)

Note: Automatic stabilizer in Sweden is 100% on de-indexing of benefits (contributions remain constant).
Graphs that follow assume retirees achieve a 70% replacement ratio in total from all sources.
Canadian Social Security

- Guaranteed Income Supplement (GIS)
  - Welfare benefit
  - To poor only (no asset test)
  - Steep clawback (50%)
  - Thus, disincentive for poor to save for retirement
  - Paid from general tax revenues
  - Benefits non-taxable
  - Highly targeted to poverty alleviation
- **Old Age Security (OAS)**
  - A “demogrant benefit”
  - Need 40 years residency for full benefit (if less, pro rata)
  - Clawback is less steep (15%)
  - Wealthy Canadians receive no GIS and no OAS
  - OAS is taxable income
- Canada / Quebec Pension Plans
  • Virtually identical
  • Worker at average wage gets 25% benefit (based on 40 years of contributions)
  • Contributions and benefit accrual stop at average wage
  • OAS + C/QPP = 40% replacement for worker at average wage
  • Taxable income
  • No clawback
  • Leaves room for occupational pensions and individual savings
• Wide range of Canadians get same $ benefits
Note:

- Extreme focus on poverty alleviation
- SSI (Supplemental Security Income), a welfare scheme
  - minimal with $1 for $1 clawback

- OASDI takes on three responsibilities
  - Poverty alleviation
  - Predictable post-retirement standard of living
  - Participant solidarity
U.S. Vs. Canada

U.S. emphasizes individual equity more
Canada emphasizes social adequacy more (poverty alleviation)

<table>
<thead>
<tr>
<th>Pre-Retirement Income</th>
<th>Ratio of “Income Replacement Ratios of the U.S. System” to “Income Replacement Ratios of the Canadian System” in 2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>$ 1,000</td>
<td>0.57416</td>
</tr>
<tr>
<td>$ 5,000</td>
<td>0.54786</td>
</tr>
<tr>
<td>$ 10,000</td>
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<tr>
<td>$ 15,000</td>
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<td>$ 90,000</td>
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</tr>
<tr>
<td>$100,000</td>
<td>1.78556</td>
</tr>
</tbody>
</table>
Other Points of Reflection

In Figure 1 (Canada) and Figure 7 (U.S.)

- Area under curve = cost
  - paid by contributions, general tax revenues, investment income
  - Has to be some maximum cost to which workers can agree

- To lower cost
  - put in sharper clawbacks (Canada)
  - lower benefits to wealthy (erodes solidarity)

- Cost must be sustainable

- Benefit formulation should be understandable to participants
Maximum Benefits and Impact on Labor Force

- Canada: OAS and C/QPP require 40 years in economy for max benefits
  - some exceptions such as child-rearing dropout / disability
  - + strange formula if you retire early
- U.S.: OASDI requires at least 35 years of contributions for max benefits

- Do these formulae create disincentives to work longer?
How do you define “Success”?

- Two Goals:
  - Income Security Post-Retirement
  - Minimal Government Intervention
How do you define “Success”?  

- Will review two papers by Brown/Prus looking at Income Inequality post-retirement
Summary

• The papers test two hypotheses:
  – In most countries income inequality declines after retirement since public benefits are more equally distributed than work income
  – The larger the public benefits, the less the income inequalities in old age
  – Used seven OECD countries to test hypotheses

• The analysis supports the hypotheses
  – Several conclusions are drawn
To Measure Income Inequality:

Used Gini Ratio

- If Gini = 1, one person has all the income
- If Gini = 0, everyone has equal income
- So, the larger the Gini, the more inequality
Figure 1 Percentage of Household Income from Government Transfers by Gini Coefficient, for Selected Countries, Household Heads Aged 65+. 
Brown-Prus NAAJ Paper

• Canada, Denmark and Sweden on “Optimal Frontier”

• Mix of public/private is political choice of citizens

• Other seven nations analyzed could do better
## Table 1: Replacement Ratios by Decile

<table>
<thead>
<tr>
<th>Decile</th>
<th>Ca</th>
<th>Fi</th>
<th>Ge</th>
<th>It</th>
<th>Ja</th>
<th>Ne</th>
<th>Sw</th>
<th>UK</th>
<th>US</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>148</td>
<td>101</td>
<td>102</td>
<td>128</td>
<td>72</td>
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<tr>
<td>6</td>
<td>86</td>
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<td>75</td>
<td>94</td>
<td>82</td>
<td>83</td>
<td>72</td>
<td>94</td>
</tr>
</tbody>
</table>
Comments on Table 1

