On the possibility and driving forces of secular stagnation

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Motivation

Are OECD countries stuck in a very long period of low economic growth and rock-bottom real interest rates?

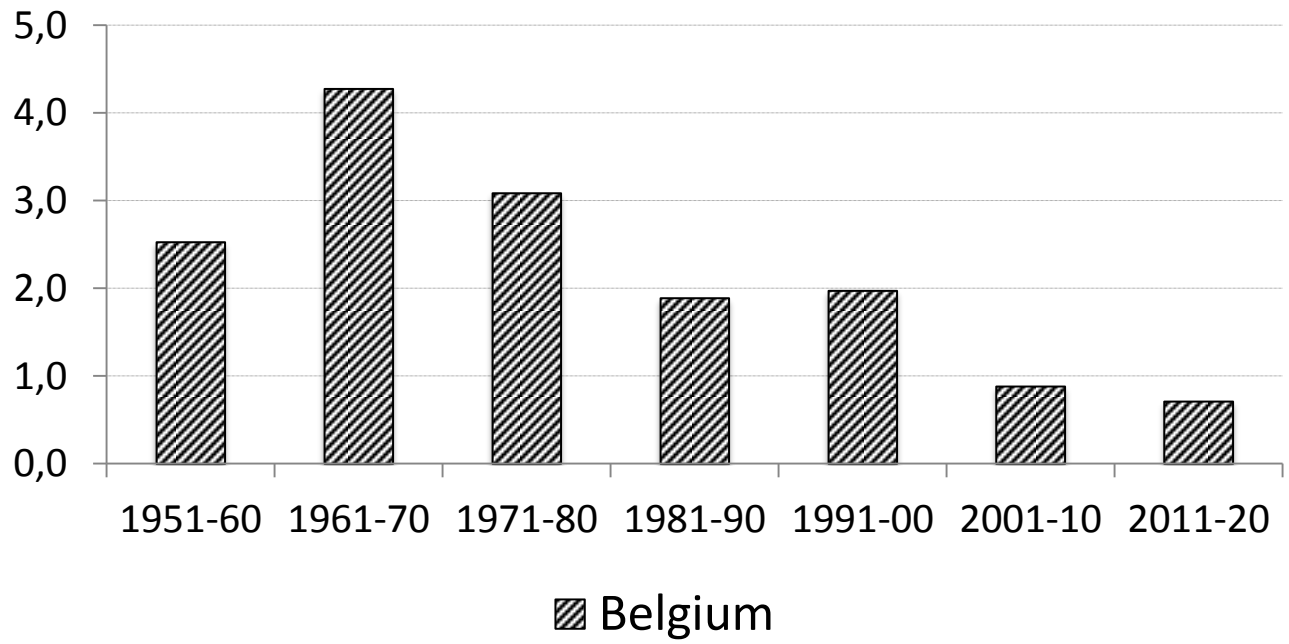
Some economist say yes (e.g. Krugman, 2014; Summers, 2014).

The data for the last decades are also suggestive.

Motivation

Are OECD countries stuck in a very long period of low economic growth and rock-bottom real interest rates?

Figure 1.a. Growth rate of real GDP per capita (annual averages, in %)



Data source: Penn World Tables 8.1. For 2011-2020 Federal Planning Bureau.

