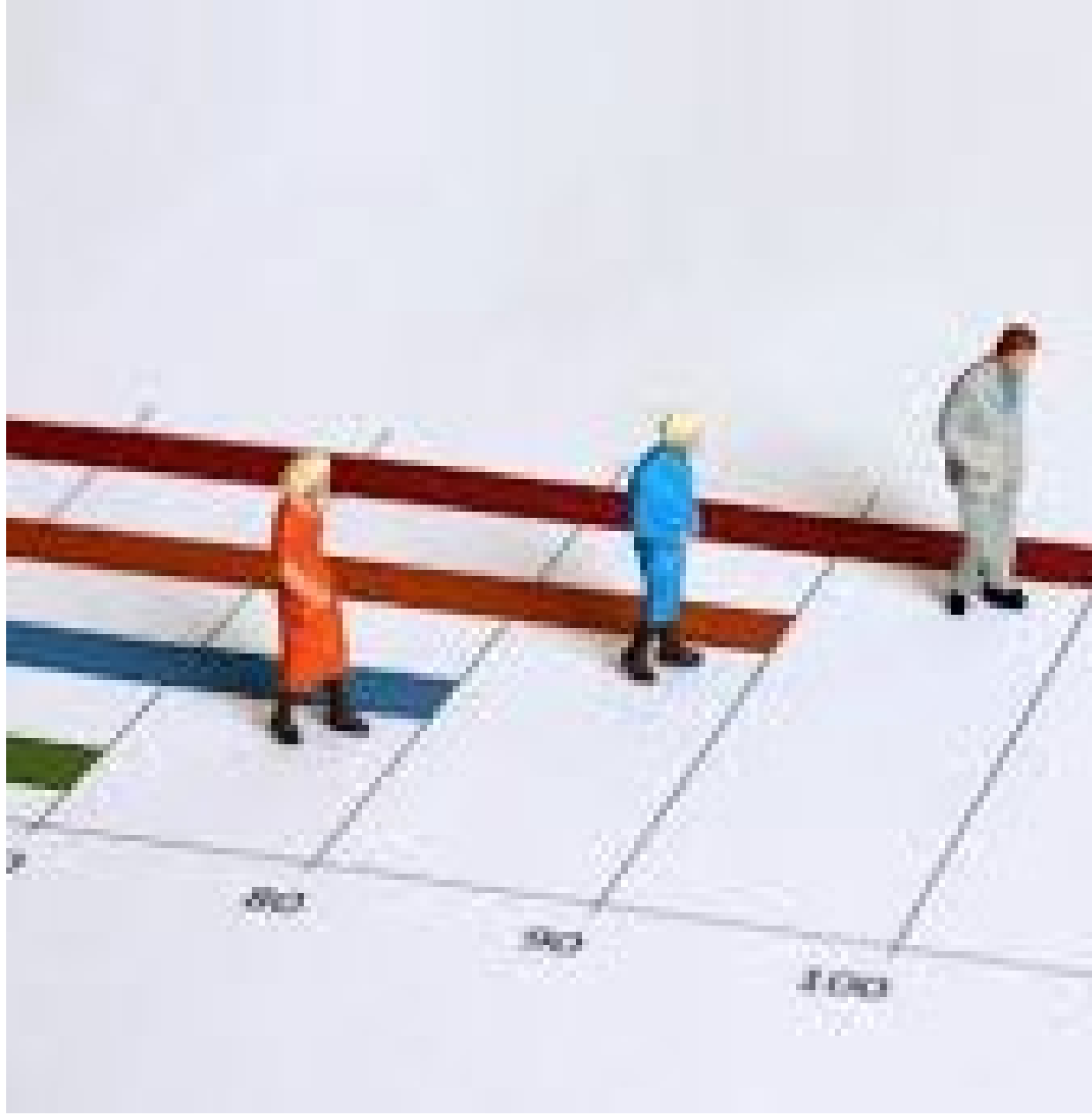
Allocation of longevity gains in public pension plans

Longevity 19 – Amsterdam – 16/17 september

Eduard Ponds
Joint work with Bram Groenewoud



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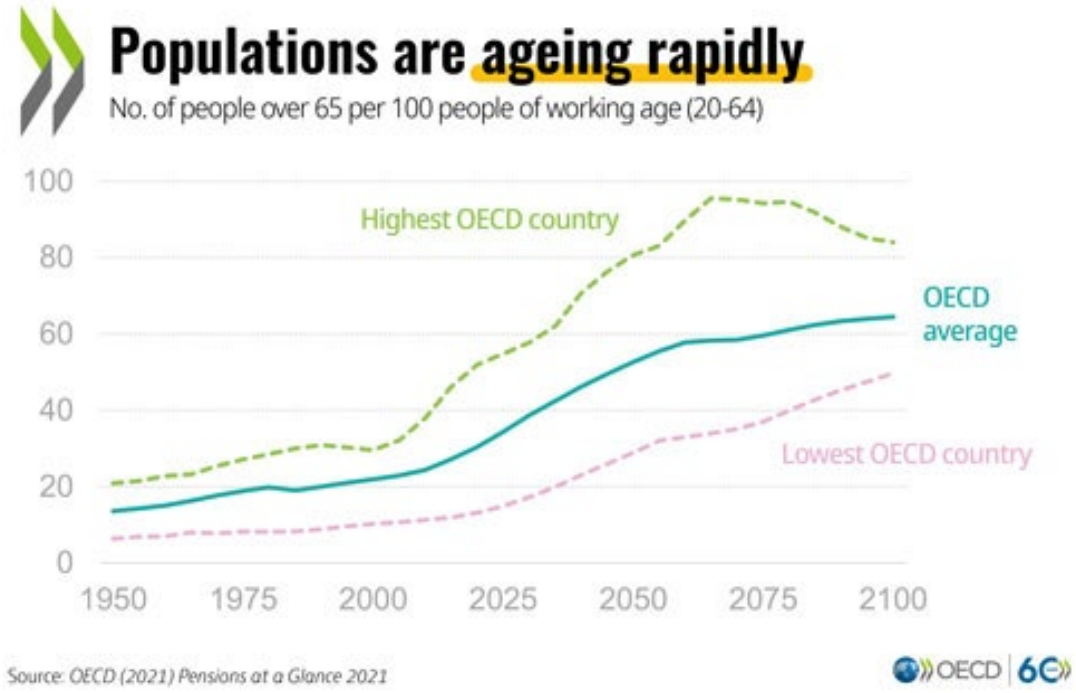
Start

Longevity increase: Threat or Gain?

Longevity often seen as **threat** to sustainability public pension plans.

This paper shows:

- Longevity is a **gain** for past, current and potentially for future generations in terms of higher return from paygo plans
- Cohorts live longer than their predecessors, implying retiring cohorts have paid less contributions in their working period than the pension benefits they receive during their extended retirement period.
- How much gain depends on the path of the retirement age. Does it stagger or increaese in line with LE?



