Valuation of Intergenerational Transfers in Funded Collective Pension Schemes

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Background: Plan REdesign

- Pension Crisis has initiated worldwide wave of REdesign of pension plans: DB, DC or something in between

- Key issues in plan REdesign

  I Solvency

  A Improvement solvency risk management

  B Sustainability

  II Fair pension deal

  A Risk bearing: who, when, and to what extent

  B Fairness: Are plan members fairly compensated for the risks allocated to them

Motivation

- We develop a realistic framework to analyse transfers between generations in pension funds due to policy changes

- Examples of policy changes:
  - investment strategy, - contribution rate, - indexation policy

- Tool of analysis = Value-based ALM (embedded options)
  - Complementary to traditional ALM

- Method applied to pension funds Netherlands based on intergenerational risk sharing, however method useful for any institutional arrangement with generational transfers

Contributions and building blocks

1. Generational Accounting: we identify generational accounts as difference between benefits to be received and contributions to be paid (Auerbach et al. 1999, Kotlikoff 2002, Ponds 2003, Cui et al. 2006)

2. Value-based: Pension deal rewritten in embedded generational options: we call this value-based generational accounting (Sharpe 1976, Blake 1999, Chapman et al. 2001, Ponds 2003, Kocken 2006)

3. Stochastic framework and long-term investing: we use a scenario generation process which accounts for horizon effects in risks (Campbell and Viceira 2002, Hoevenaars et al. 2007)

4. Classic ALM: integral framework to analyze implications of policy changes in investments, contributions and indexation for multi-member pension plans with multiple objectives

Stylized pension fund setting

General:

1. Stand-alone multi-member plan with intergenerational risk sharing
   - No risk bearing by employer(s)
   - Stylized representation of a Dutch industry pension fund

