Productivity slowdown, aging and pension systems

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Task

- Take productivity slowdown as given
- How does it affect the **adequacy of pension benefits** in Europe (US), especially given population aging?
- How does it affect the **financial sustainability of pension systems** in Europe (US), especially given population aging?
- Do we need **policy action**? If so, which kind of action?

Scenarios

- **Baseline:** German population forecast with strong population aging generated by babyboom-babybust transition, constant low fertility and continuing increase of life-expectancy. Constant productivity growth at 1.5% p.a. in real terms. 1.5% inflation.
- **Productivity slowdown:** Real wage growth of 1.5% p.a. in 2020 will linearly decrease to 0.9% in 2050. Inflation is 1.5% in 2020 and then declines with labor productivity. Nominal wage growth thus declines from 3% p.a. in 2020 to 1.8% in 2050.
- **Aging slowdown:** No further increases of life expectancy. This may be interpreted as a slowdown of medical/societal progress in increasing life expectancy. Otherwise same as baseline.

Result

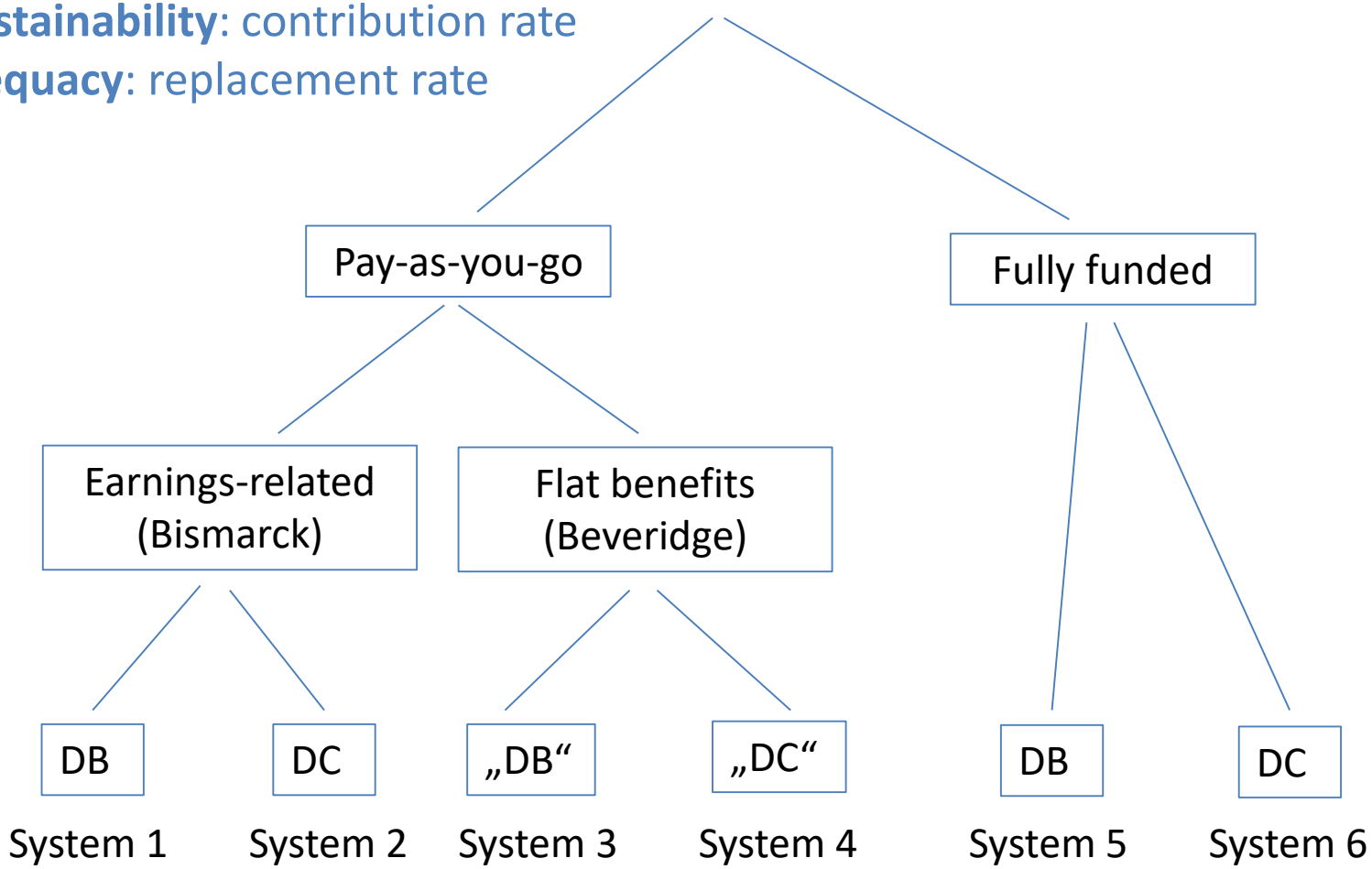
- Take productivity slowdown as given
- How does it affect the **adequacy of pension benefits** in Europe (US), especially given population aging?
- How does it affect the **financial sustainability of pension systems** in Europe (US), especially given population aging?
- Do we need **policy action**? If so, which kind of action?
- **Our favorite result: it depends**