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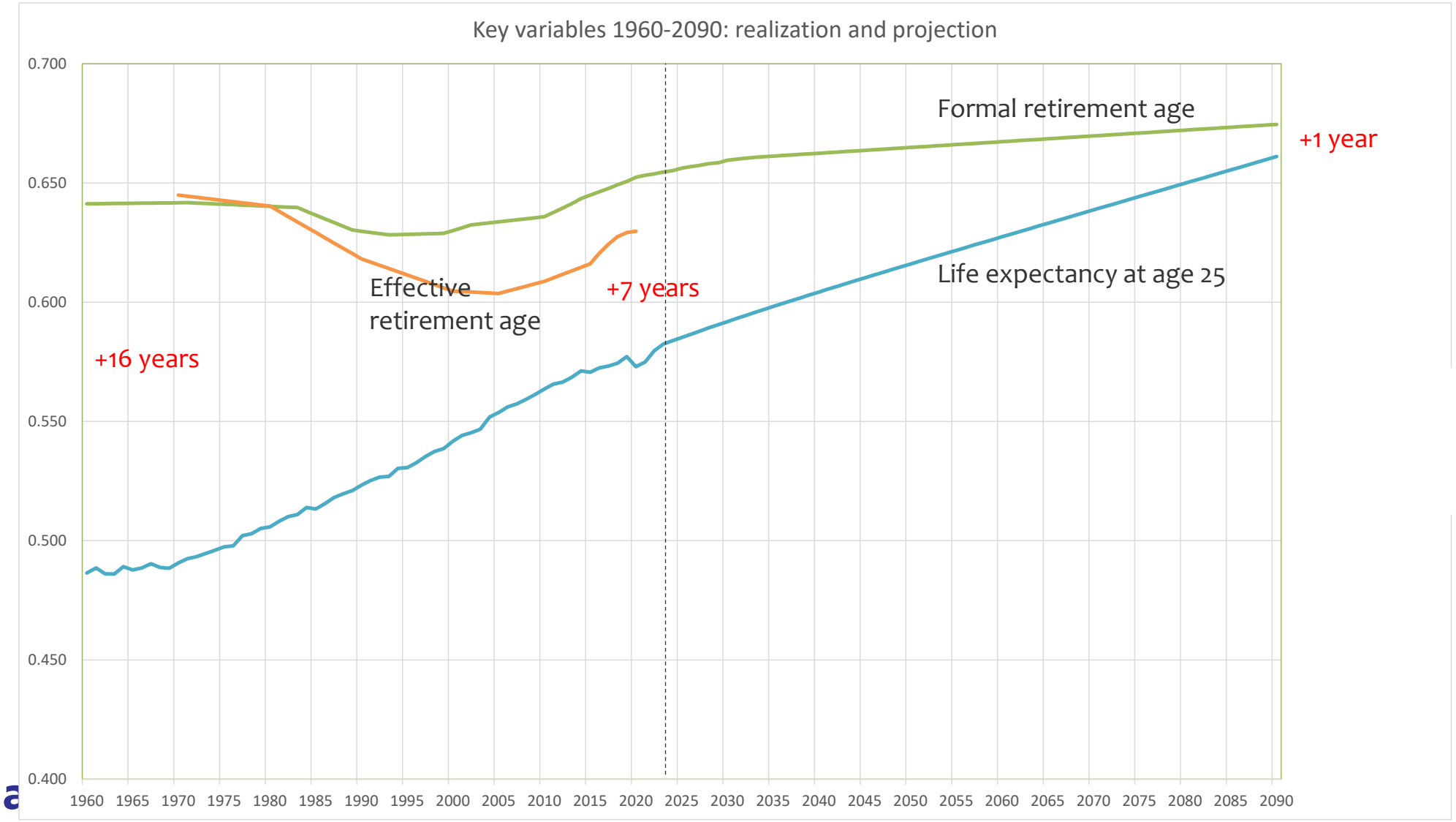
Sustainability of public pension plans at risk:
Increase in retirement age lags behind growth trend longevity (17 OECD countries)



What we want to know?

- **Classic result:**
  Main driver return public pension plans is **growth rate of the economy** (Aaron 1966, Samuelson 1958)

- **This paper** looks at:
  - What is the impact of longevity growth on the return from public pension plans?
  - What is the role of the formal retirement age
  - Are we able to detect the gain from empirical evidence?

What we add to the literature?

- Construction **unique dataset** of public pension plan variables
- **Empirical analysis of impact LE on return paygo** in 17 countries for cohorts born in 1935-1990 over the period 1960-2090
- **Update IRR studies:** to our knowledge, the latest report of long series of internal rates of return was done by Disney (2004)

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Main findings

- Main driver of IRR is **growth rate GDP**

- **Longevity is a gain!**
  - 0.10% pt to 0.30%-pt
  - The gain depends on the settings of the pension plans.

- **Fair Rule:**
  - Allocation longevity gain proportional over work period and pension period

- **Fair rule warrants long term sustainability**
  - stable dependency ratios
  - stable contribution

- Fair rule in post-war period → reduction of IRRs with on **average 0.5%-point**

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Literature about impact of LE on return paygo

- **Knell (2017):** Analytical study (determinstic OLG) showing:

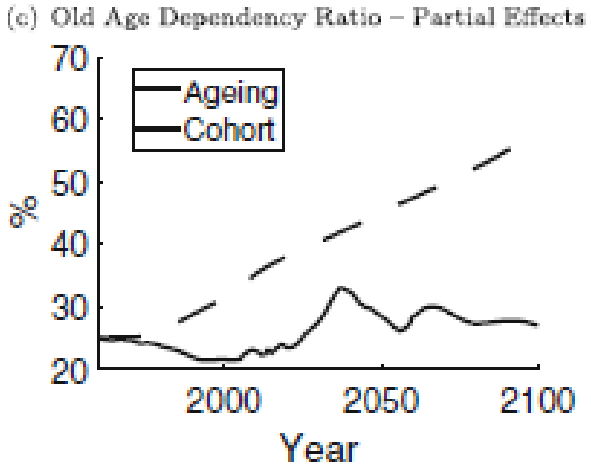
  Return paygo = g_GDP + g_LE (=0.4%-pt)

- **Schön (2023):** Longevity effect structural;

  Cohort effect is temporarily (zero sum)

- **Eviv (2014):** Longevity gain makes paygo relatively more attractive

  vis-a-vis funding



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Construction dataset

Key variables of paygo plans 17 OECD countries

- **Data set problem**
  - Each country own practice regarding benefits and payments.
- We collect data from **public datasets (OECD, IMF, WB, EU, ILO)** regarding public pensions.
- We **process** public data to create a unique dataset with uniform defined data
- Period 1960-2020: real data
- Period 2025-1990: projected data

Dataset for each of the 17 country :

- Contribution rate
- Replacement rate
- Population structure
- Dependency ratio
- Life expectancy
- Formal retirement age
- Growth rate wages
- Growth rate GDP economy