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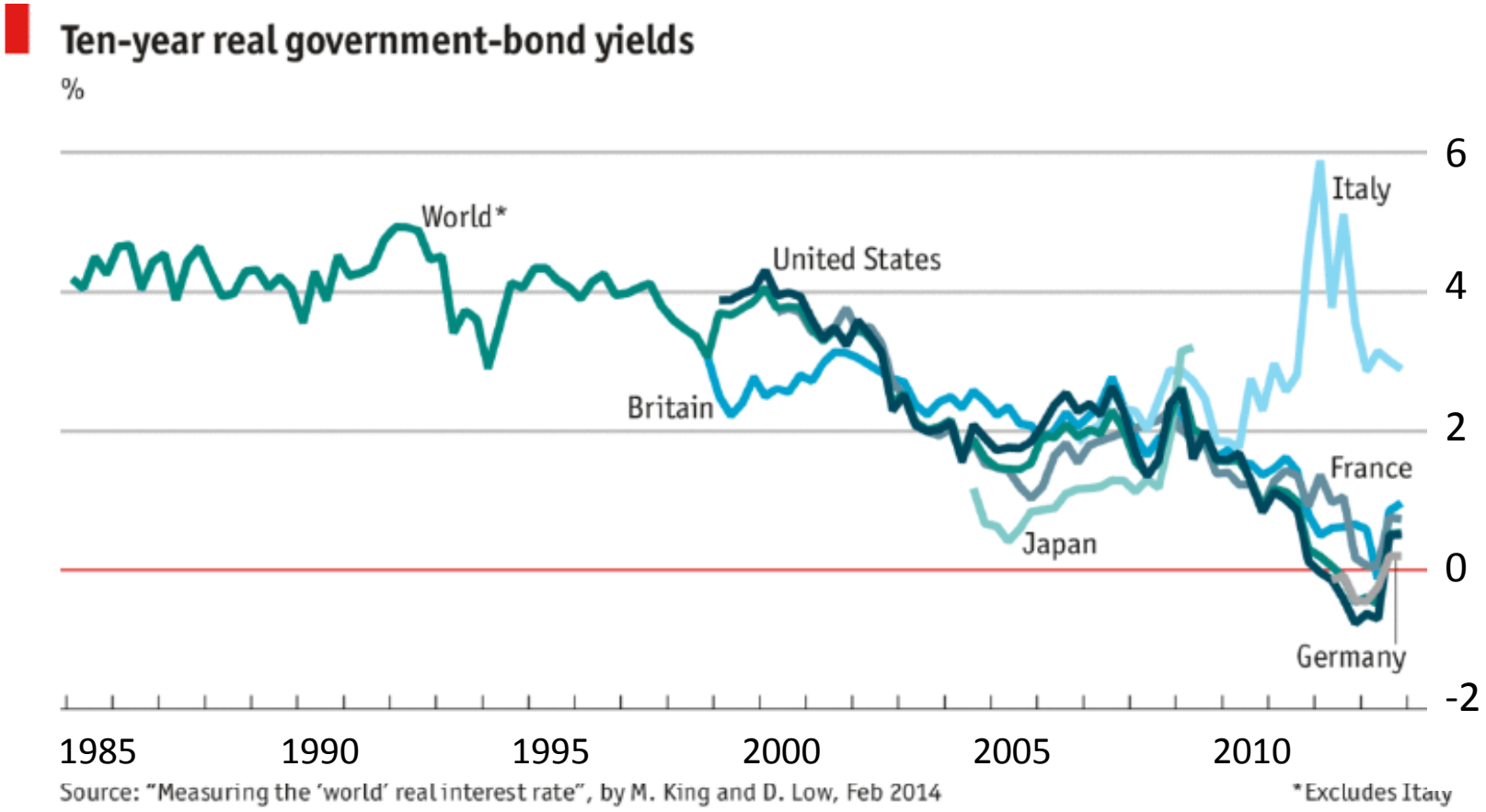
Are OECD countries stuck in a very long period of low economic growth and rock-bottom real interest rates?



Motivation

Are OECD countries stuck in a very long period of low economic growth and rock-bottom real interest rates?

Other economists say no (Goodhart & Erfurth, 2014; Mokyr, 2014; Bernanke, 2015; Rogoff, 2015; …).

A clear opposition in views…

→ **Our research question(s):** *Secular stagnation: could it be possible? What would "secular" actually mean? And what would be the main driving forces?*

Overview of the presentation

0. Motivation
1. Literature : two perspectives on secular stagnation
2. Model
   - Construction
   - Data, calibration and backfitting
3. Model simulations
4. Conclusions

Literature: perspectives on secular stagnation

- **First perspective:** a long lasting period of low potential per capita economic growth

- **Second perspective:** a situation of a persistent negative output gap, i.e. output below potential for a long period

First perspective: A long lasting period of low potential per capita growth.

- Starting from a neoclassical production function,

$$Y_t = K_t^{\alpha}(A_t H_t)^{(1-\alpha)} \qquad 0 < \alpha < 1$$

$H_t = hL_t$ = effective labour (rising in number of workers L, and in workers' ability and human capital (h)

- In the long run per capita growth is equal to the rate of technical progress $\frac{\Delta A_t}{A_{t-1}} = x_t$.