- General replacement rates are very high (acceptable)
- In some countries (Canada) benefits are highly targeted (to low income earners)
- Others are not (Japan and UK)
- This Table comes from an OECD report
Brown/Prus (2) Data

- Luxembourg Income Study (LIS)
- Most recent surveys (Y2000)
- For seven countries (defined in next slide)
- Uses total household income by age of head
- Adjusted to reflect size of household using $n^{0.5}$ (approximates per capita indicator)
Table 2: Gini Coefficients of Disposable Household Income and Changes

<table>
<thead>
<tr>
<th></th>
<th>45 - 54</th>
<th>55 - 64</th>
<th>65 - 74</th>
<th>75 +</th>
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<tbody>
<tr>
<td>Canada</td>
<td>.301</td>
<td>.330(+ 9.6%)</td>
<td>.266(- 19.4%)</td>
<td>.259(- 2.6%)</td>
</tr>
<tr>
<td>Germany</td>
<td>.239</td>
<td>.282(+ 18.0)</td>
<td>.256(- 9.2)</td>
<td>.254(- 0.1)</td>
</tr>
<tr>
<td>Netherlands</td>
<td>.238</td>
<td>.261</td>
<td>.241(- 11.1)</td>
<td>.238(- 1.2)</td>
</tr>
<tr>
<td>Norway</td>
<td>.255</td>
<td>.281(+ 10.2)</td>
<td>.224(- 20.3)</td>
<td>.209(- 6.7)</td>
</tr>
<tr>
<td>Sweden</td>
<td>.226</td>
<td>.273(+ 20.8)</td>
<td>.231(- 15.4)</td>
<td>.201(- 13.0)</td>
</tr>
<tr>
<td>U.K.</td>
<td>.339</td>
<td>.357(+ 5.3)</td>
<td>.301(- 15.7)</td>
<td>.286(- 5.0)</td>
</tr>
<tr>
<td>U.S.</td>
<td>.351</td>
<td>.385(+ 9.7)</td>
<td>.375(- 2.5)</td>
<td>.370(- 1.3)</td>
</tr>
</tbody>
</table>
Comments on Table 2

- Levels of Income Inequality Decline after Retirement
  - Sweden, Canada, UK and Norway decline the most (but at different ages)
  - The US declines the least

- Post-retirement, Sweden and Norway have lowest income inequality

- US: the highest income inequality
Further Analysis (in Paper) shows:

- Sweden and Norway transfer income from top quintile to all lower quintiles of income

- Canada, Netherlands and UK transfer income from top quintile to the lowest quintiles only (highly targeted)

- Countries with the largest public pension systems have the least income inequality post-retirement

- Sweden has the largest public pension reliance and the lowest inequality in post-retirement income

- The US has the smallest reliance on public pensions but the highest inequality in post-retirement income
Conclusions:

- Negative Correlation between Level of Publicly Provided Retirement Income and Income Inequality
- Overall Income Replacement Ratios are Acceptably High
- Some Systems use Heavily Targeted Income Redistribution
Caveats:

• Living Expenses, Especially Health Care Costs Vary Widely across Countries

• Differing Levels of Home Ownership have not been measured

• Differences in Workforce Participation (especially by women) have an impact on both Income and Expenditures
Final Conclusions

- Area under curve = cost
  - There must be a maximum acceptable cost (will vary from country to country)
  - Must be sustainable

- Plan benefit formulation should be understood by participants

- Preferable to have drop-out periods (exemptions) rather than a short overall benefit qualification period

- Benefits / contributions should not encourage evasion of participation (e.g., cash economy)
Final Conclusions

• Clawbacks lower cost but create disincentives to private saving for retirement

• To achieve solidarity, the wealthy must also benefit

• Benefit formulation should not incent early retirement (very important in aging populations)
Final Conclusions

- Goals in conflict one to another
- Compromise must occur
- Can’t achieve all goals fully
- Design will fit local culture
Figure 1 Percentage of Household Income from Government Transfers by Gini Coefficient, for Selected Countries, Household Heads Aged 65+. 
Distribution of Surpluses and the role of Bookkeeping in the Swedish Public Pay-As-You-Go Pension Scheme
Part A.
The basics - financial stability - accounting for a PAYGO system

Part B.
The objective of the “surplus inquiry” (UTÖ)

Part C.
The simulations and conclusions of the “surplus inquiry” (UTÖ)
The Swedish public PAYG pension system works like this:

The amount on the notional account, SEK

- Survivors bonus
- Net indexation
- Administration
- Interest with change in average income*

Credited contributions

Pension

- Life expectancy (65 = 18,5)
- Interest rate 1,6%
- Annuity divisor 15,7

*As long as the balance mechanism is inactive.
Task for the balance mechanism:
Given the general NDC-set up:
secure full financial stability* while striving for “optimal” social (political) features of benefit.