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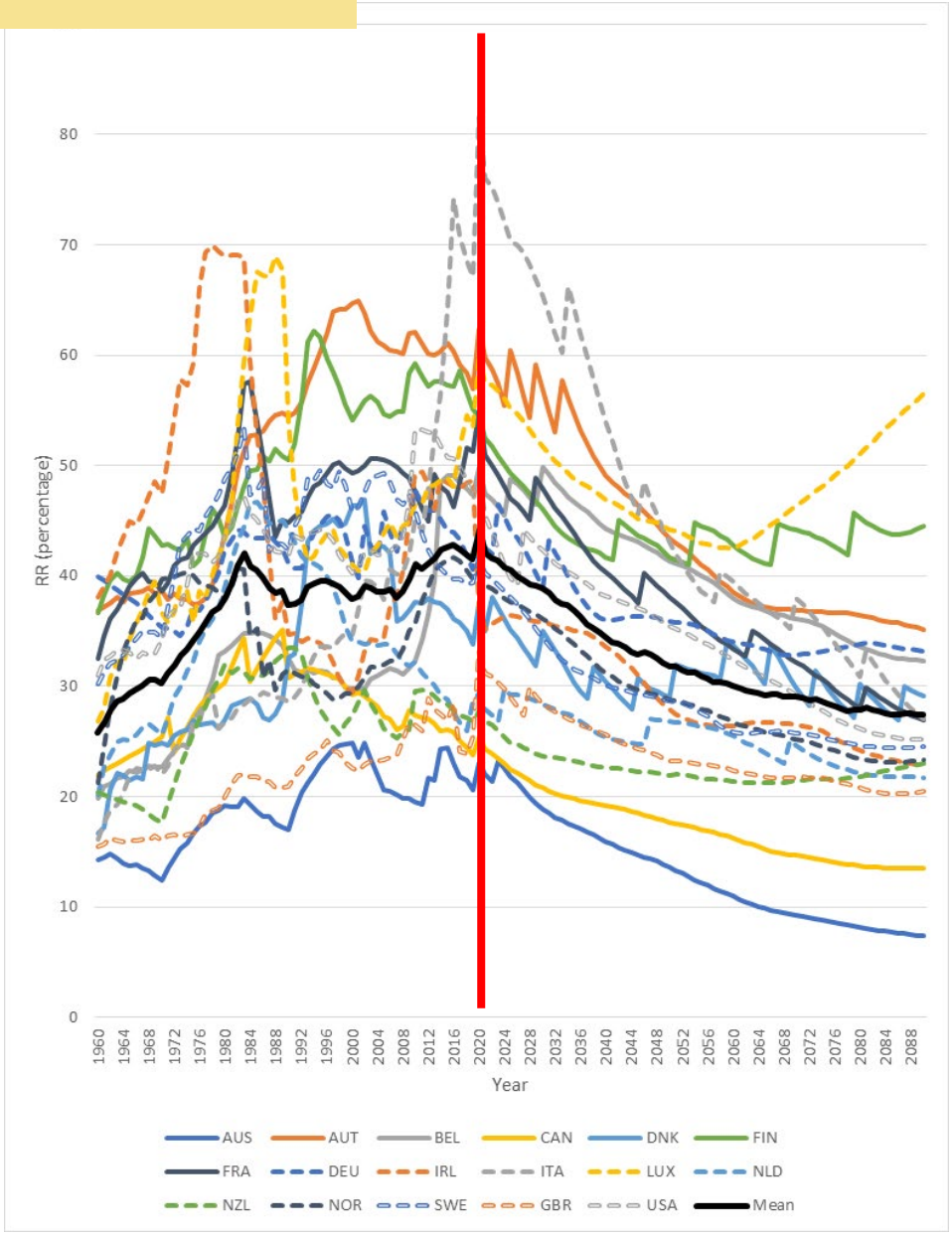
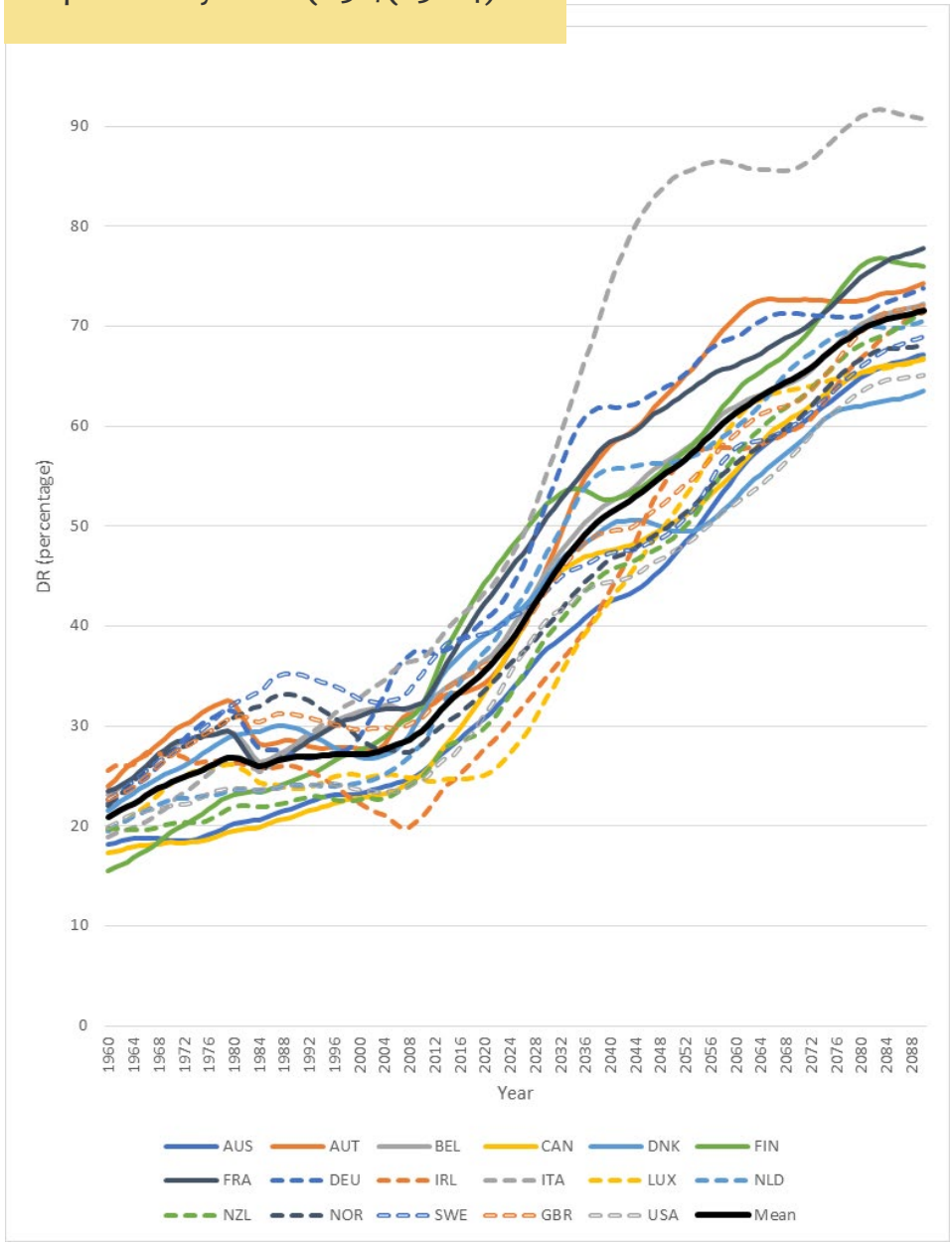
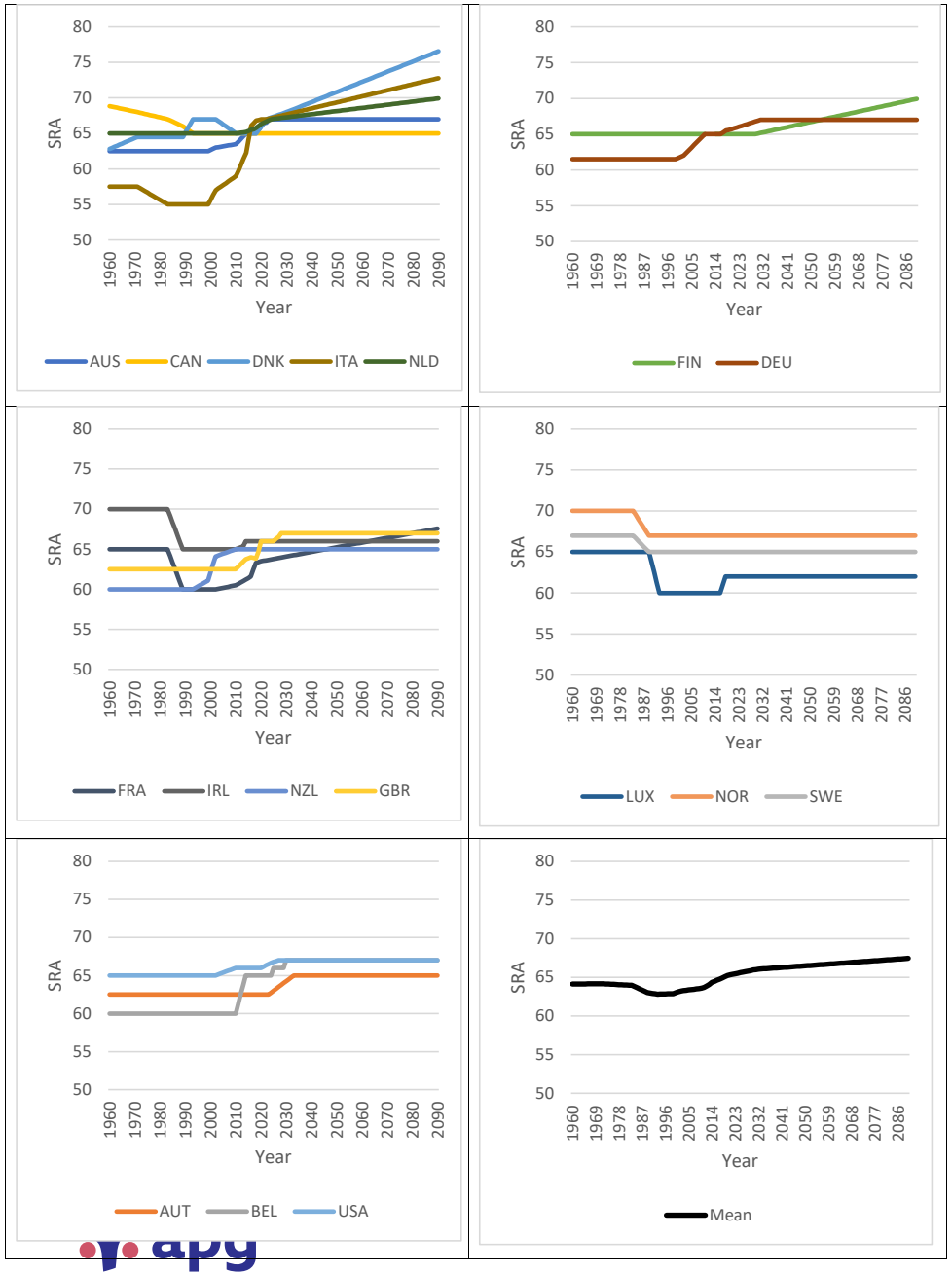
Replacement rate