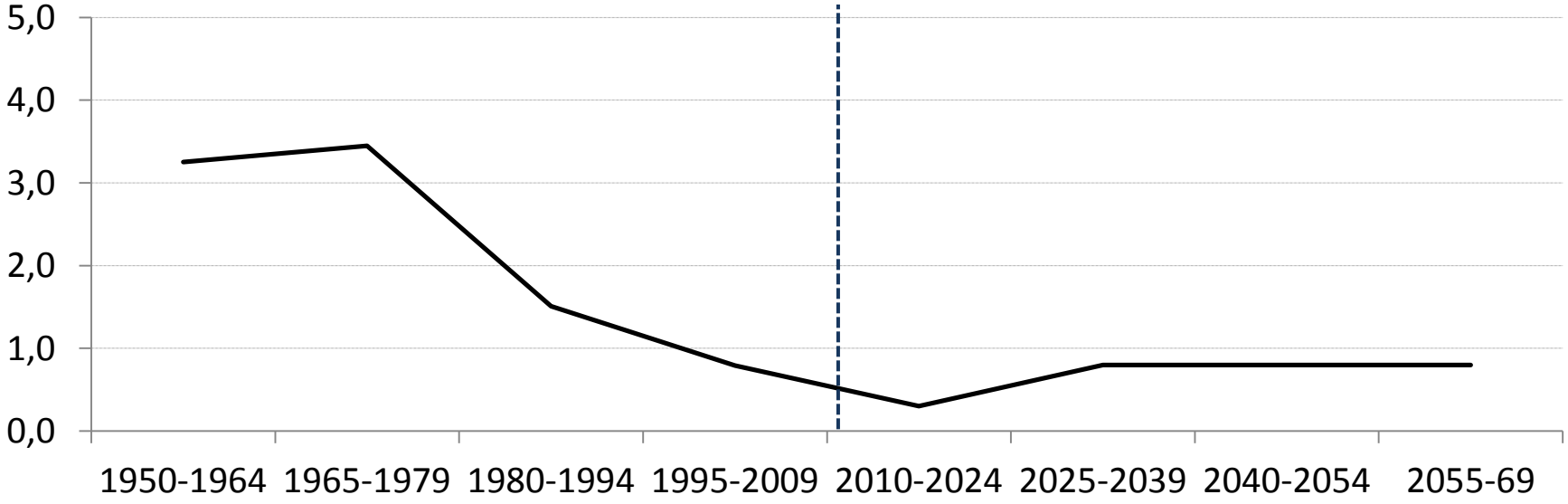
Optimists and 'realists'. Our approach...

Note: TFP-growth $= (1\text{-}\alpha)^{*}x$

First perspective: A long lasting period of low potential per capita growth.

Average annual rate of technical change (x) in %

1950-2010 : actual data (PWT)
2010-... : our projection



First perspective: A long lasting period of low potential per capita growth.

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$$Y_t = K_t^{\alpha}(A_t H_t)^{(1-\alpha)} \qquad 0 < \alpha < 1$$

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- In the long run, per capita growth equals the rate of technical progress.

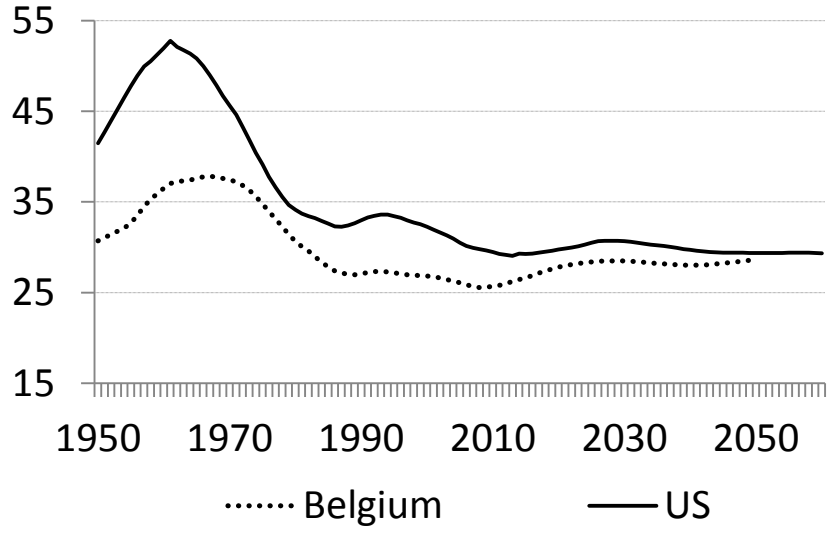
- In the intermediate periode, per capita growth may be different:
  - demography: lower per capita growth when total population grows faster than population at working age (= rising dependency)
  - demographic change may affect investment rates and labour supply (employment) of those at working age: hL_t, K_t may change.

First perspective: A long lasting period of low potential per capita growth.