Pension systems

Criteria:

Financial **sustainability**: contribution rate

Pension **adequacy**: replacement rate



PAYG: Macro level

First key equation: PAYG identity of revenues and expenditures:

(4) $\tau_t \cdot w_t \cdot NW_t = p_t \cdot NP_t$

Second key equation: Determination of either the replacement rate in a DB system or the contribution rate in a DC system.

- **DB system: Fixed replacement rate q_0** such that $p_t = q_0 \cdot w_t$.

  (5) $\tau_t = q_0 \cdot NP_t / NW_t$.

- **DC system: Fixed contribution rate τ_0** for a cohort of workers.

  (6) $q_t = \tau_0 \cdot NW_t / NP_t$

- **Hybrid DB/DC system:**

  (7) $p_t/p_{t-1} = w_t/w_{t-1} \cdot (DR_{t-1}/DR_t)^{\alpha}$,
  with $DR_t = NP_t / NW_t$ dependency ratio and $0 \leq \alpha \leq 1$ weight

$\Rightarrow$ **Internal rate of return:** $irr = g + \alpha \cdot n$

PAYG: Micro level

Third key equation: Pension benefits $p_{i,R}$ for an individual *i* claiming benefits at age *R*:

(9) $$p_{i,R} = \bar{q}\, s_i\, \omega_R\, .$$

$\bar{q}$ = **basic replacement rate** for an average worker retiring at the statutory retirement age. It is either q_0 or q_t depending on the type of pension system, DB or DC *(from second key equation)*.

s_i = **pension points linking the pension benefit to this individual's earnings:**
Flat benefits: $s_i = 1$. Otherwise

(10) $$s_i = \sum_{i=0}^{R-1} \frac{w_i h_i}{\overline{w}\,\overline{h}} / R\, .$$

ω_R = **adjustment factor linking pension benefit to claiming age *R*:**

(11) $$\omega_R = 1 + \left(R - \overline{R}\right)\omega.$$

FF: Much easier

FF pension income *p* is

(12) $p = (1+r) \cdot \tau \cdot w,$

(r in units commensurable with the period length)

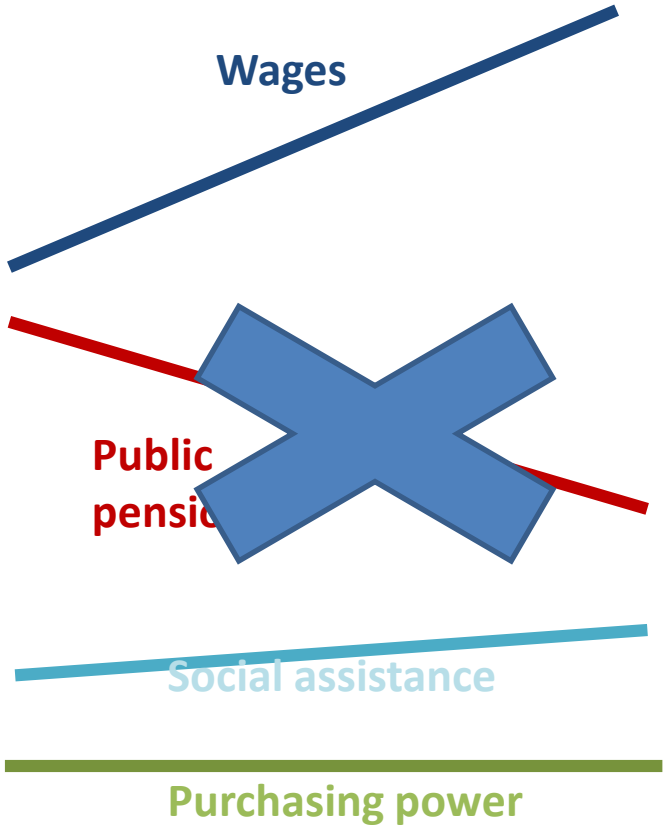
- **FF-DC system:** *r* = realized capital market ex post
- **FF-DB system:** *r* = ex ante rate of return guaranteed by the sponsor of the pension system.