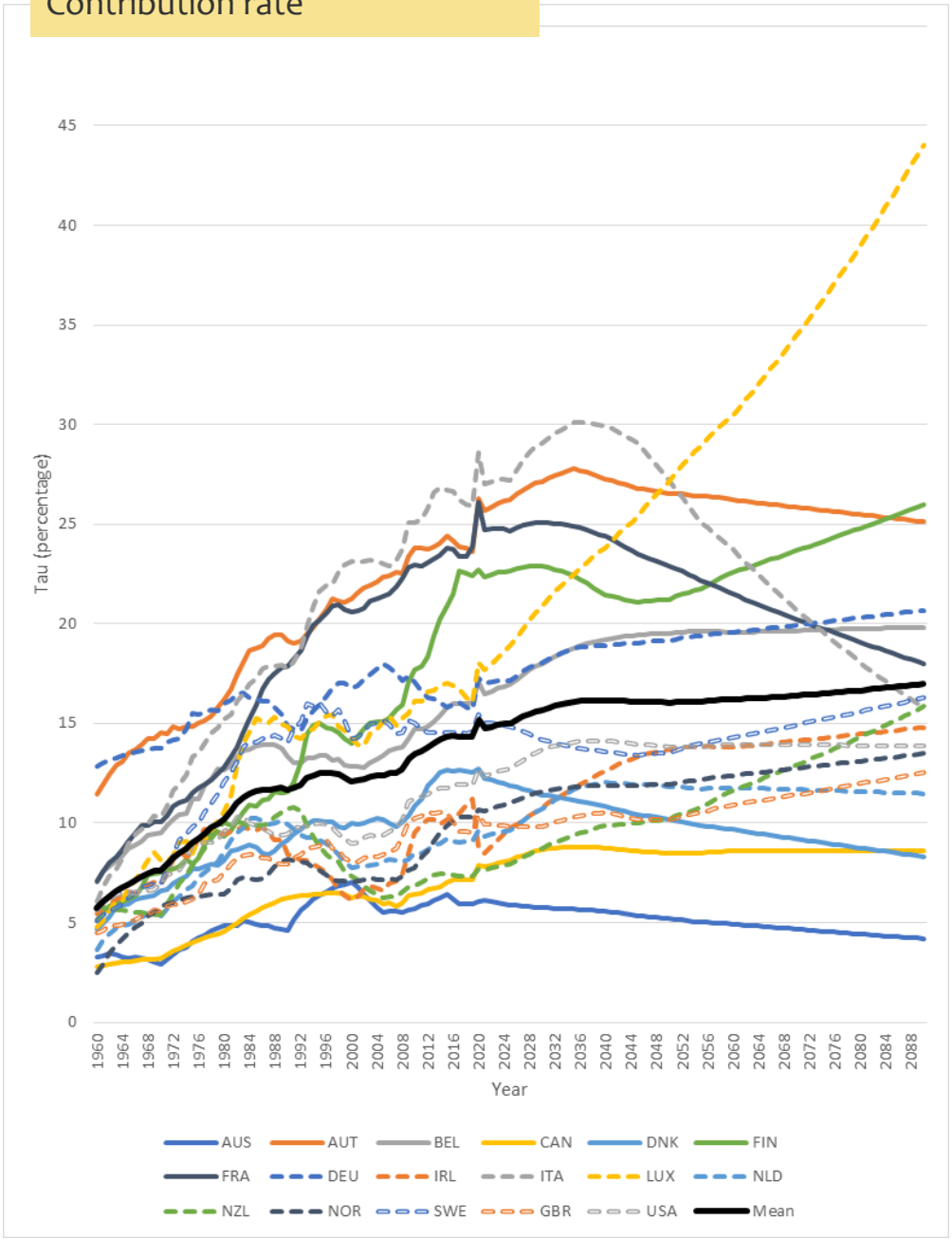
Dependency ratio (65+/(25-64)