2. Average-wage plan with wage-indexed liabilities

3. Indexation rate linked to growth rate wages

4. Investment policy: rebalancing policy in stocks and bonds only

5. Initial real funding ratio = 85%

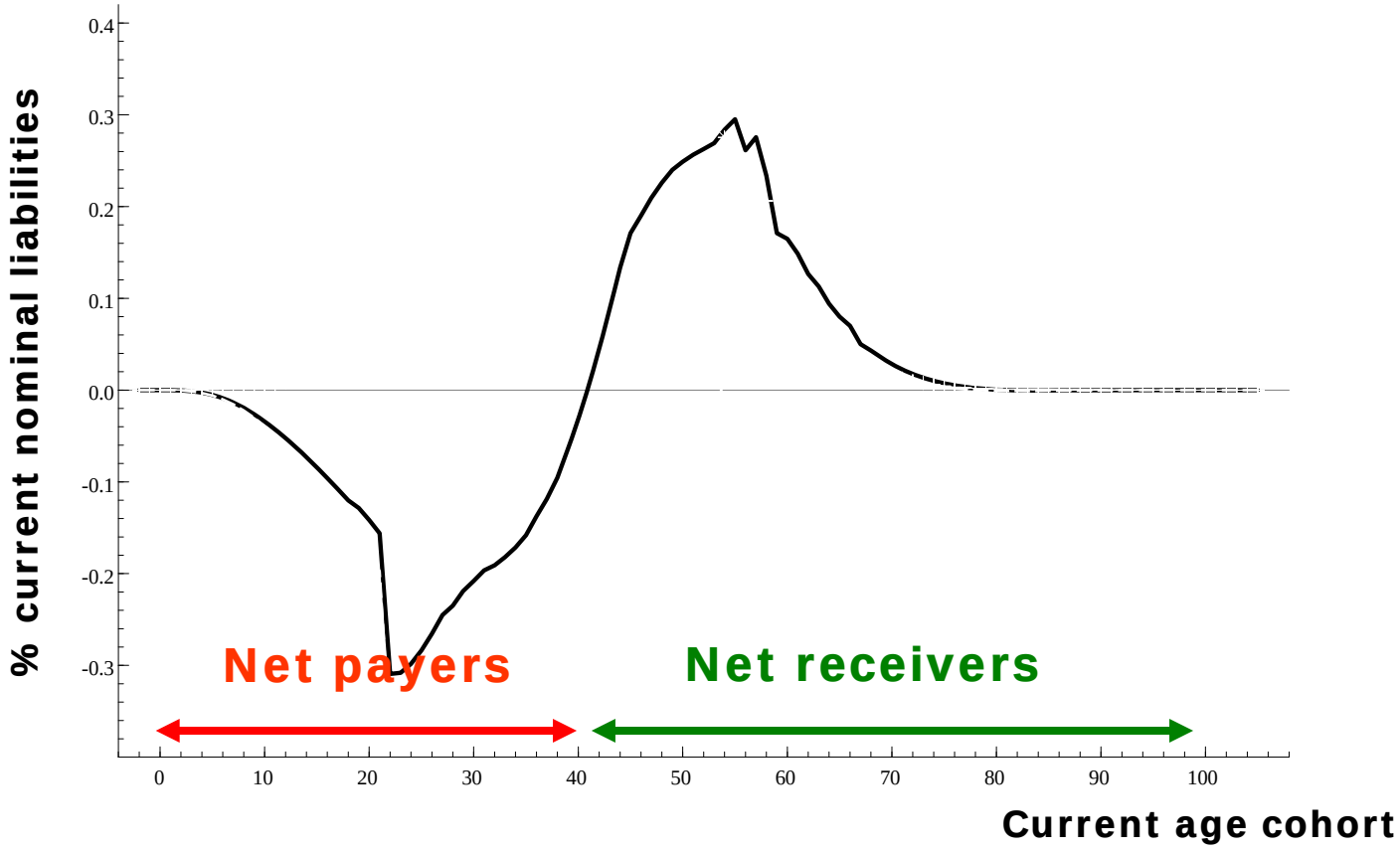
Main findings

1. Value-based ALM useful tool complementary to classic ALM

2. Pension fund is a zero-sum game: any policy change leads to value transfers between generations
   - Investments: conservative asset mix beneficial for older members, aggressive mix beneficial for younger members
   - Indexation: switch from fixed benefits (traditional DB) to flexible benefits (hybrid DC, collective DC) is beneficial for young at expense of old
   - Contribution rate setting: funding approach to accounting approach favours the retirees, whereas workers lose value

Embedded generational transfers

Intergenerational risk transfers when a “standard” collective DB scheme with conditional indexation and fixed contr. rate switches from 50-50 equity-bonds to 100% bonds



Remainder of presentation

A. Value based generational Accounting (VBGA):
   - Generational accounting
   - Pension deal as embedded generational options
   - Horizon effects in risks and valuation of embedded options

B. Applications of VBGA to policy changes
   4. Investments
   5. Contributions

C. Conclusion

Generational Accounting

- What are benefits and costs of existing government policy for current and future generations? (Kotlikoff, Auerbach, Gokhale)

- Intertemporal (government) budget constraint:
  - Sum of government's wealth (including debt) plus net tax receipts of current and future generations has to match current and future government consumption
  - Sum of pension fund assets plus current and future contributions has to back current and future benefits
  - Government uses tax instrument to close the budget over time, Pension funds use adjustments in contributions and indexation to close budget over time

- Zero-sum: what some generation gets, will have to be paid by some other generations

Generational Accounts pension fund (1)

1. Balance pension fund at t=0:

$$A_0 = L_0 + R_0$$

2 Generational account of cohort x at t=0:

$$GA_0^x = L_0^x + R_0^x$$

$$R_0^x = \frac{L_0^x}{L_0} R_0$$

3 Sum of all GA's is equal to value assets:

$$\Sigma GA_0^x = \Sigma(L_0^x + R_0^x) = A_0 = L_0 + R_0$$

Generational Accounts pension fund (2)

4 Balance pension fund at t=1 expressed as PV at t=0:

$$A_0 + C_1 - PP_1 = L_0 + \Delta L_1 - R_1$$

5 Change in GA for x between t=1 and t=0:

$$\Delta GA^x = GA_1^x - GA_0^x = \underbrace{\Delta L_1^x - C_1^x}_{NB_x} + \underbrace{R_1^x - R_0^x}_{\Delta R_x}$$

NB=Net Benefit option =
+ new accrued liabilities
+ pension payments
-/- written off liabilities
-/- contributions

ΔR=Residue option =
+ claim on future residue
-/- claim on current residue

Generational Accounts pension fund (3)