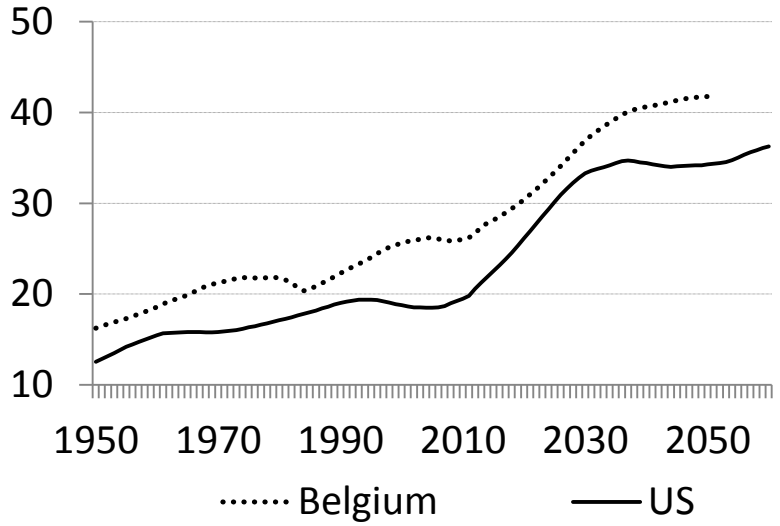
Demographic changes

Dependency ratios (1950-2060, in %)

a. Youth dependency ratio



b. Old age dependency ratio

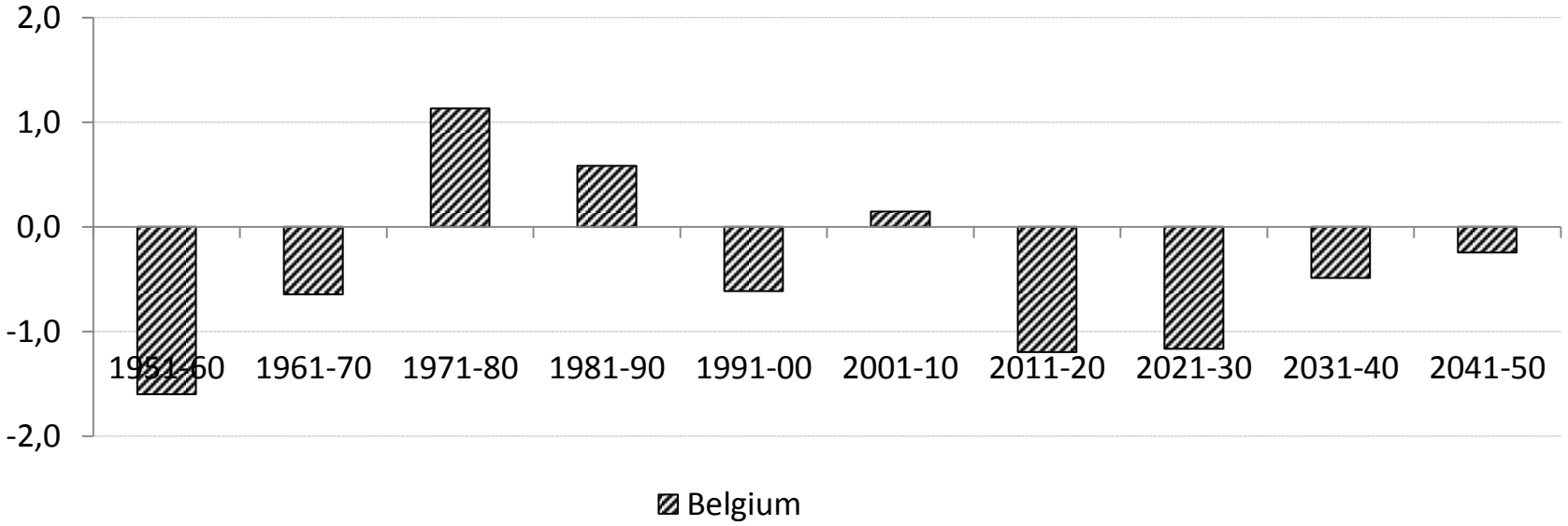


Data source: OECD Labour Force Statistics

First perspective: A long lasting period of low potential per capita growth.

Demographic changes

Average annual growth rate of population at working age relative to total population.