*In the sense that deficits are excluded, i.e. an asymmetric type of stability
Chosen solution:


A. Use socially/politically preferred indexation as default indexation

B. Switch from preferred indexation to what is financially possible if and only if system has a “negative net present value”, i.e. when “assets” < liabilities.

C. Use no projections when estimating system “assets” and liabilities.
The *inkomstpension* system (NDC) attributes its financial stability to 5 design features:

- **Pension credit = contribution**
  No credits without contribution. No contributions without credit.

- **Indexation of account values and benefits by growth (change) in average income**
  Benefits with a reduction = the imputed interest rate 1.6 percentage units

- **Cohort specific annuity divisors**
  Calculated annually with fresh mortality experience. Will be a source for deficits when life-expectancy increases.

- **Existence of buffer funds**

- **The balance mechanism**

Also sources for positive/or negative financial imbalances

Dealt with by
Switch from preferred indexation to what is financially possible if and only if system has a “negative net present value”, i.e. when “assets” < liabilities.
Balance ratio \[= \frac{\text{"Assets"}}{\text{Liabilities}}\]
The balance mechanism is simple:
It reduces the rate of indexation. If this has happened it can increase the rate of indexation up to the level given by the income index.

Index

<table>
<thead>
<tr>
<th>Year</th>
<th>Income index</th>
<th>Balance index = income index</th>
<th>Balance ratio &lt; 1, balancing triggered</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>100</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>110</td>
<td>105</td>
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<td>3</td>
<td>120</td>
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<td>4</td>
<td>130</td>
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<td>125</td>
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</tr>
<tr>
<td>7</td>
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<td>130</td>
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<td>8</td>
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</tr>
<tr>
<td>9</td>
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<td></td>
</tr>
<tr>
<td>14</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Balance ratio > 1, faster rate of indexation
Slower rate of indexation
Thus the balance mechanism is simple, but how are “assets” and liabilities calculated?
The liability is taken at “face value” i.e. …

1. The sum of the money value of notional accounts of the active population

+  

2. Remaining life expectancy of each retired age group

Pension payments to each retired age group

= Total net pension liability
Expected Pension Liability

Accrual of pension rights, new liability

Pension payments, amortization of pension liability
Expected Pension Liability

Contributions

...few technical steps...

Turnover Duration
Pension Liability and the Fund

Pension Liability

Contribution Asset

Fund requirement
Some basic, but unconventional, “theory” of PAYG financing
End of theory, enter practise
### Income Statement, in percent of GDP

<table>
<thead>
<tr>
<th></th>
<th>2006</th>
<th>2005</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Change in funded assets</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pension contributions</td>
<td>8.0</td>
<td>7.6</td>
<td>7.0</td>
</tr>
<tr>
<td>Pension disbursements</td>
<td>-7.7</td>
<td>-7.1</td>
<td>-6.7</td>
</tr>
<tr>
<td>Return on funded capital</td>
<td>3.6</td>
<td>4.8</td>
<td>2.6</td>
</tr>
<tr>
<td>Costs of administration</td>
<td>-0.1</td>
<td>-0.1</td>
<td>-0.1</td>
</tr>
<tr>
<td>Total change in funded capital (a)</td>
<td>3.9</td>
<td>5.2</td>
<td>2.8</td>
</tr>
<tr>
<td><strong>Change in contribution asset</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value of change in contribution revenue</td>
<td>10.3</td>
<td>6.9</td>
<td>5.8</td>
</tr>
<tr>
<td>Value of change in turnover duration</td>
<td>-0.6</td>
<td>-2.1</td>
<td>0</td>
</tr>
<tr>
<td>Total change in contribution asset (b)</td>
<td>9.8</td>
<td>4.8</td>
<td>5.8</td>
</tr>
<tr>
<td><strong>Change in pension liability</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Pension credits and ATP points</td>
<td>-8.4</td>
<td>-8.0</td>
<td>-10.0</td>
</tr>
<tr>
<td>Pension disbursements</td>
<td>7.7</td>
<td>7.1</td>
<td>6.6</td>
</tr>
<tr>
<td>Indexation</td>
<td>-8.5</td>
<td>-6.8</td>
<td>-6.6</td>
</tr>
<tr>
<td>Value of change in life-expectancy</td>
<td>-1.4</td>
<td>-1.5</td>
<td>-0.7</td>
</tr>
<tr>
<td>Inheritance gains arising</td>
<td>0.4</td>
<td>0.4</td>
<td>0.3</td>
</tr>
<tr>
<td>Inheritance gains distributed</td>
<td>-0.4</td>
<td>-0.4</td>
<td>-0.3</td>
</tr>
<tr>
<td>Deduction for costs of administration</td>
<td>0.0</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Total change in pension liability (c)</td>
<td>-10.6</td>
<td>-9.2</td>
<td>-10.6</td>
</tr>
<tr>
<td><strong>Net income/ -loss (a)+(b)+(c)</strong></td>
<td>3.1</td>
<td>0.8</td>
<td>-2.0</td>
</tr>
</tbody>
</table>
## Balance sheet, in percent of GDP