6 Pension fund is a zero-sum game: sum of all changes in GA's sums up to 0

$$\Sigma \Delta GA^{x} = 0$$

7 Evaluating change in ΔGA due to switch to a variant pension fund policy:

$$\Delta GA^{x}_{variant} - \Delta GA^{x}_{basic} = \left(NB^{x}_{variant} - NB^{x}_{basic}\right) + \left(\Delta R^{x}_{variant} - \Delta R^{x}_{basic}\right)$$

Change in Generational Account	Change in Net Benefit option	Change in Residue option

Literature embedded options and pension funds

- Development of tool of embedded options for pension funds
  - Sharpe 1976
  - Blake 1999
  - Steenkamp 1998
  - Kocken 2006
  - Cui et al. 2006: combination of generational accounting options + welfare analysis

- Application of tool embedded options to real-existing pension funds
  - Value-based ALM
    - Chapman et al. 2001: UK company pension fund
    - Kortleve & Ponds 2003: NL industry pension fund
  - Value-based ALM + generational accounting
    - Hoevenaars & Ponds 2006: industry pension fund

Use of deflators

- Return Dynamics in economic scenarios: a first-order VAR model is used in which next period stock returns and interest rate are explained from a lineair combination of current period stock returns and interest rates:

$$z_{t+1} = c + Bz_t + \Sigma\zeta_{t+1}.$$

- Future realizations are deflated to t=0 with help of deflators (stochastic discount factor):

- Deflator = riskfree return + risk adjustment for realisation risk drivers

$$-m_{t+1} = \delta_0 + \delta_1 z_t + \frac{1}{2}\lambda_t'\lambda_t + \lambda_t'\zeta_{t+1}$$

- Risk adjustments via deflators reflect risk aversion: good economic times get low value whereas bad economic times get high value