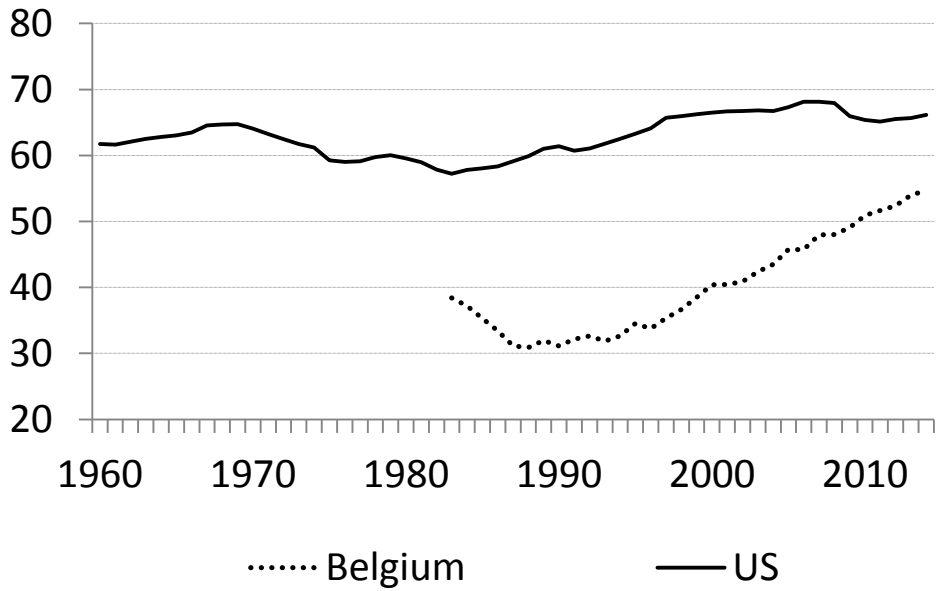


Data source: OECD Labour Force Statistics

First perspective: A long lasting period of low potential per capita growth.

Changes in employment rate

Employment rate among individuals aged 50 and older (in %)



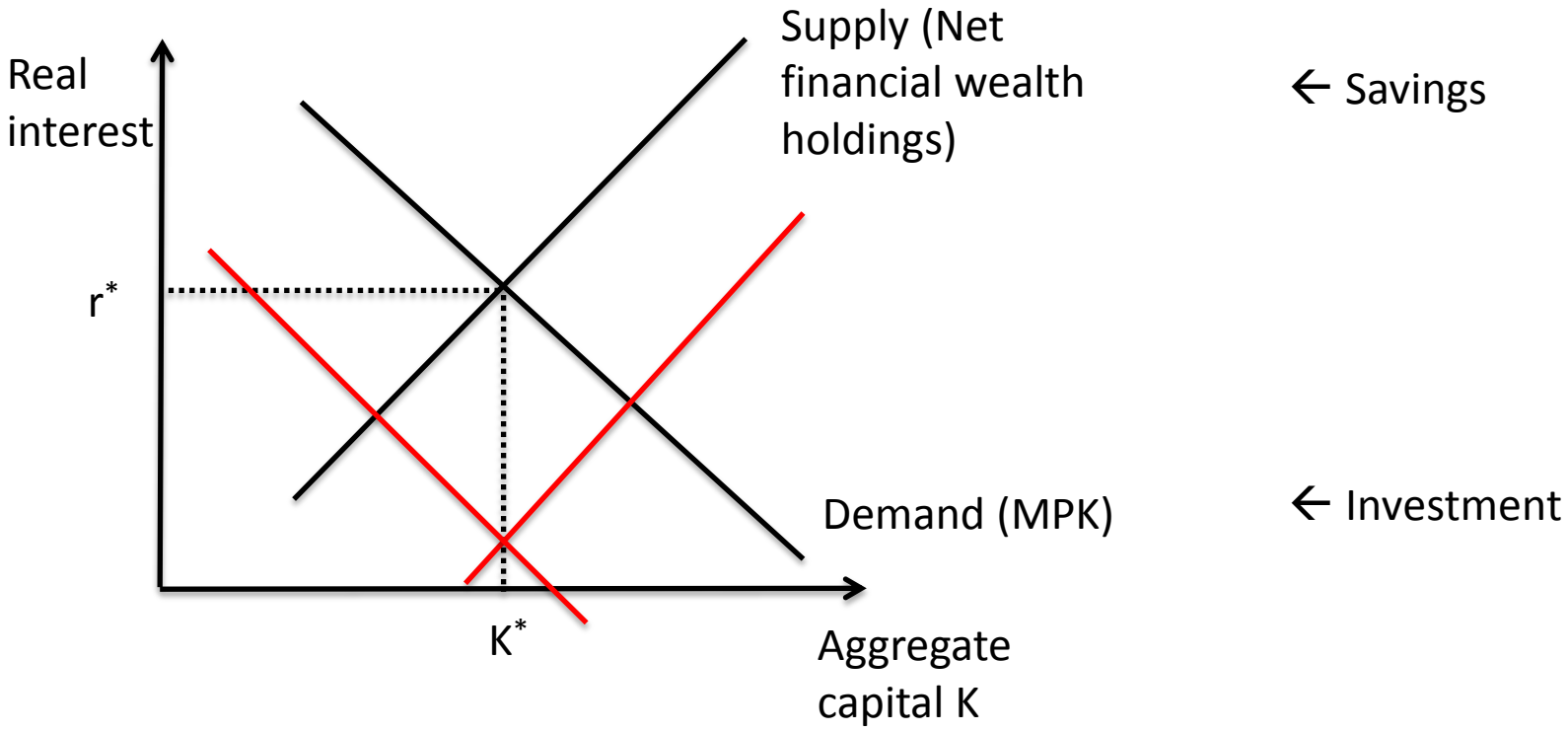
Data source: OECD Labour Force Statistics.