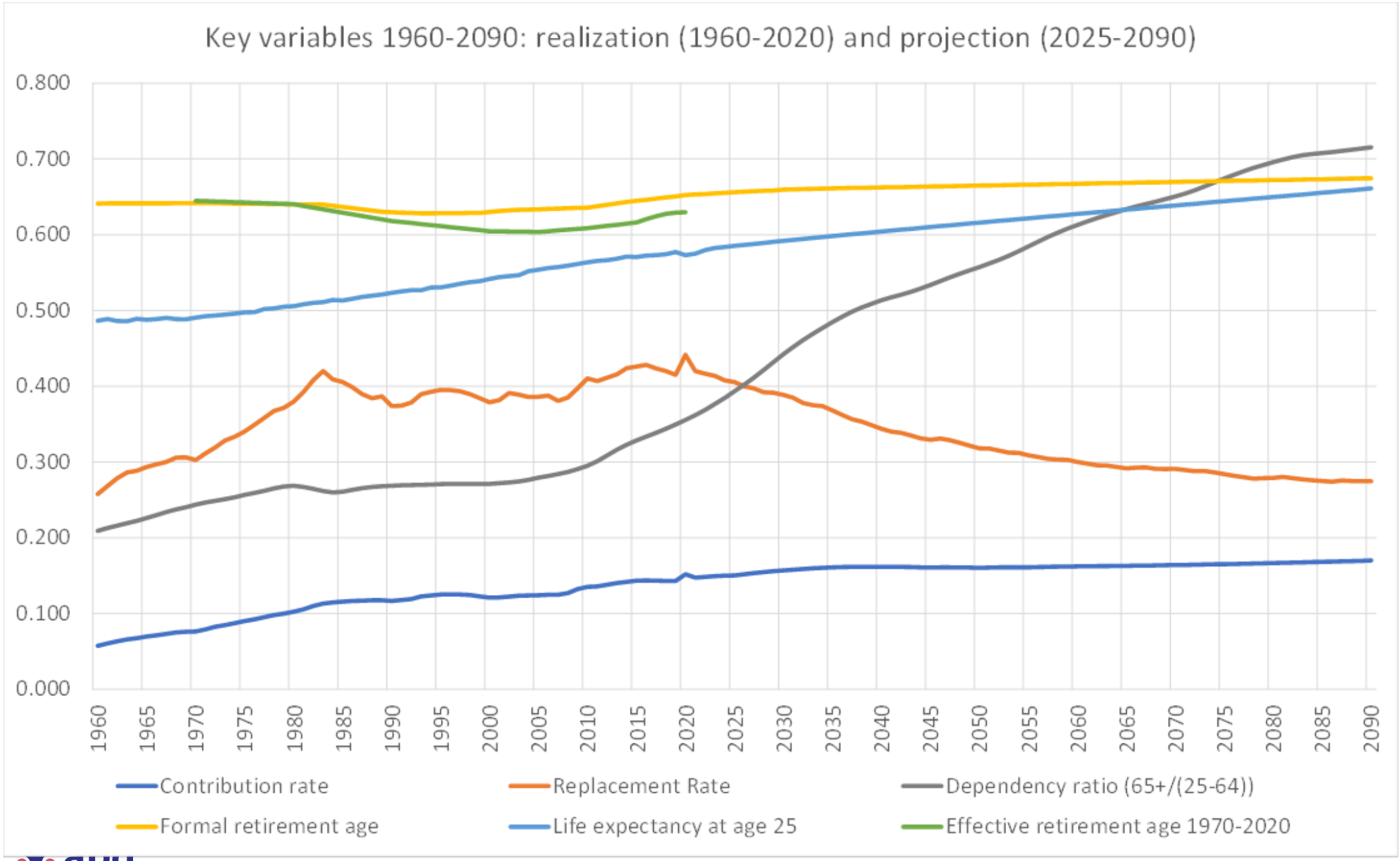


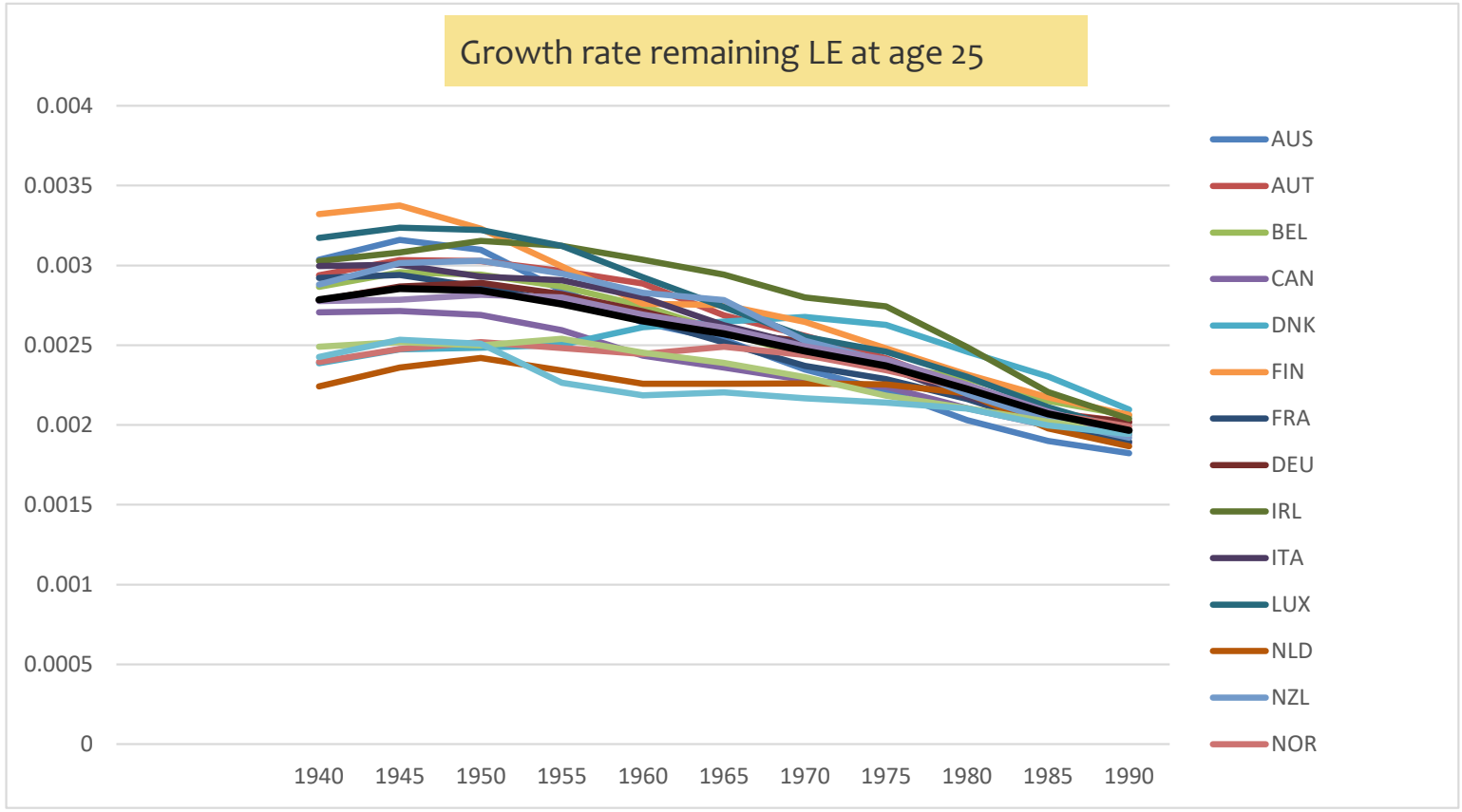
Formal retirement age



Contribution rate




Key variables 1960-2090: realization (1960-2020) and projection (2025-2090)
0.800
0.700
0.600
0.500
0.400
0.300
0.200
0.100
0.000
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
2075
2080
2085
2090
Contribution rate
Replacement Rate
Dependency ratio (65+/(25-64))
Formal retirement age
Life expectancy at age 25
Effective retirement age 1970-2020


Growth rate remaining LE at age 25
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
AUS
AUT
BEL
CAN
DNK
FIN
FRA
DEU
IRL
ITA
LUX
NLD
NZL
NOR

Internal rate of return

Internal rate of return

IRR = the rate of return at which

PV Contributions = PV Benefits

$$\sum_{t=25}^{FRA-1_{c,i}} \frac{\beta_{c,i,t} T_{c,t}}{\left(1+IRR_{c,i}\right)^{t}} = \left(\frac{1}{1+IRR_{c,i}}\right)^{FRA_{c,i}-25} \cdot \sum_{t=SRA_{c,i}}^{100} \frac{\gamma_{c,i,t} B_{c,t}}{\left(1+IRR_{c,i}\right)^{t}}$$

Where:

- c, i, and t indicate the country, cohort, and year, respectively.
- T = total effective contributions
- B = total public pension expenditures.
- $\beta_{c,i,t}$ and $\gamma_{c,i,t}$ indicate the share of public pension contributions and expenditures that are paid or received by the cohort
- Survival probability in T and B

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Expected results

H1: IRRs > GDP growth rate because of growth rate longevity

H2: A **sticky retirement age** allocates longevity gain to older cohorts

The **fair rule retirement age** distributes the longevity gain fairly over the cohorts