Summary statistics data and scenarios

3-month and 10-year nominal interest rates

CPI

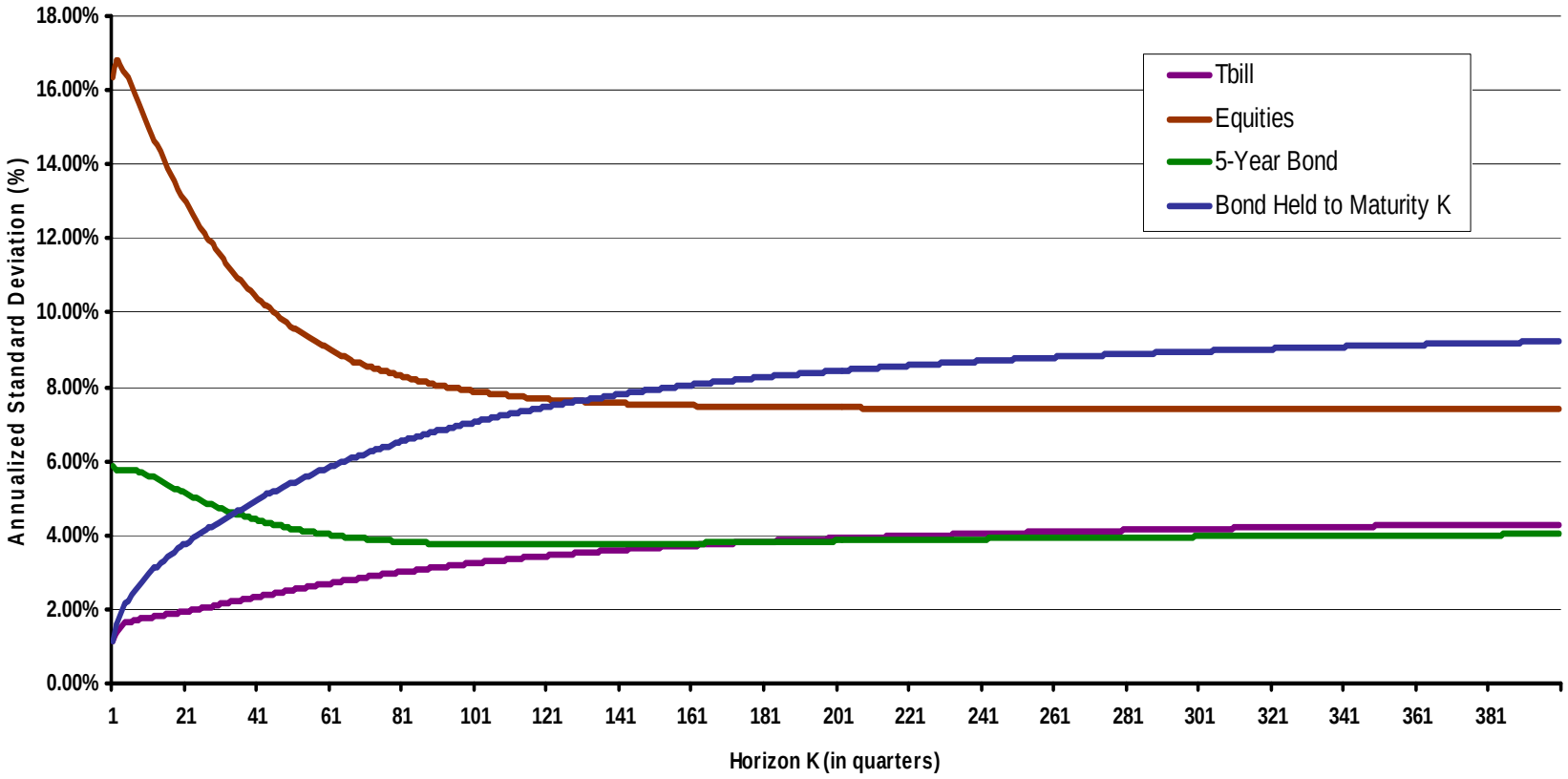
MSCI world stock returns and dy

	y^3	y^{10}	π	x_s	dy
Data					
Average	5.56	6.72	3.46	4.32	3.05
stdev	2.70	1.67	1.34	17.26	1.21
Scenarios					
Average	3.50	4.45	2.00	5.00	3.30
stdev	1.80	1.02	1.00	21.80	0.73

- Quarterly data (1973:III-2005:IV): German yields, MSCI stock returns
- We transform constant term to impose different mean on scenario's

A. Horizon dependent risks

Figure 1. Annualized Percent Standard Deviations of Real Returns Implied by Quarterly VAR(1) Estimates (1952.Q-2002.Q4)



Source: Campbell and Viceira 2005

See also Hoevenaars et al. 2007 for horizon dependent risks, Correlations, inflation hedge and liability hedge qualities.

Remainder of presentation

A. Value based generational Accounting (VBGA):
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   - Pension deal as embedded generational options
   - Horizon effects in risks and valuation of embedded options

B. Applications of VBGA to policy changes
   4. Investments: risky or conservative strategy
   5. Contributions: funding or accounting approach
   6. Risk sharing: flexible contributions or flexible benefits