Second perspective: A long lasting period of a negative output gap (output below potential, cf. Summers, 2014)

Persistent negative output gaps, due to:

- Low and/or falling macroeconomic propensity to invest
- High and/or rising macroeconomic propensity to save
- downward rigidity in the real interest rate

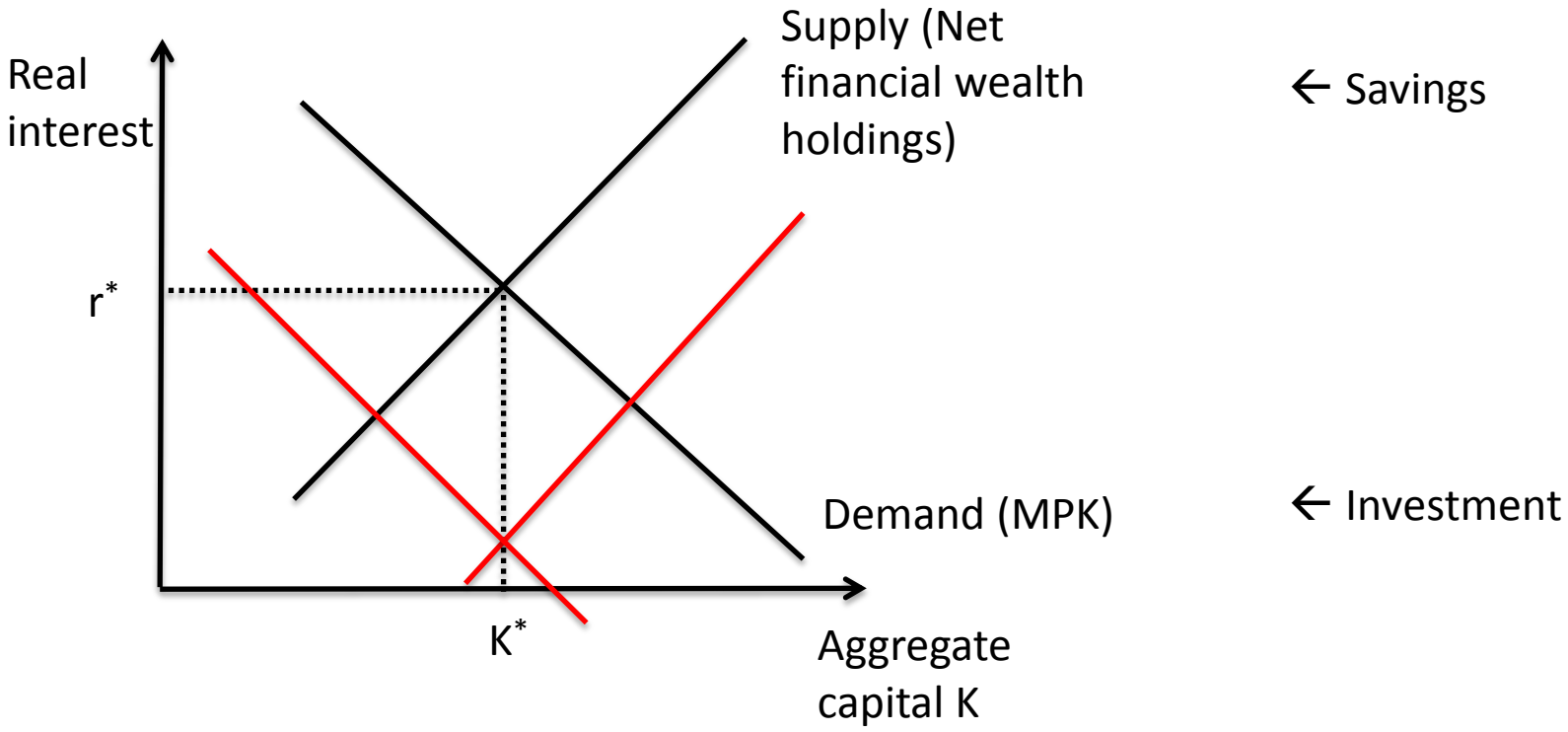
Second perspective: A long lasting period of a negative output gap (output below potential, cf. Summers, 2014)



Explanation for these shifts?