First principles

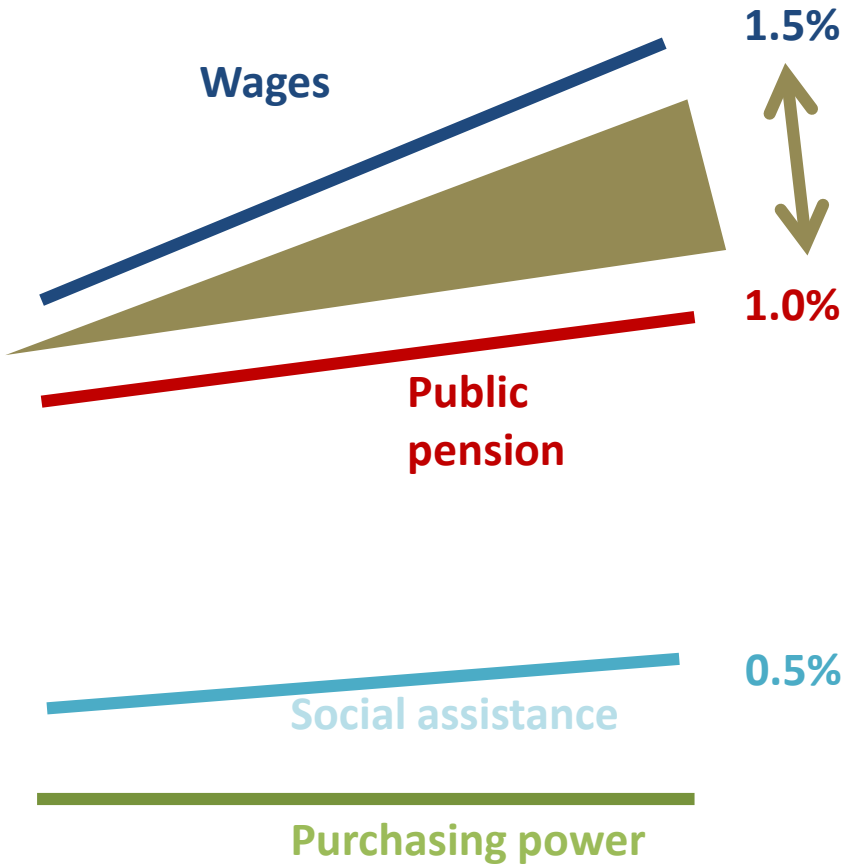
- Most pension systems in Europe: **benefits wage indexed**, (roughly proportional to life-time contributions for average worker), contributions are a percentage of wages
- Hence, if productivity changes equal to wage changes, **no effects on financial sustainability and *relative* pension adequacy**
- **Second order effects** in real world: base pension; mixed indexation; unequal wage distribution; government subsidies financed by various taxes
- **Feedback effects** in equilibrium: employment, interest rate
- ***Absolute* adequacy** depends on remaining growth vs. force of aging
- If **benefits inflation indexed**: shielded from productivity slowdown, increases contributions: **intergenerational effects**

Absolute adequacy

Frequent perception:



Actual development:



PENSIM model

Actuarial model of pension system:

- German (and Swedish) **population structure and projection**
- (also variants: fertility, life expectancy, labor force partipation)
- Detailed **rules of** German (and Swedish) **pension system**
- For this project: add prototypical pension systems, systematically structured by PAYG/FF – DB/DC – wage/inflation indexation

