Collective saving schemes and return smoothing mechanism

Oskar Goecke
Institut für Versicherungswesen
Forschungsstelle FaRis
FH Köln
Overview

- Economic background/ interest rate environment/ risk premium
- What does it mean „collective saving“?
- Results from theory
- Results from backtesting
- Concluding remarks
Interest rates (1972 – 2013)

Source: Deutsche Bundesbank/ own calculations

O. Goecke: Collective saving schemes
Yield curve – secular trend

Source: Deutsche Bundesbank/ own calculations
Yield 10-year Government bonds

Source: Deutsche Bundesbank/ ECB/ own calculations
There is no free lunch! Or: Risk pays off!
Risk Return-Transformation

private saver

savings

loan

own capital

real investment

bank

savings

loan

own capital

real investment

entrepreneur

real market

Return

Risk

real investment

O. Goecke: Collective saving schemes
## Risk pays off! – But how much?

### Table 2. Market Risk Premium (MRP) used for 51 countries in 2013

<table>
<thead>
<tr>
<th>MRP</th>
<th>Number of answers</th>
<th>average</th>
<th>Median</th>
<th>St. Dev.</th>
<th>max</th>
<th>min</th>
<th>Av-Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>2394</td>
<td>5.7%</td>
<td>5.5%</td>
<td>1.6%</td>
<td>15.8%</td>
<td>2.5%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Spain</td>
<td>804</td>
<td>6.0%</td>
<td>5.5%</td>
<td>1.7%</td>
<td>15.0%</td>
<td>3.0%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Germany</td>
<td>343</td>
<td>5.5%</td>
<td>5.0%</td>
<td>1.7%</td>
<td>18.0%</td>
<td>1.6%</td>
<td>0.5%</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>247</td>
<td>5.5%</td>
<td>5.0%</td>
<td>1.4%</td>
<td>11.0%</td>
<td>2.0%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Italy</td>
<td>205</td>
<td>5.7%</td>
<td>5.5%</td>
<td>1.5%</td>
<td>12.0%</td>
<td>3.0%</td>
<td>0.2%</td>
</tr>
<tr>
<td>France</td>
<td>134</td>
<td>6.1%</td>
<td>6.0%</td>
<td>1.6%</td>
<td>12.0%</td>
<td>3.0%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Switzerland</td>
<td>113</td>
<td>5.6%</td>
<td>5.5%</td>
<td>1.5%</td>
<td>12.0%</td>
<td>3.0%</td>
<td>0.1%</td>
</tr>
<tr>
<td>Brazil</td>
<td>112</td>
<td>6.5%</td>
<td>6.0%</td>
<td>2.1%</td>
<td>12.0%</td>
<td>1.6%</td>
<td>0.5%</td>
</tr>
<tr>
<td>Canada</td>
<td>110</td>
<td>5.4%</td>
<td>5.3%</td>
<td>1.3%</td>
<td>12.0%</td>
<td>3.0%</td>
<td>0.1%</td>
</tr>
<tr>
<td>China</td>
<td>95</td>
<td>7.7%</td>
<td>7.0%</td>
<td>2.3%</td>
<td>14.0%</td>
<td>3.0%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Portugal</td>
<td>52</td>
<td>6.1%</td>
<td>5.9%</td>
<td>2.3%</td>
<td>12.0%</td>
<td>2.5%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Norway</td>
<td>51</td>
<td>6.0%</td>
<td>6.0%</td>
<td>1.8%</td>
<td>12.0%</td>
<td>3.0%</td>
<td>0.0%</td>
</tr>
<tr>
<td>Greece</td>
<td>50</td>
<td>7.3%</td>
<td>6.0%</td>
<td>4.1%</td>
<td>20.8%</td>
<td>3.0%</td>
<td>1.3%</td>
</tr>
<tr>
<td>Sweden</td>
<td>50</td>
<td>6.0%</td>
<td>5.9%</td>
<td>1.7%</td>
<td>12.0%</td>
<td>3.0%</td>
<td>0.1%</td>
</tr>
</tbody>
</table>

Source: Fernandez/ Aguirreamalloa/ Linares (IESE Business School, June 2013), Internet survey bases on 6237 answers.
20-year indiv. saving plans: accrued capital

- equities (DAX)
- fixed inc. (REXP)
- money market

O. Goecke: Collective saving schemes
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Individual vs. collective saving

individual saving
(mutual fund)

unit price follows exactly the market value of assets

collective saving

part of the assets is not allocated to the individuals

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Balance sheet of collective saving model

\[ P_t = R_t + V_t \]
Intergenerational risk sharing

„bull markets“

„bear markets“

volatile market values are buffered into the collective reserve
## Asset liability - management

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portfolio</td>
<td>coll. reserve $R_t$</td>
</tr>
<tr>
<td>Saving accounts (distributed assets)</td>
<td>$V_t$</td>
</tr>
</tbody>
</table>

- **Risk exposure (asset allocation)**: $\sigma_t$
- **“Declaration“ (profit participation)**: $\eta_t$