Demography → fall in population at working age → fall in MPK and return to investment
→ rising longevity → middle aged and older people save more
→ over time : growing fraction of retired old versus active people → rising share of dissavers → negative effect on aggregate savings

Second perspective: A long lasting period of a negative output gap (output below potential, cf. Summers, 2014)

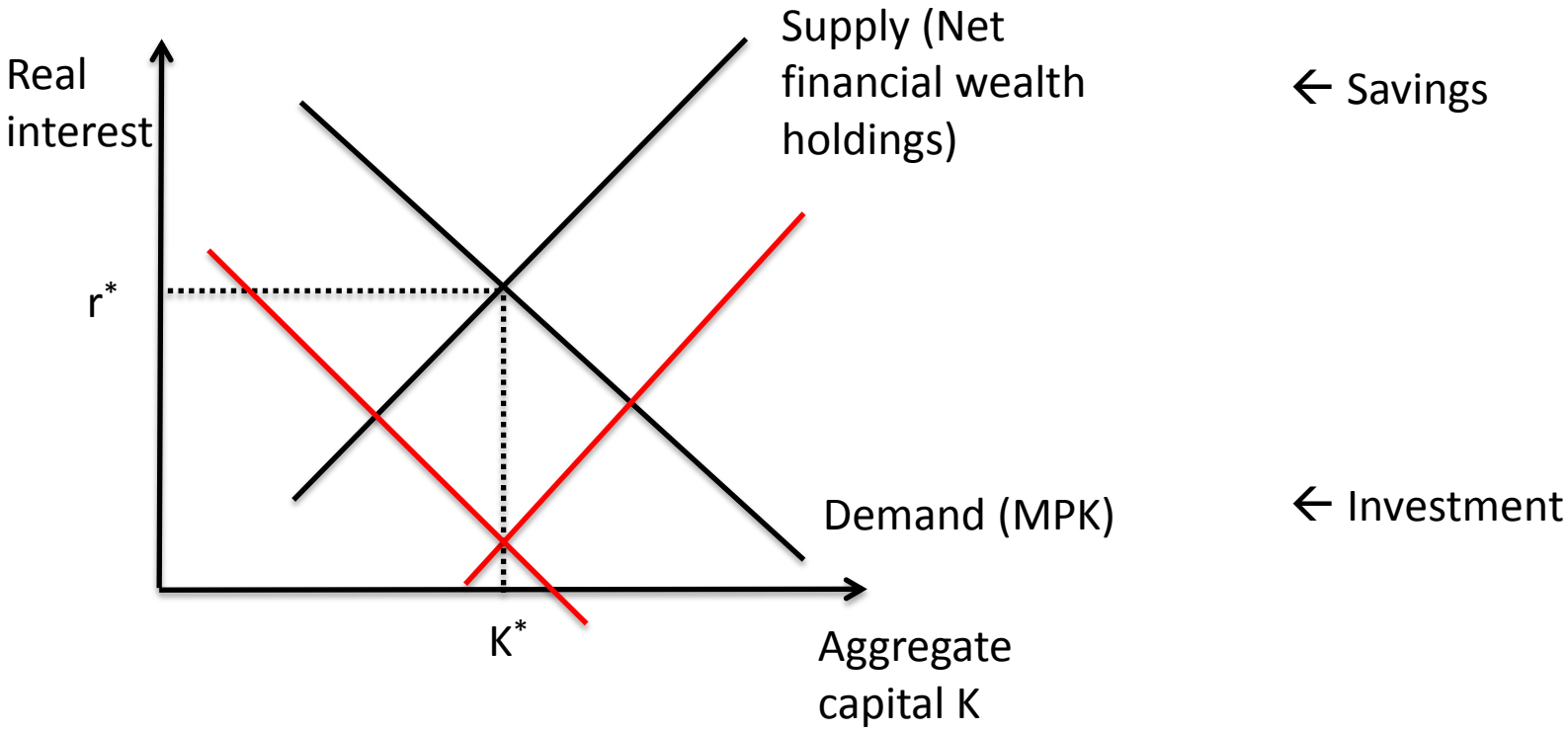


Explanation for these shifts?