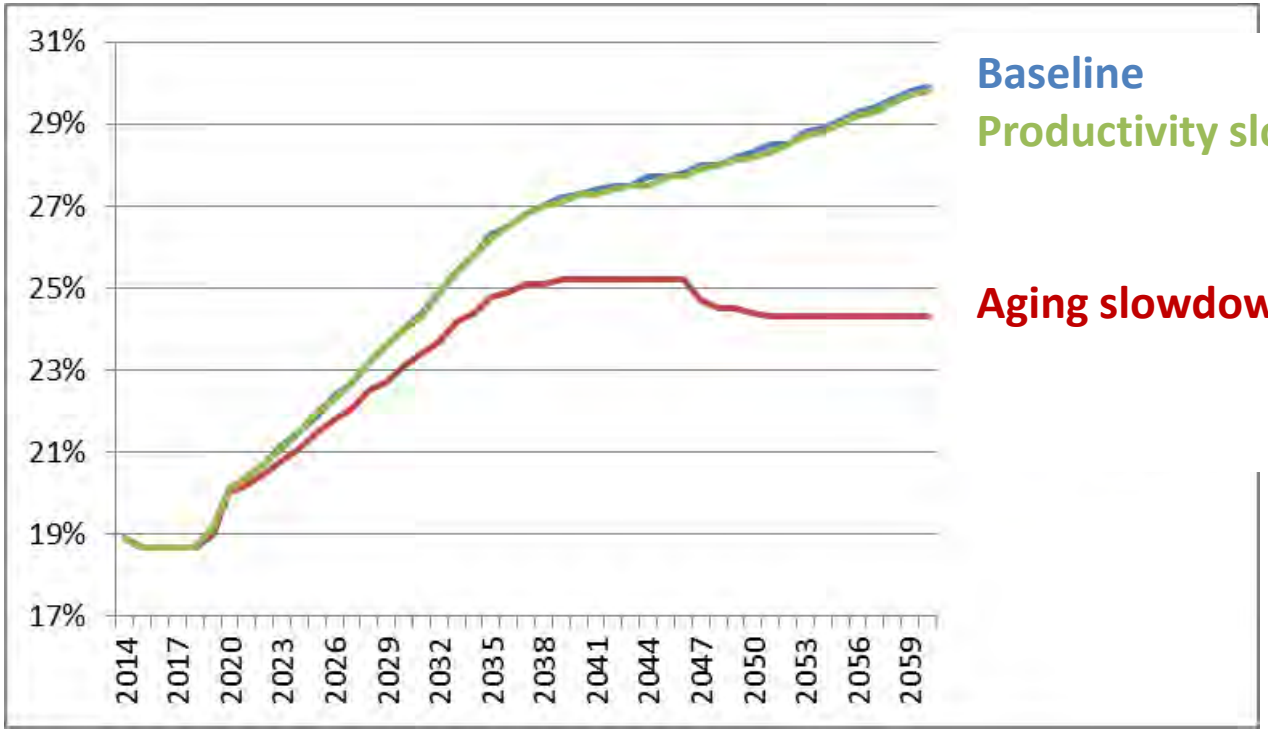
Output:

- **Contribution/tax rate** (% average wage)
- **Replacement rate** (% average wage)