C. Conclusion

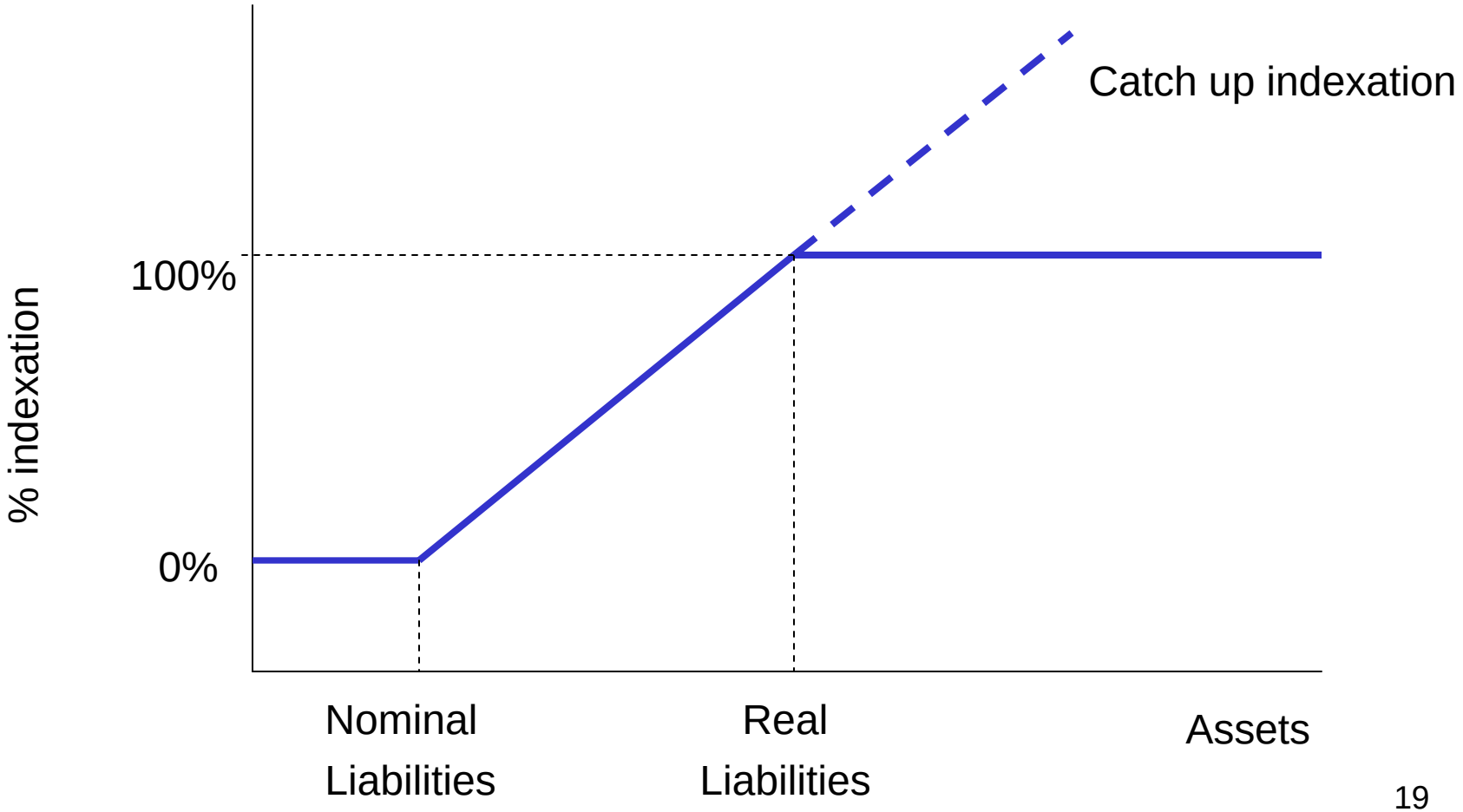
Variants Investment strategy

1. Basic Variant
   - 50% bonds + 50% stocks
   - Fixed contribution rate = 18%
   - Flexible indexation

2. Conservative variant
   - 100% bonds + 0% stocks
   - Fixed contribution rate = 22%
   - Flexible indexation

3. Risky Variant
   - 0% bonds + 100% stocks
   - Fixed contribution rate = 14%
   - Flexible indexation

Flexible indexation



Results classic ALM

Variants

Indicators ALM

		50% 50%	100% equities	100% bonds
Funding ratio				
Mean	2025	110	125	95
st dev	2025	22	52	5
within P(Assets<NomLiab)	2025	5	49	0
Contribution rate	av 20 year	17	14	22
Indexation ratio				
Mean	av 20 year	91	95	74
P(IndRatiocum<100%)	2025	56	40	90
P(IndRatiocum<80%)	2035	15	20	36

Results classic ALM (2)

- 100% equities: low contribution rate, high means funding ratio and indexation ratio, but also very risky
- 100% bonds: high contribution rate, low means funding ratio and indexation ratio, but low risk implying no underfunding risk
- 50%-50%: mid position