O. Goecke: Collective saving schemes
Asset liability - management

- reserve reduction
- building up reserves
- reserve neutral declaration (capital market line)
- risk exposure
- asset management
- liability management
- declaration

O. Goecke: Collective saving schemes
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ALM-Model

Assets
\[ \frac{dA(t)}{A(t)} = (\bar{\mu} + r_M \sigma(t)) dt + \sigma(t) dW_t \]

Liabilities
\[ \frac{dV(t)}{V(t)} = \eta(t) dt \]

„control“
\[ \hat{\rho}(t) := \ln \left( \frac{A(t)}{V(t)} \right) - \rho_{\text{target}} \]

ALM
\[ \sigma(t) = \hat{\sigma} + a \hat{\rho}(t) \]
\[ \eta(t) = \left( \bar{\mu} + r_M \sigma(t) - \frac{1}{2} \sigma^2(t) \right) + \theta \hat{\rho}(t) \]
ALM-Model

\[ A(t) = A_0 \exp\left( \int_0^t \bar{\mu} + r_M \sigma(s) - \frac{1}{2} \sigma^2(s) \, ds + \int_0^t \sigma(s) \, dW_s \right) \]

\[ V(t) = V_0 \exp\left( \int_0^t \eta(s) \, ds \right) = V_0 \exp\left( \int_0^t \left( \bar{\mu} + r_M \sigma(t) - \frac{1}{2} \sigma^2(t) \right) + \theta \hat{\rho}(t) \, ds \right) \]

\[ \hat{\rho}(t) = \ln\left( \frac{A(t)}{V(t)} \right) - \rho_{\text{target}} = \hat{\rho}_0 - \theta \int_0^t \hat{\rho}(s) \, ds + \int_0^t (\hat{\sigma} + a \hat{\rho}(s)) \, dW_s \]

\[ d\hat{\rho}(t) = -\theta \, \hat{\rho}(t) \, dt + \left( \hat{\sigma} + a \, \hat{\rho}(t) \right) \, dW_t \]
Solution:

For \( Z_t := \exp \left( aW_t - \frac{1}{2} a^2 t \right) \) we get

\[
\sigma(t) = e^{-\theta t} Z_t \left( \sigma_0 + \theta \hat{\sigma} \int_0^t \frac{e^{\theta s}}{Z_s} ds \right)
\]

\[
\hat{\rho}(t) = \begin{cases} 
\frac{\hat{\sigma}}{a} \left( e^{-\theta t} Z_t \left( 1 + \frac{a \hat{\rho}_0}{\hat{\sigma}} + \theta \int_0^t \frac{e^{\theta s}}{Z_s} ds \right) - 1 \right) & \text{for } a \neq 0 \\
\left( \hat{\rho}_0 + \hat{\sigma} \int_0^t e^{\theta s} dW_s \right) & \text{for } a = 0
\end{cases}
\]
Limit results

For $\theta > 0$, $a \neq 0$:

$\rho(t) \xrightarrow{\text{in distribution}} \hat{\rho}_\infty$

$\sigma(t) \xrightarrow{\text{in distribution}} \sigma_\infty$

$\eta(t) \xrightarrow{\text{in distribution}} \eta_\infty$

The limits are inverse gamma distributed or closely related to the inverse gamma distribution.
Collective saving ....

What is it good for?
What is the effect on the risk return profile?
Individual vs. collective saving

Invest $S_0$ for $T$ years

a) individual saving plan with const-mix-strategy ($\sigma$)

b) collective saving plan with reserve buffering ($\hat{\sigma}, a, \theta, \hat{\rho}_0$)

$$\frac{dA(t)}{A(t)} = (\bar{\mu} + r_M \sigma(t)) dt + \sigma(t)dW_t$$

$$\bar{\mu} = 3\%, \quad r_M = 0.25$$

$$\sigma(t) = \sigma (\text{const} - \text{mix})$$

$$\Rightarrow S_T = S_0 \exp\left(\left(\bar{\mu} + r_M \sigma - \frac{1}{2} \sigma^2\right)T + \sigma W_T\right)$$

$$\Rightarrow \text{annual return} = \frac{1}{T} \ln\left(\frac{S_T}{S_0}\right) = \bar{\mu} + r_M \sigma - \frac{1}{2} \sigma^2 + \sigma \frac{W_T}{T}$$

$$\Rightarrow \text{risk} := \text{annualized stdev} = \sigma$$
risk-return profile (const-mix)
risk return profiles cs

\[ \bar{\eta}(T) := \frac{1}{T} \int_0^T \eta(t) dt \]

\[ \text{StdDev}(\bar{\eta}(T)) := \hat{\sigma} \sqrt{1 - \frac{(1 - e^{-\theta T})(3 - e^{-\theta T})}{2\theta T}} \]