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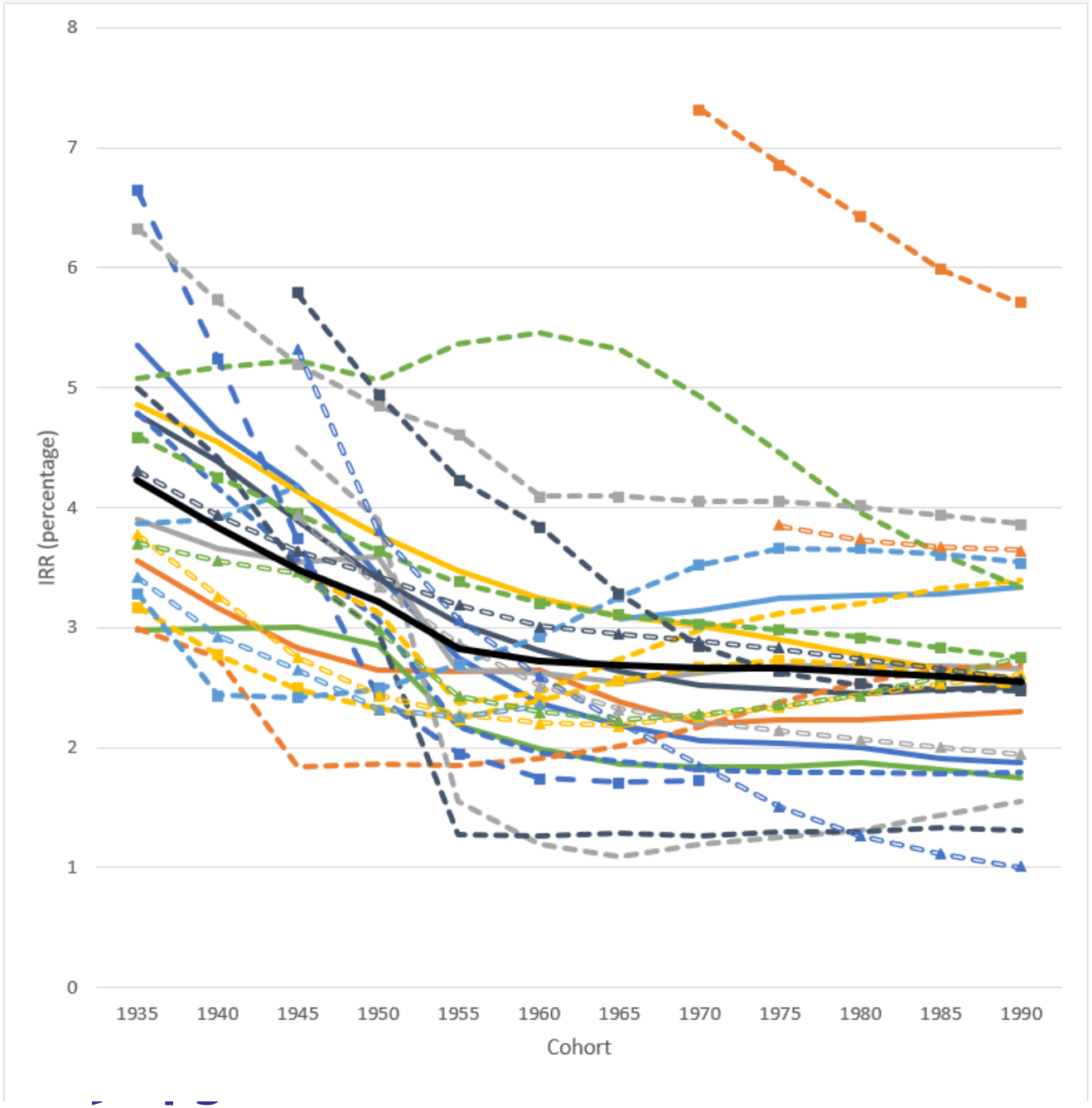
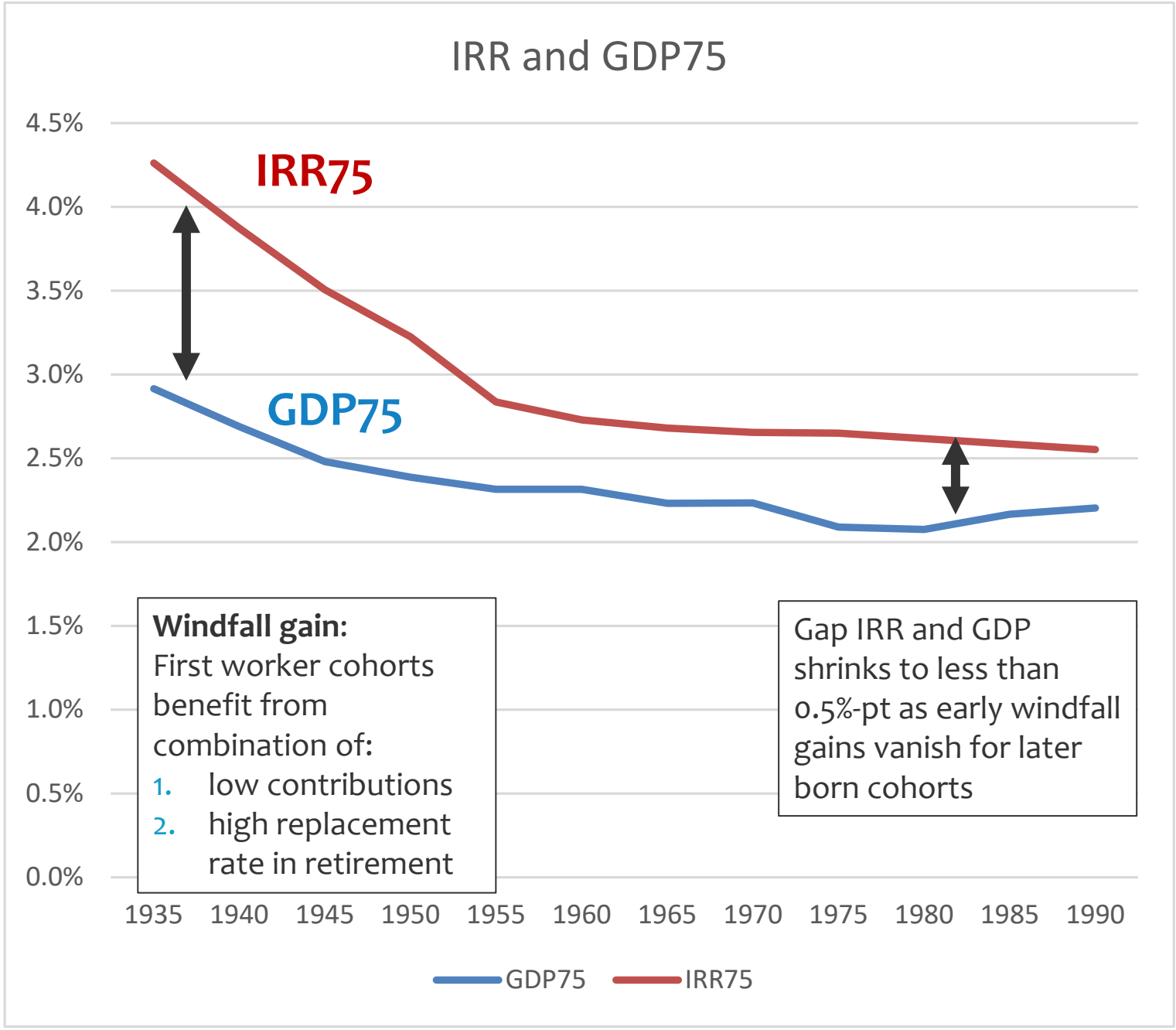
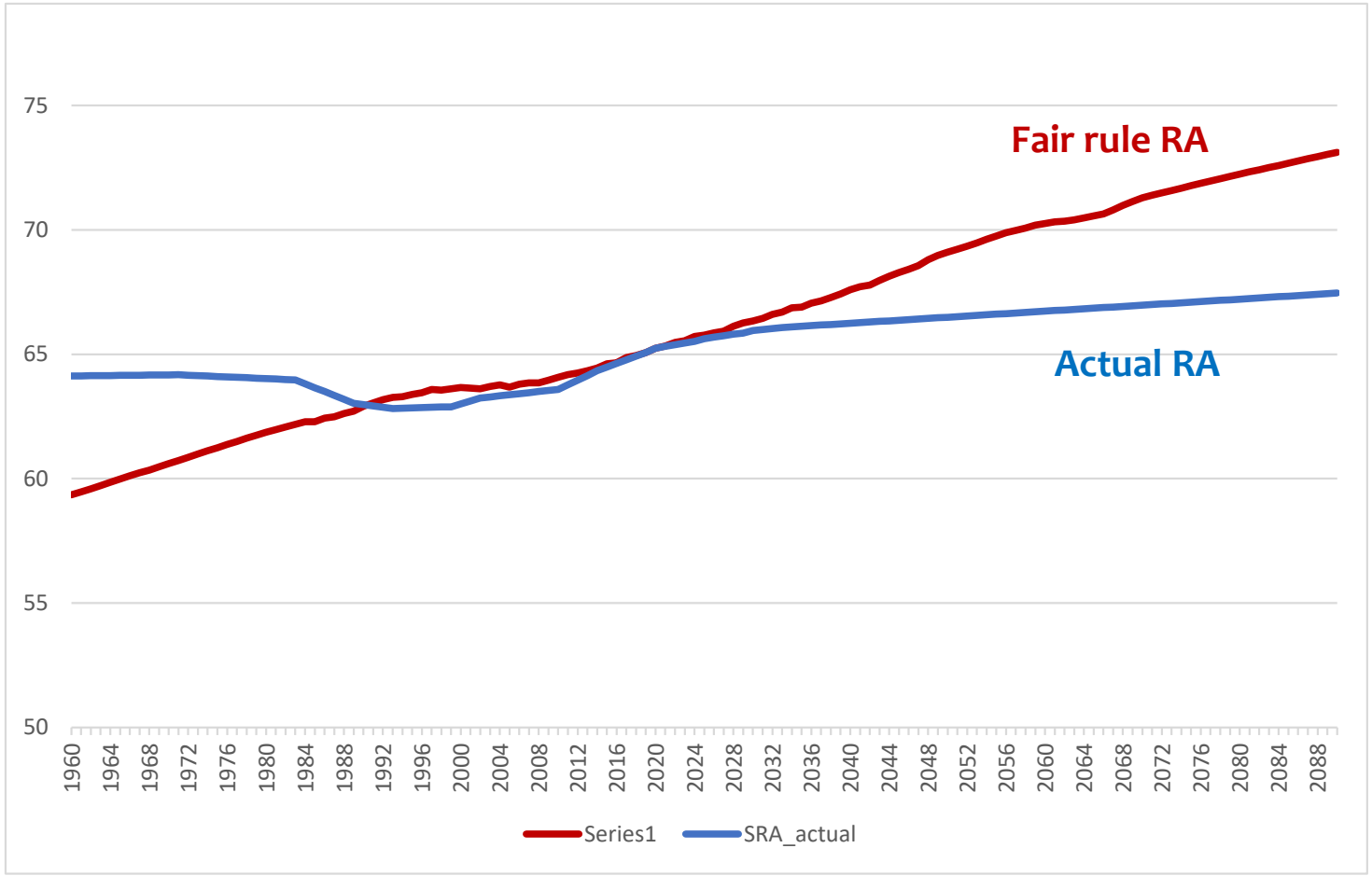
IRRs for OECD countries




IRR and GDP75
4.5%
4.0%
3.5%
3.0%
2.5%
2.0%
1.5%
1.0%
0.5%
0.0%
IRR75
GDP75
Windfall gain:
First worker cohorts benefit from combination of:
1. low contributions
2. high replacement rate in retirement
Gap IRR and GDP shrinks to less than 0.5%-pt as early windfall gains vanish for later born cohorts
1935
1940
1945
1950
1955
1960
1965
1970
1975
1980
1985
1990
GDP75
IRR75

Fair rule retirement age

- **Fair rule** = Retirement Age is set so that all cohorts have the same ratio working period over pension period as the 1960 cohort



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Research – in – progress

Results from a REPLAY of the past

Implementing Fair Rule :

- Allocation increase life expectancy proportional to working period and pension period
- Benchmark = cohort born in 1935 /start working in 1960

First results:

- Fall in Internal rates of return: average 0.5%-pt
- Higher economic growth: more workers, less retirees
- More fairness between age cohorts
- More stable contribution rates
- More stable dependency ratios