		50% 50%	100% equities	100% bonds
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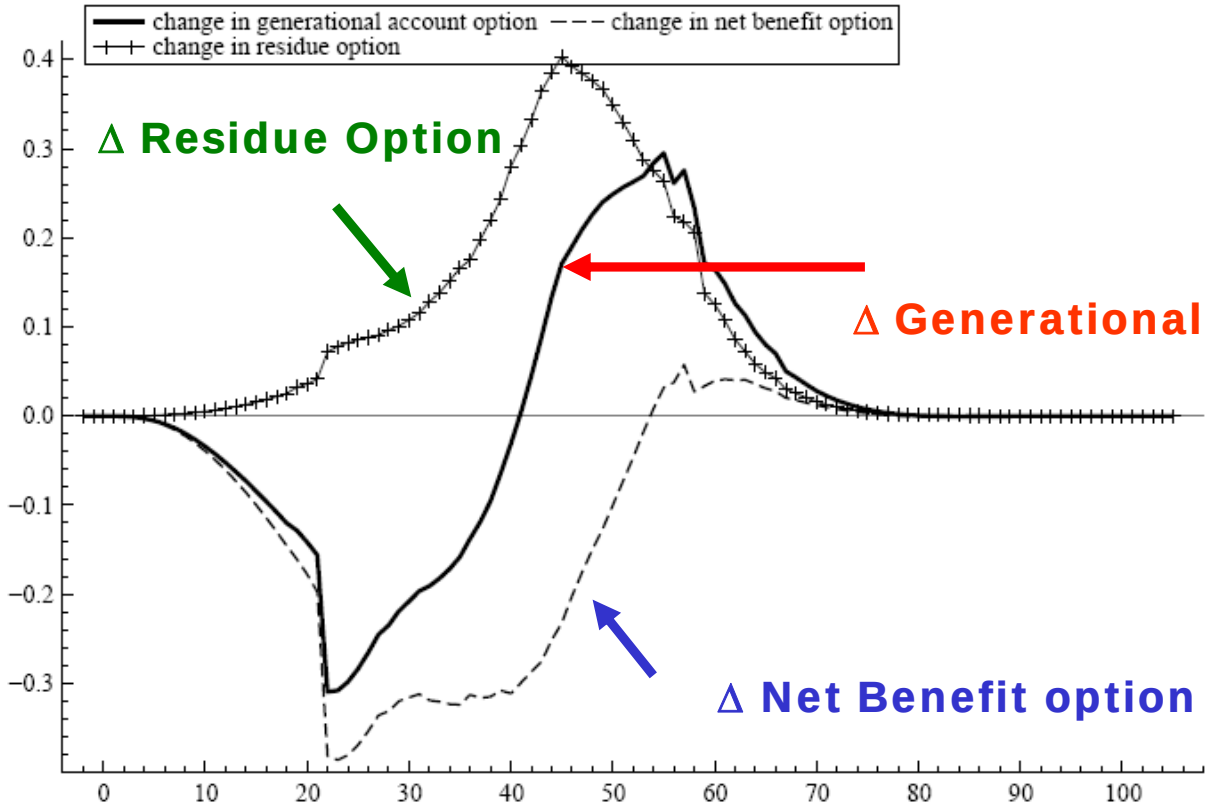
From 50%-50% to 100% bonds: changes in options

Generational effects when asset mix hybrid plan is changed to 100% bonds expressed as % of total nominal liabilities in 2006 (y-axis) for various age cohorts with age at 2006 on x-axis.



Δ Residue Option

Δ Generational Account Option

Δ Net Benefit option

From 50%-50% to 100% bonds: changes in options (2)

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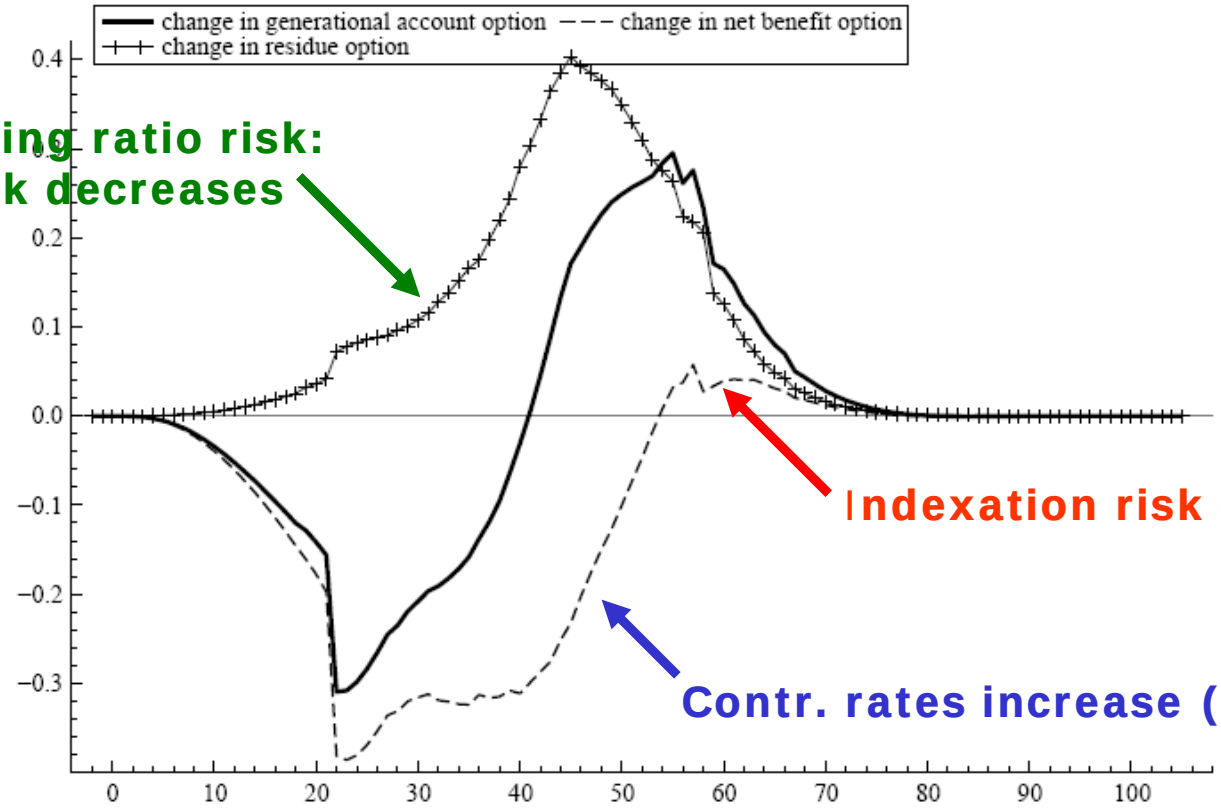