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assets</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>National Pension Funds</td>
<td>37.5</td>
<td>32.4</td>
<td>26.3</td>
</tr>
<tr>
<td>Contribution asset</td>
<td>259.8</td>
<td>241.2</td>
<td>228.0</td>
</tr>
<tr>
<td><strong>Total assets</strong></td>
<td>297.3</td>
<td>273.6</td>
<td>254.2</td>
</tr>
<tr>
<td><strong>Liabilities and surplus</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opening surplus</td>
<td>1.2</td>
<td>0.4</td>
<td>2.2</td>
</tr>
<tr>
<td>Net income/-loss</td>
<td>3.1</td>
<td>0.8</td>
<td>-2.0</td>
</tr>
<tr>
<td>Closing surplus</td>
<td>4.4</td>
<td>2.4</td>
<td>2.2</td>
</tr>
<tr>
<td>Pension liability</td>
<td>292.9</td>
<td>245.2</td>
<td>244.0</td>
</tr>
<tr>
<td><strong>Total liabilities and surplus</strong></td>
<td>297.3</td>
<td>273.6</td>
<td>254.2</td>
</tr>
</tbody>
</table>
Part B.
The objective of the “surplus inquiry” (UTÖ)

Why an inquiry in the first place?
Surpluses can arise if...

Inquiry assigned 2002.

1. The sum of wages grow faster than average wages (due to demographic or economic reasons)
2. The buffer fund return is higher than the average wage growth
3. More income is earned at a younger age, i.e. turnover duration increases
4. + 65 mortality increases

Reversed developments are, of course, causes for deficits
Actual net contributions 1960-2004, simulation 2005-2080
In percent of total contributions

Actual net contributions in percent of total contributions are depicted over time, divided into historical and projected periods. The graph illustrates the net contributions from various birth decades (1940's, 1960's) with projected contributions under optimistic, base, and pessimistic scenarios. The chart also indicates provisions for balancing in the pessimistic scenario.
Actual fund ratio 1960-2004, projected 2005-2080

Fund ratio = market value of buffer fund / same years total pension payments
Define the following

Inquiry assigned 2002.

1. What is an excess surplus?

2. How large should it be (to be considered an excess)?

3. How should it be distributed to the insured?
Part C.
The simulations and conclusions of the “surplus inquiry” (UTÖ)
Randomization of
• Labour participation
• Real return on Buffer Fund
• Inflation

Pension liabilities

Swedish Pension Model
(Micro)

Base Line assumptions

UTÖ Model
(Cell based)

Different rules
for surplus distribution
1.00, 1.01, …, 1.20, none

With & Without the rule X
Buffer Fund Contributions
Pension benefits Balance Ratio
(assets & liabilities)

1) Repeat it “many” times
2) Aggregate sums, counts,
   (Average Gain & St. Dev.)
3) Analyse & make your choice

Ready!
Model presentation mainly in MS Excel
Proposals of the inquiry:
The inquiry’s proposed legislation was presented 2004

1. Excess surpluses are defined by the level of the balance ratio
2. Distribution of excess surpluses shall be Made if the balance ratio exceeds 1.1000
3. Distribution through higher indexation of notional accounts and pensions

Government has yet not moved to submit parliament a proposal.