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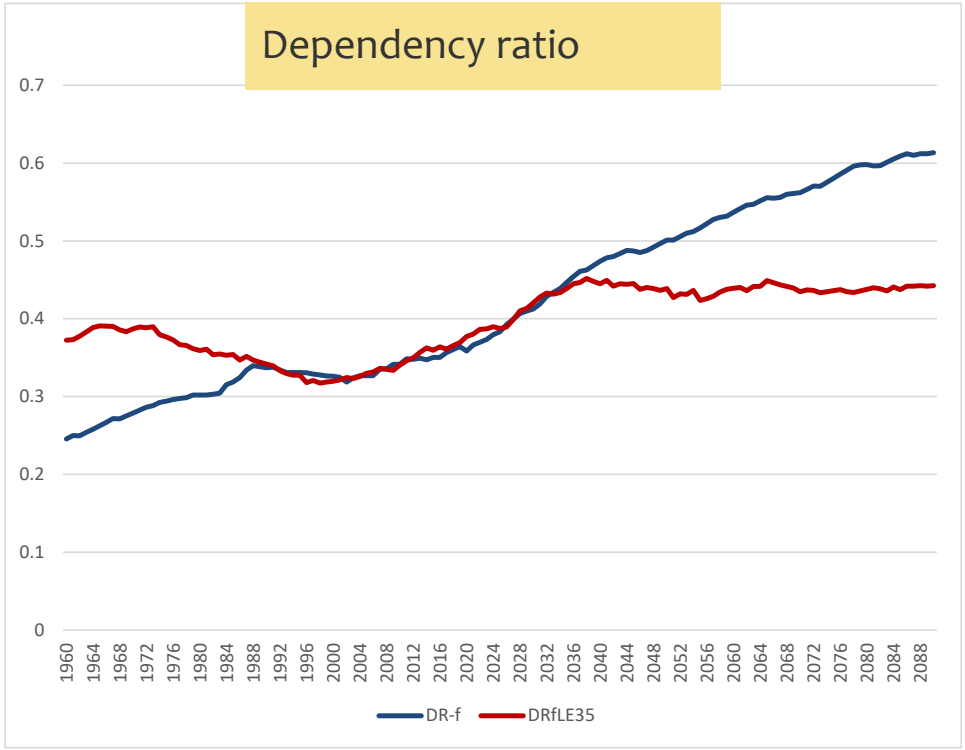
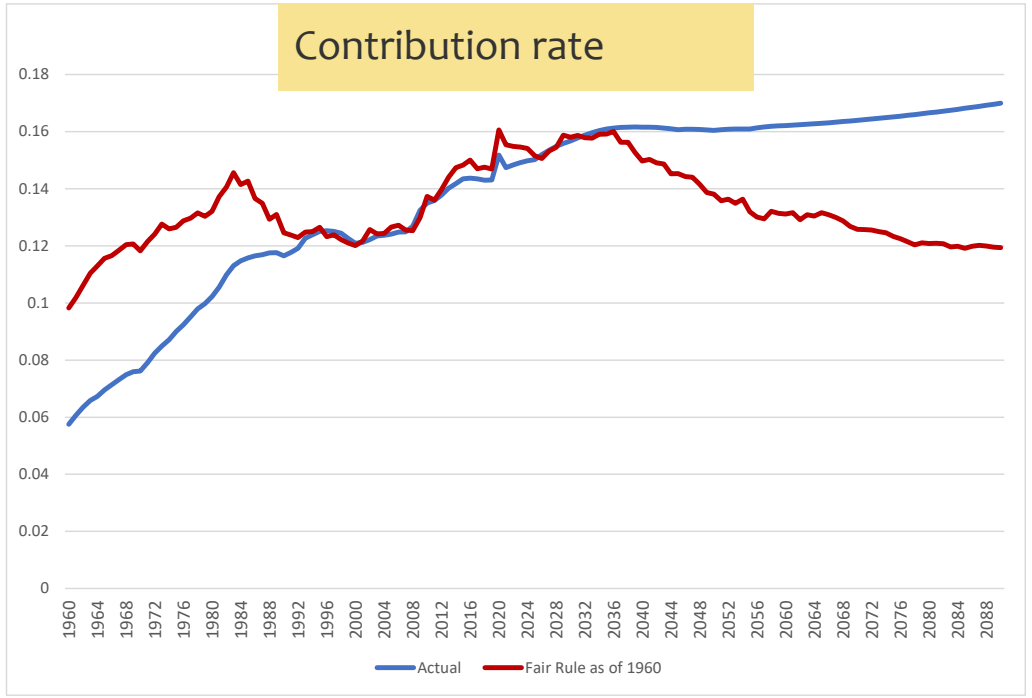
Automatic rule, retirement age and dependency ratio





Actual LE-link

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Table 3: Mean internal rate of return with constant GDP per capita

	Cohort:											
	1935	1940	1945	1950	1955	1960	1965	1970	1975	1980	1985	1990
Actual	2.44	2.22	2.02	1.79	1.37	1.15	0.96	0.80	0.66	0.50	0.35	0.24
SRA = f(LE)												
SRA = f(LE) 1960+												

Table 3: Mean internal rate of return with constant GDP per capita

	Cohort:											
	1935	1940	1945	1950	1955	1960	1965	1970	1975	1980	1985	1990
Actual	2.44	2.22	2.02	1.79	1.37	1.15	0.96	0.80	0.66	0.50	0.35	0.24
SRA = f(LE)	1.42	1.46	1.47	1.34	1.19	1.02	0.77	0.52	0.24	-0.04	-0.23	-0.32
SRA = f(LE) 1960+												

Table 3: Mean internal rate of return with constant GDP per capita

	Cohort:											
	1935	1940	1945	1950	1955	1960	1965	1970	1975	1980	1985	1990
Actual	2.44	2.22	2.02	1.79	1.37	1.15	0.96	0.80	0.66	0.50	0.35	0.24
SRA = f(LE)	1.42	1.46	1.47	1.34	1.19	1.02	0.77	0.52	0.24	-0.04	-0.23	-0.32
SRA = f(LE) 1960+	2.44	2.22	2.02	1.79	1.37	1.15	0.85	0.59	0.31	0.01	-0.19	-0.30

Main findings

- Main driver of IRR is **growth rate GDP**

- **Longevity is a gain!**
  - 0.10% pt to 0.3%-pt
  - The gain depends on the settings of the pension plans.

- **Fair Rule:** allocation longevity gain proportional over work period and pension period

- **Fair rule warrants long term sustainability**
  - stable dependency ratios
  - stable contribution

- **Fair rule in post-war period** → reduction of IRRs with on **average 0.5%-point**
  - Windfall gains for first retirees and workers (!)

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Appendix

- We have also calculated the IRR for two cases:
  - the
  - actual course of the re with the fair rule
  - Retirement Age is set so that all cohorts have the same ratio between working period and pension period as the 1960 cohort

FRA is lower in:

H6: Countries with higher dependency ratio

H7: Countries with more generous pension plans

H8: Countries with less funding

Determinants FRA

	Dependent variable:						
	SRA_actual						I(SRA_actual/LE25)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AuM	0.019***					0.019***	0.037***
	(0.002)					(0.002)	(0.005)
LE25		0.265*				-0.072	
		(0.158)				(0.143)	
GDP75			-0.077			0.861***	2.404***
			(0.246)			(0.244)	(0.559)
DR40				0.083**		0.242***	0.315***
				(0.034)		(0.037)	(0.084)
RR75					-0.049***	-0.048***	0.011
					(0.014)	(0.015)	(0.031)
Constant	0.617***	0.500***	0.631***	0.607***	0.647***	0.583***	1.116***
	(0.005)	(0.077)	(0.009)	(0.010)	(0.007)	(0.073)	(0.035)
Observations	216	216	216	216	216	216	216
R2	0.471	0.311	0.302	0.321	0.340	0.568	0.613
Adjusted R2	0.439	0.270	0.260	0.281	0.301	0.533	0.584
Residual Std. Error	0.019 (df = 203)	0.022 (df = 203)	0.022 (df = 203)	0.022 (df = 203)	0.022 (df = 203)	0.018 (df = 199)	0.041 (df = 200)
F Statistic	15.043*** (df = 12; 203)	7.628*** (df = 12; 203)	7.305*** (df = 12; 203)	8.008*** (df = 12; 203)	8.703*** (df = 12; 203)	16.356*** (df = 16; 199)	21.110*** (df = 15; 200)
Note:							*p<0.1; **p<0.05; ***p<0.01

FRA is lower in:

X H6: Countries with higher dependency ratio

0 H7: Countries with more generous pension plans

V H8: Countries with less funding

What we do in the paper?

Empirical analysis:

- We calculate for a sample of 17 OECD countries for cohorts born in 1935-1990 the return they (will) get from the public pension plan

- We split up the return to its components,
  - In particular longevity related variables

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What we do in the paper?