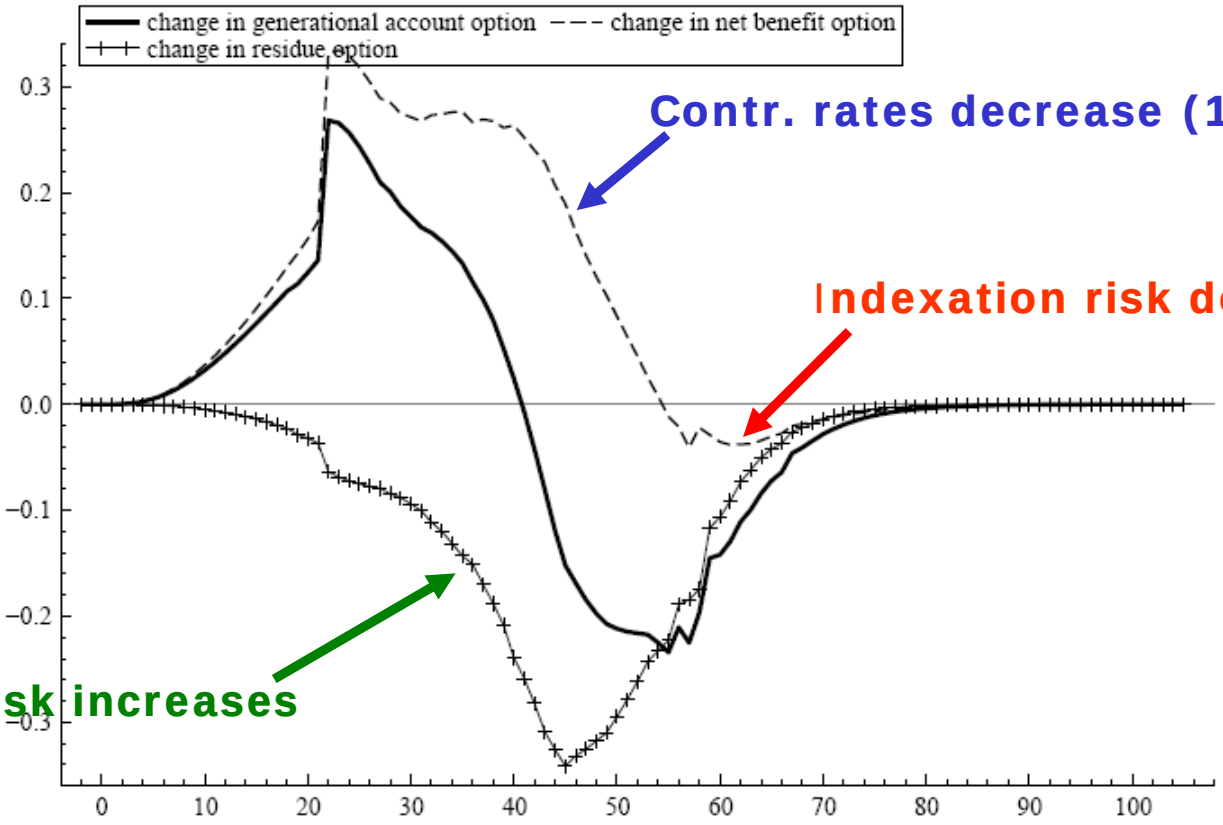
Lower funding ratio risk: Deficit risk decreases

Indexation risk decreases

Contr. rates increase (17 to 22%)

From 50%-50% to 100% equities: changes in options

Generational effects when asset mix hybrid plan is changed to 100% equities expressed as % of total nominal liabilities in 2006 (y-axis) for various age cohorts with age at 2006 on x-axis.