- Budget (% GDP)
- Implicit debt (% GDP)
- Internal rate of return

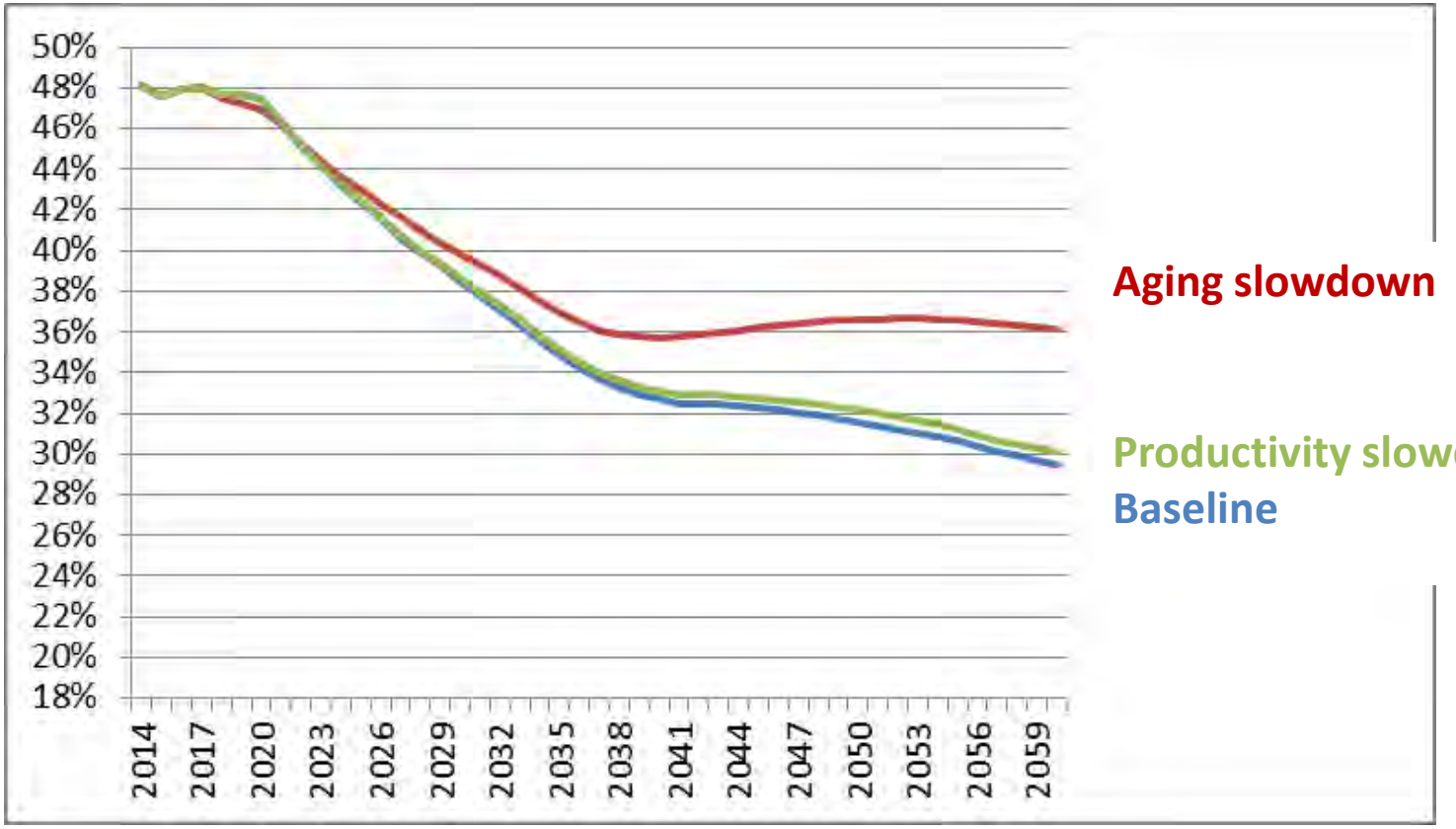
Direct impact

Figure 1: Contribution rate in earnings-related DB system. Replacement rate fixed at 48%.