Parameters: \( a = 0 \), \( \theta = 0.4 \), \( \hat{\rho}_0 = 0 \)

risk = annualized standard deviation

const-mix-portfolio
Idea: risk = path volatility
Risk-Return-Profile: Path volatility
(lump-sum investment, $T = 20$ years, 5000 Monte Carlo simulations)
Risk-Return-Profile: **Maximum Drawdown**
(lump-sum investment, T = 20 years, 5000 Monte Carlo simulations)
Overview

- Economic background/interest rate environment/risk premium
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ALM- strategy

- Fix the **strategic risk exposure**
  (e.g. 50% stocks, 50% fixed income)

- Fix the **strategic reserve ratio** (e.g. 20%)

- Each month (year) determine the
  **reserve cushion**: = actual *minus* strategic reserve

- Decide on **tactical ALM**:
  - *reserve cushion* > 0: declaration and risk exposure up
  - *reserve cushion* < 0: declaration and risk exposure down
Backtesting 02.1967 – 03.2013

2 asset classes: equities and fixed income with proxies:

- DAX (German stock market performance index)
- REXP (Performance index of synthetic portfolio of German goovies, $\phi$ time-to-maturity=5.5 years)

Assumptions/ ALM strategy

- strategic asset allocation: 50% shares/ 50% fixed income
- strategic/initial reserve ratio: 20%
- monthly adjustment of tatical ALM
DAX/ REXP/ Money market (31.1.1967=1)

- DAX
- DAX (without dividends before 1987)
- REXP
- 1-month money market rate
Backtesting 02.1967 – 03.2013

Basic saving plan: Save 100€ per month for 20 year.
⇒ 314 samples for backtesting.

We compare:

- individual saving (100% equities/ DAX)
- individual saving (100% fixed income/ REXP)
- individual saving (100% money market funds/ …)
- collective saving

no administration charge/ no transactions expenses
20-year indiv. saving plans: accrued capital

- equities (DAX)
- fixed inc. (REXP)
- money market
20-year indiv. saving plans: annualized return

- equities (DAX)
- fixed inc. (REXP)
- money market
Collective saving
Initial portfolio (Febr 1962):

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portfolio:</td>
<td>coll. reserve: 20%</td>
</tr>
<tr>
<td>50% equities</td>
<td></td>
</tr>
<tr>
<td>50% fixed inc.</td>
<td>Saving accounts (distributed assets): 80%</td>
</tr>
</tbody>
</table>

reserve ratio

risk exposure (share ratio)

declaration (per month)
20-year saving plans: accrued capital

- equities (DAX)
- fixed inc. (REXP)
- money market
- coll. saving (initial res.=20%)
- coll. saving (initial res.= 0%)

163.803 €
31.632 €
20-year saving plans: annualized return

- coll. saving
- fixed inc. (REXP)
- equities (DAX)
Special Sample: 03.1989-02.2009 (worst case)
Special Sample: 03.1980-02.2000 (best case)

- equities (DAX)
- fixed inc. (REXP)
- coll. saving

Accrued capital:
- 163.803 € in 2000
- 83.527 € in 1996
- 53.309 € in 1985
Annualized return on saving rates
(Statistical analysis of 314 samples)

<table>
<thead>
<tr>
<th>20-year saving plan</th>
<th>fixed income (REXP)</th>
<th>equities (DAX)</th>
<th>collective saving</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>7.23%</td>
<td>9.29%</td>
<td>9.52%</td>
</tr>
<tr>
<td>Minimum</td>
<td>5.87%</td>
<td>5.49%</td>
<td>8.43%</td>
</tr>
<tr>
<td>Maximum</td>
<td>8.31%</td>
<td>16.01%</td>
<td>11.52%</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>0.61%</td>
<td>2.48%</td>
<td>0.90%</td>
</tr>
</tbody>
</table>
Pros and Cons

+ fair risk sharing between generations of savers
- risk sharing produces “loosers” and “winners”
+ allows for a high proportion of investment in real asset
+ improved risk return profile
+ rewards contractual loyalty
- requires contractual loyalty (no premature cash out)
- requires an initial reserve (!!!!)
+ requires no payments to shareholders
- grants no guarantees from outside
+ high degree of transparency possible
- no regulatory framework so far
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Concluding remarks

The idea behind collective saving is not new! We find some elements in the traditional with-profit life insurance products.

- traditional with-profit policies involve year-to-year interest rate guarantees
  ⇒ low share ratio ⇒ low/no \textit{real} return

- most with-profit products are quite opaque
  (amalgamation of policy holder and shareholder interests)
Concluding remarks

- capital funded old age provision requires a high proportion of investment into real assets
- but investments into shares or real estates are „punished“ in the Solvency 2 regime
- intergenerational risk transfer of capital market risks is a proper answer to the mark-to-market mania.
Thank you for your kind attention!

Oskar Goecke
Institut für Versicherungswesen
Claudiusstraße 1
50678 Köln
oskar.goecke@fh-koeln.de
For more details …


- O.G.: *Sparprozesse mit kollektivem Risikoausgleich - Backtesting*; Institut für Versicherungswesen, Forschungsstelle FaRis. Working Paper 05/2012; http://opus.bsz-bw.de/fhk/volltexte/2012/12/