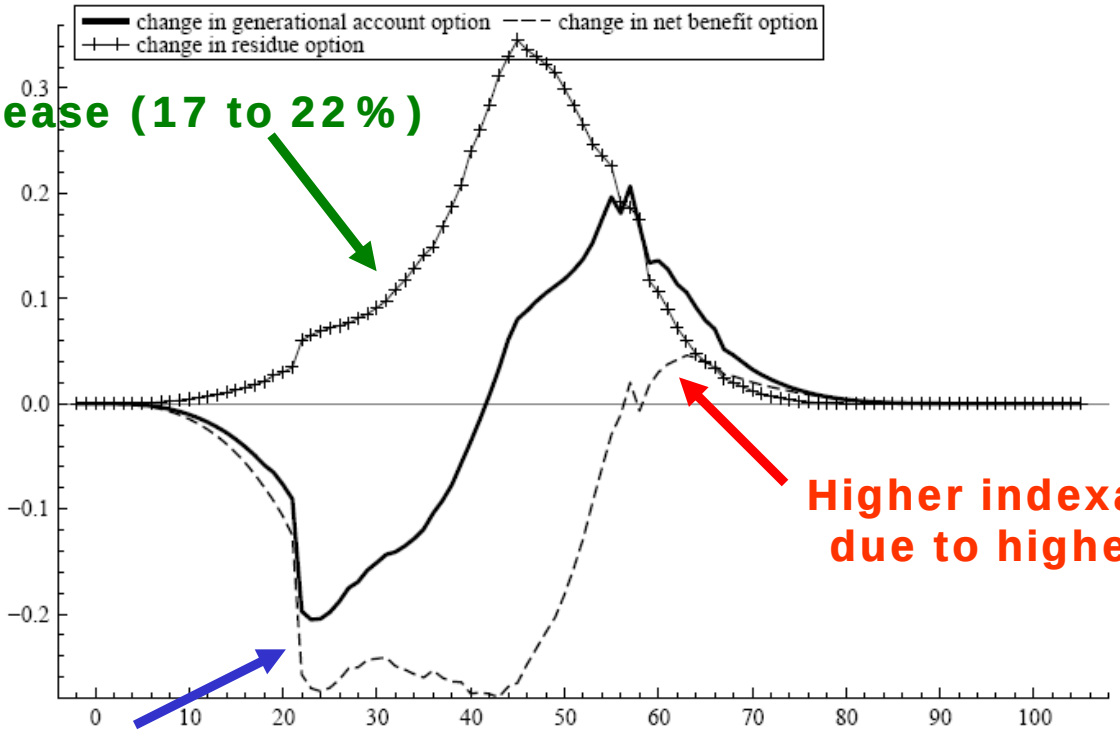
Contr. rates decrease (17 to 14%)

Indexation risk dominates

Deficit risk increases

Intergenerational transfers: Changing contribution policy

Generational effects when stepping over from a contribution rate policy based on funding to accounting in hybrid plan expressed as % of total nominal liabilities in 2006 (y-axis) for various age cohorts with age at 2006 on x-axis.



Contr. rates increase (17 to 22 %)

Higher indexation due to higher FR

Contr. rates increase (17 to 22 %)

Conclusions

1. We develop a realistic method of VBGA which reveals intergenerational risk sharing and checks for fairness in redesigning pension plans or any other institutional set-up implying generational transfers

2. Value-based ALM complementary to classic ALM

3. Pension fund is a zero-sum game: any policy change leads to value transfers between generations
   - Investments: conservative asset mix beneficial for older members, aggressive mix beneficial for younger members
   - Indexation: switch from fixed benefits (traditional DB) to flexible benefits (hybrid DC, collective DC) is beneficial for young at the expense of old
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Concerns

- Partial vs general equilibrium
- History
- Utility functions vs value transfers
- ….