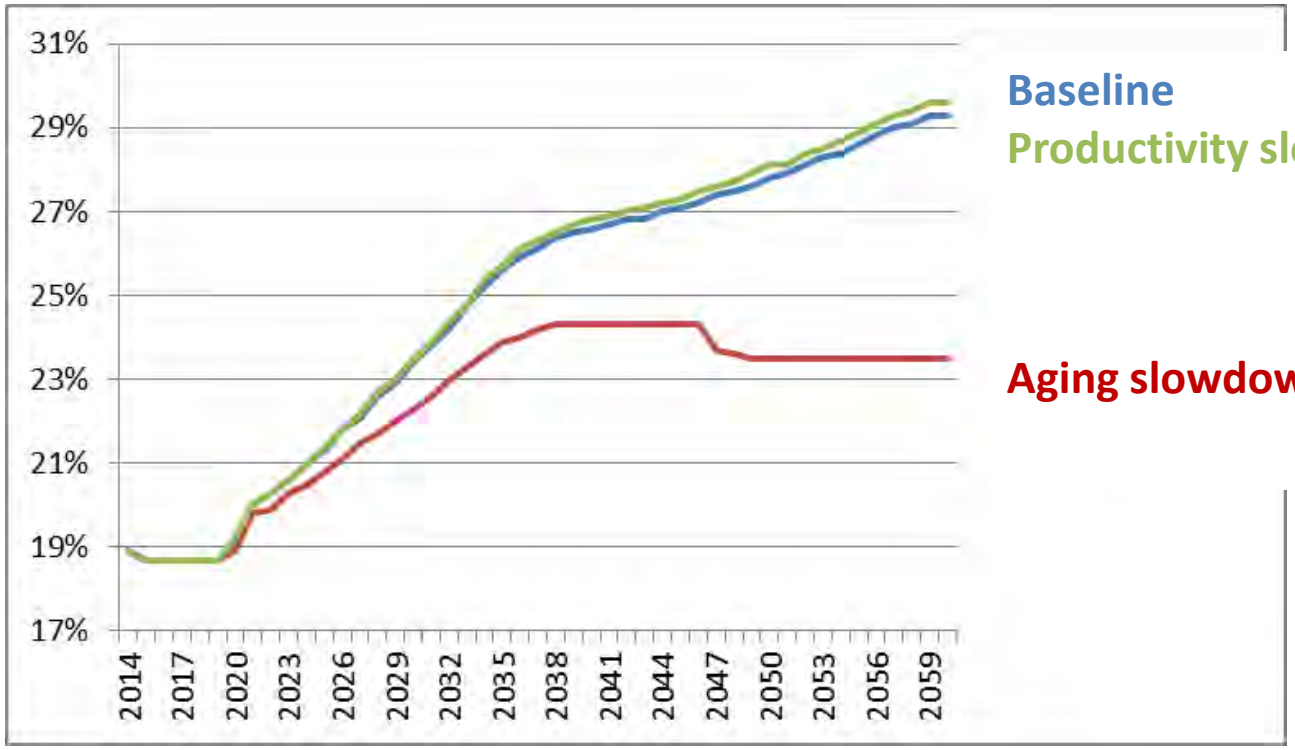
Direct impact

Figure 2: Replacement rate in earnings-related DC system. Contribution rate fixed at 19%.



Direct impact

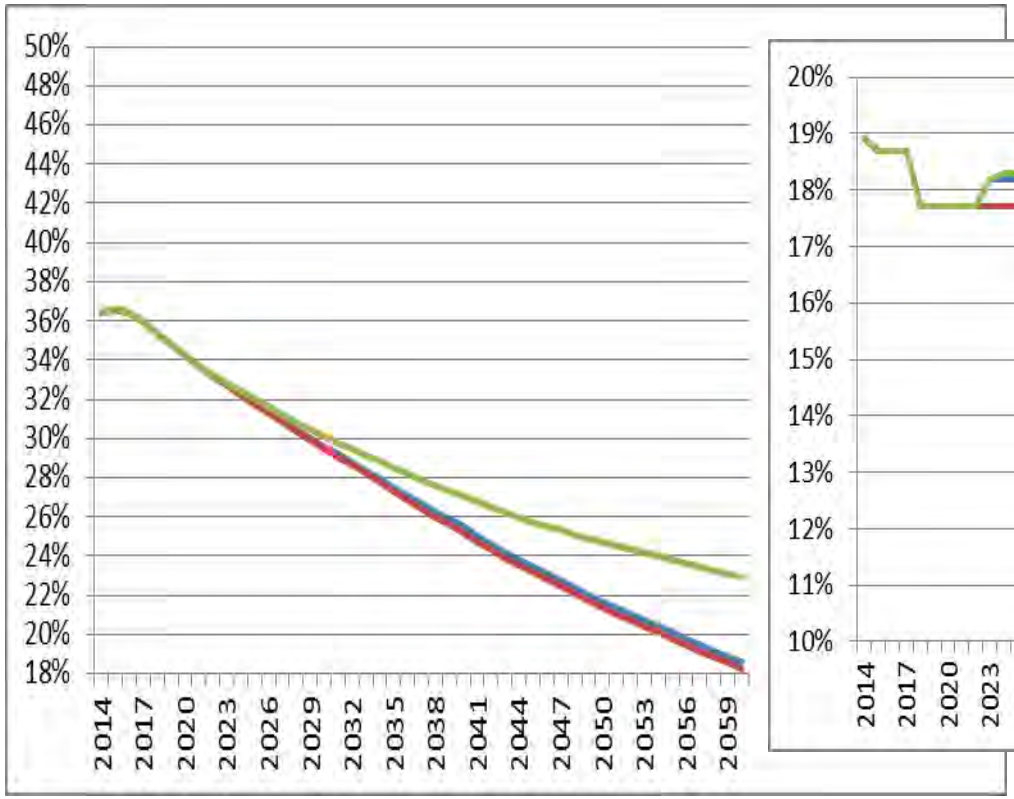
Figure 3: Contribution rate in wage-indexed flat-benefits system.