Analytical model:

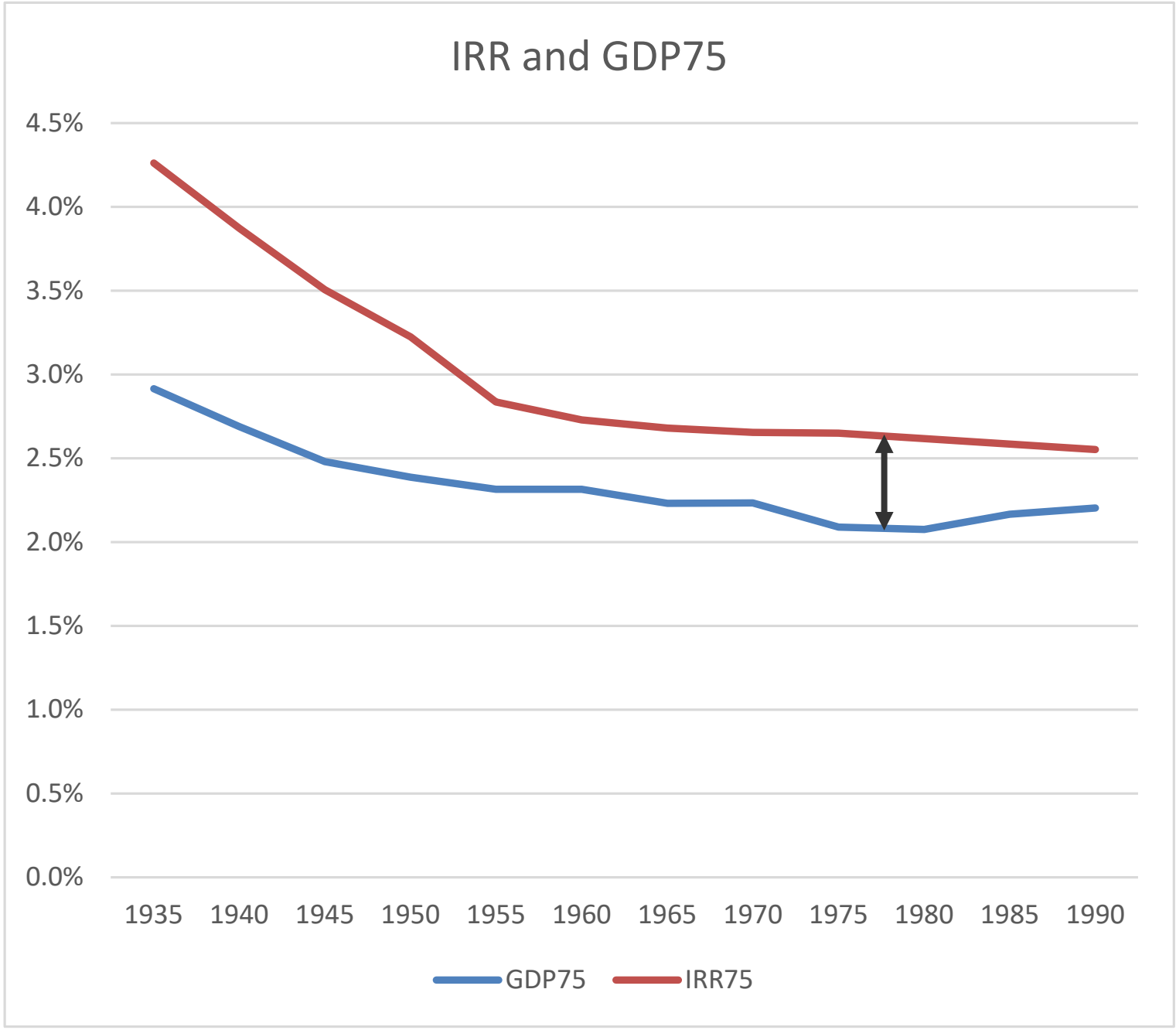
- Derivation of OLG model with stable growth rates for population, wages and life expectancy to show:
  - R_paygo = g_GDP + γ*g_LE
  - The term 'γ' is defined by settings of public pension plan, in particular the retirement age.
    Outcome of **policy choices**
  - 'γ' =1 Fixed Retirement age
  - 'γ' =0 Retirement age increases with growth LE

Empirical analysis:

- We calculate for a sample of 17 OECD countries for cohorts born in 1935-1990 the return they (will) get from the public pension plan
- We split up the return to its components,
  - In particular longevity related variables

H1: IRRs > g_GDP because of longevity gain

H2: IRR is higher for countries with a higher ‘a’ (pension period / LE 25)



1 g_LE

2 Low retirement age

```
==========================================================================================================
==
                                                    Dependent variable:
                    ------------------------------------------------------------------------------------
--
                                                           IRR75
                             (1)                    (2)                    (3)                    (4)
----------------------------------------------------------------------------------------------------------
--
g_GDP75                       1.043***
                             (0.057)

g_LE25

g_RA

Pension period/LE25

Constant                     0.012***
                             (0.002)

------------------------------------------
--
Observations                  216
Time Fixed Effects             Y
R2                           0.740
Adjusted R2                  0.725
Residual Std. Error     0.005 (df = 203)
F Statistic         48.119*** (df = 12; 203)
200)
==========================================================================================================
==
Note:                                                                        *p<0.1; **p<0.05;
***p<0.01
```

	Dependent variable:			
	IRR75			
	(1)	(2)	(3)	(4)
g_GDP75	1.043***			
	(0.057)			
g_LE25				
g_RA				
Pension period/LE25				
Constant	0.012***			
	(0.002)			
Observations	216			
Time Fixed Effects	Y			
R2	0.740			
Adjusted R2	0.725			
Residual Std. Error	0.005 (df = 203)			
F Statistic	48.119*** (df = 12; 203)			

200)

Note: *p<0.1; **p<0.05; ***p<0.01

216 observations = 18 countries (17 + 1) x 12 cohorts

Cohorts: born in 1935, 1940……., 1985, 1990

```
==========================================================================================================
==
                                                    Dependent variable:
                    ------------------------------------------------------------------------------------
--
                                                           IRR75
                             (1)                    (2)                    (3)                    (4)
----------------------------------------------------------------------------------------------------------
--
g_GDP75                       1.043***
                             (0.057)

g_LE25

g_RA

Pension period/LE25

Constant                     0.012***
                             (0.002)

------------------------------------------
--
Observations                  216
Time Fixed Effects             Y
R2                           0.740
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Residual Std. Error     0.005 (df = 203)
F Statistic         48.119*** (df = 12; 203)
200)
==========================================================================================================
==
Note:                                                                        *p<0.1; **p<0.05;
***p<0.01
```

```
==========================================================================================================
==
                                                  Dependent variable:
                     ---------------------------------------------------------------------------------
--
                                                          IRR75
                              (1)                     (2)                     (3)                     (4)
----------------------------------------------------------------------------------------------------------
--
g_GDP75                       1.043***                1.037***
                             (0.057)                 (0.057)

g_LE25                                                0.559**
                                                      (0.282)

g_RA


Pension period/LE25


Constant                     0.012***                0.012***
                             (0.002)                 (0.002)

----------------------------------------------------------------------
--
Observations                  216                     216
Time Fixed Effects             Y                       Y
R2                           0.740                   0.745
Adjusted R2                  0.725                   0.728
Residual Std. Error     0.005 (df = 203)        0.005 (df = 202)
F Statistic         48.119*** (df = 12; 203) 45.363*** (df = 13; 202)
200)
==========================================================================================================
==
Note:                                                                          *p<0.1; **p<0.05;
***p<0.01
```

	Dependent variable:			
	IRR75			
	(1)	(2)	(3)	(4)
g_GDP75	1.043***	1.037***	1.004***	
	(0.057)	(0.057)	(0.058)	
g_LE25		0.559**	0.598**	
		(0.282)	(0.278)	
g_RA			-0.073***	
			(0.028)	
Pension period/LE25				
Constant	0.012***	0.012***	0.013***	
	(0.002)	(0.002)	(0.002)	
Observations	216	216	216	
Time Fixed Effects	Y	Y	Y	
R2	0.740	0.745	0.753	
Adjusted R2	0.725	0.728	0.736	
Residual Std. Error	0.005 (df = 203)	0.005 (df = 202)	0.005 (df = 201)	
F Statistic	48.119*** (df = 12; 203)	45.363*** (df = 13; 202)	43.848*** (df = 14; 201)	
200)				

Note: *p<0.1; **p<0.05; ***p<0.01

	Dependent variable:			
	IRR75			
	(1)	(2)	(3)	(4)
g_GDP75	1.043***	1.037***	1.004***	1.041***
	(0.057)	(0.057)	(0.058)	(0.052)
g_LE25		0.559**	0.598**	0.521**
		(0.282)	(0.278)	(0.250)
g_RA			-0.073***	-0.054**
			(0.028)	(0.025)
Pension period/LE25				0.052***
				(0.007)
Constant	0.012***	0.012***	0.013***	0.001
	(0.002)	(0.002)	(0.002)	(0.003)
Observations	216	216	216	216
Time Fixed Effects	Y	Y	Y	Y
R2	0.740	0.745	0.753	0.803
Adjusted R2	0.725	0.728	0.736	0.788
Residual Std. Error	0.005 (df = 203)	0.005 (df = 202)	0.005 (df = 201)	0.005 (df = 200)
F Statistic	48.119*** (df = 12; 203)	45.363*** (df = 13; 202)	43.848*** (df = 14; 201)	54.211*** (df = 15; 200)

Note: *p<0.1; **p<0.05; ***p<0.01

- H1: “IRRs > Economy growth rate” because of longevity gain

- H2: IRR is higher for countries with a high ‘a’ (pension period / LE 25)