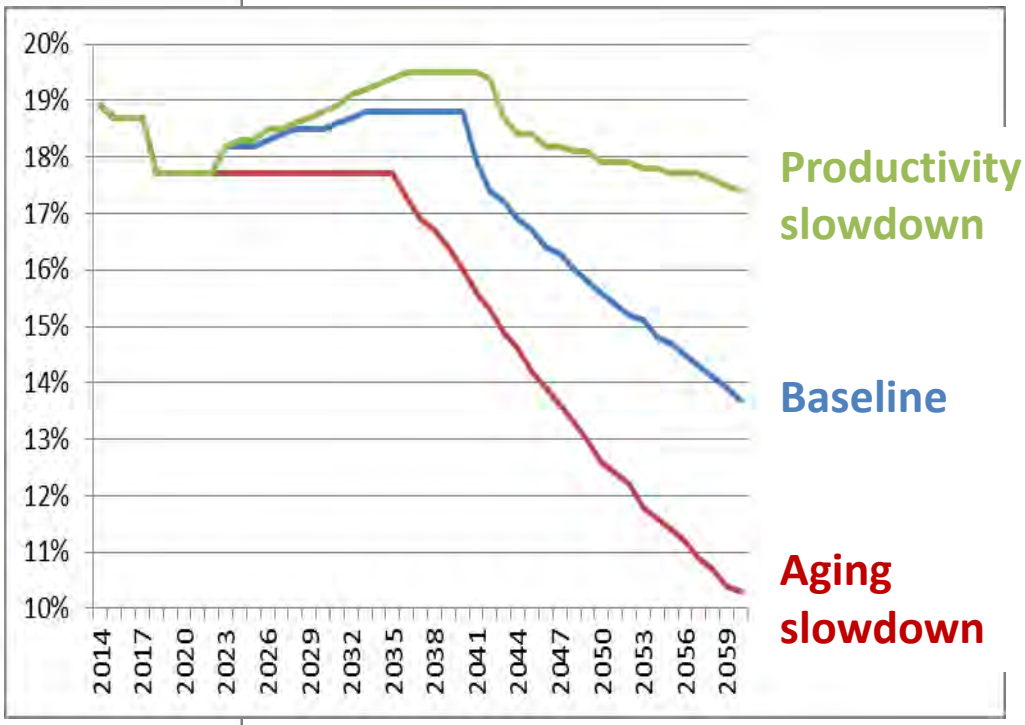
Direct impact

Figures 4 and 5: Inflation-adjusted flat-benefits system

Replacement rate



Contribution rate



Fully funded systems

Fully funded pension systems suffer from **lower interest rates** due to the productivity decline.

Fully funded-DB:

- Retirees are shielded from benefit declines in spite of declining capital returns. *Details depend on formulation of benefit (last salary, lifetime, flat).*
- The sponsors of the system have to increase their contributions. Hence, the financial sustainability of the system may be endangered.

Fully funded-DC:

- Retirees will receive lower pension incomes but the financial sustainability of the system is unaffected.
- Pension adequacy is not endangered as long as productivity is slowing down but not declining.

Adaption options

Is adaption needed at all? People may have backwards perspective!

Need to increase quantity (labor volume, savings volume)
by 0.6% p.a. to offset loss in value (productivity slowdown).

Corresponds to a **20% increase between 2020 and 2050**.

• ***Retire later***	Base: 40 y/life	Target: 48 y/life in 2050
• ***Work more hours***	Base: 40 h/wk	Target: 48 h/wk in 2050
• ***More immigrants***	Base: 43mio	Migrants p.a.: 260,000 net
• ***Save more***	Base: 4% income	Target: 4.8% income
• ***Educate better***	No evidence	

Conclusions

1. Productivity slowdown **lowers the tide for all the boats:** If benefits indexed to wages, **neither financial stability nor relative adequacy endangered**. **Entire system shrinks** in proportion to wage bill

2. Depending on DB versus DC, **decline in absolute terms will make older or younger generation worse off** than the preceding generation relative to the baseline at historical productivity growth rates.

3. Even a slower growth of labor productivity of about 0.9% p.a. is more than the annual loss in resources due to population aging (~0.5% p.a.). Hence annual benefits increase by only 0.4% -- but **still increase in absolute terms**.

4. If such small increase politically unacceptable, one has to increase labor or capital **volume**. Need **policy mix** consisting of working longer, working more, allowing more migration, saving more, and educating better.