Rising inequality → larger fraction of income and wealth in hands of people with high propensity to save

→ if borrowing constraints : more 'able but poor' young individuals may be constrained in investing in education → negative for labour at older age and negative for MPK and return to investment

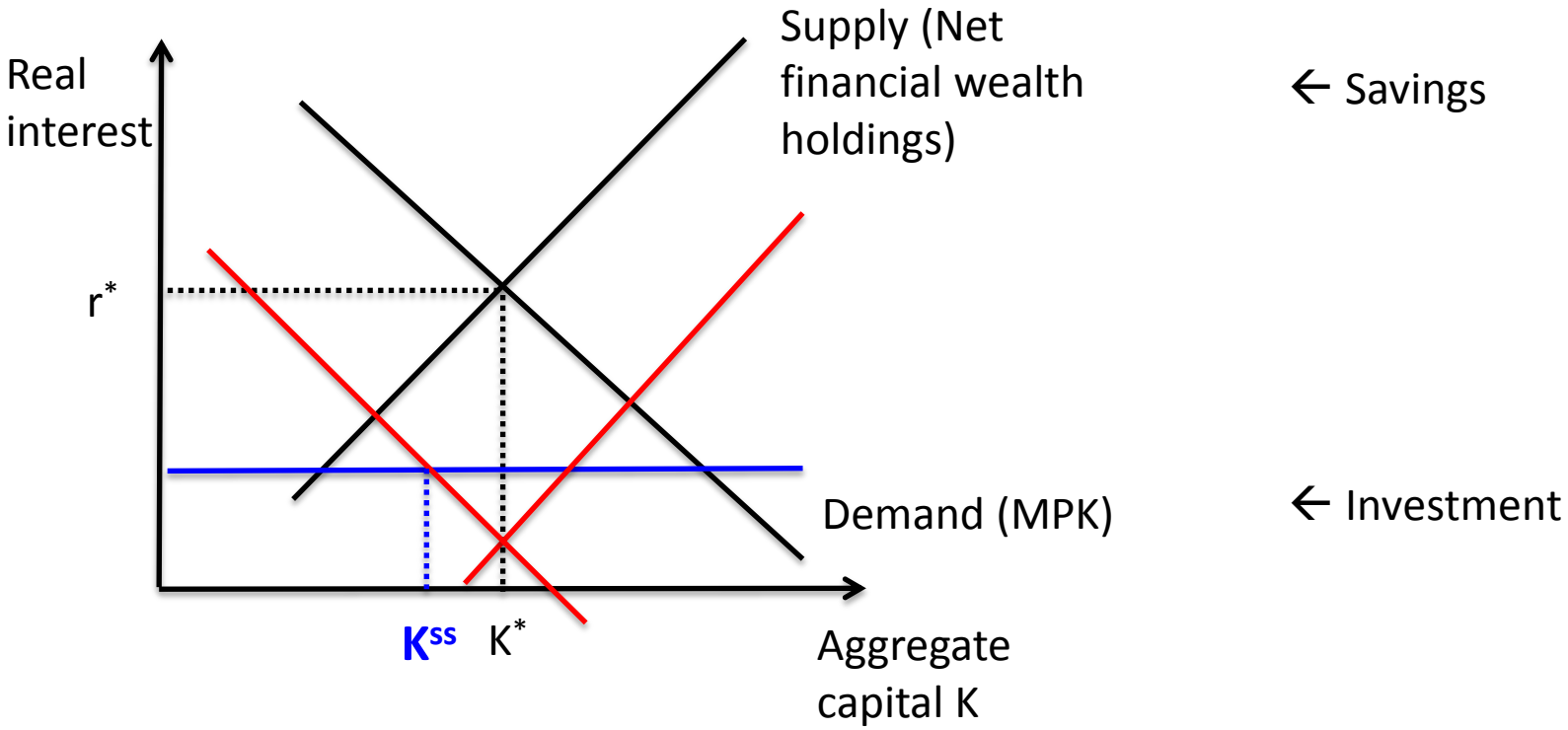
Second perspective: A long lasting period of a negative output gap (output below potential, cf. Summers, 2014)



Explanation for these shifts?

Tightening of borrowing constraints since financial crisis → young generation can borrow less. At middle age, they will have to repay less accumulated debt, and so save more...

Second perspective: A long lasting period of a negative output gap (output below potential, cf. Summers, 2014)



No problem if the interest rate is fully flexible.
But if it is not fully flexible → disinvestment, reduced demand...

Why a bottom to the interest rate?

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The model and basic assumptions

0) Basics

An overlapping-generations (OLG) model

- 6 generations: (10-24, 25-39, 40-54, 55-69, 70-84, 85-99)
- Heterogeneous individuals
  - not only by age, also by ability (3 types: low, medium, high)
  - differences in ability and (inherited) wealth → inequality
  - no social mobility
- In each period *t*, N_1^t new young people enter the model.
- They are sure to become 55, but then face the probability to die (probability rising in age).
- Over time the probability to live at older age has increased.

The model and basic assumptions

1) Demography

- Demographic changes reflected by changes in N_1^t and π_j^t

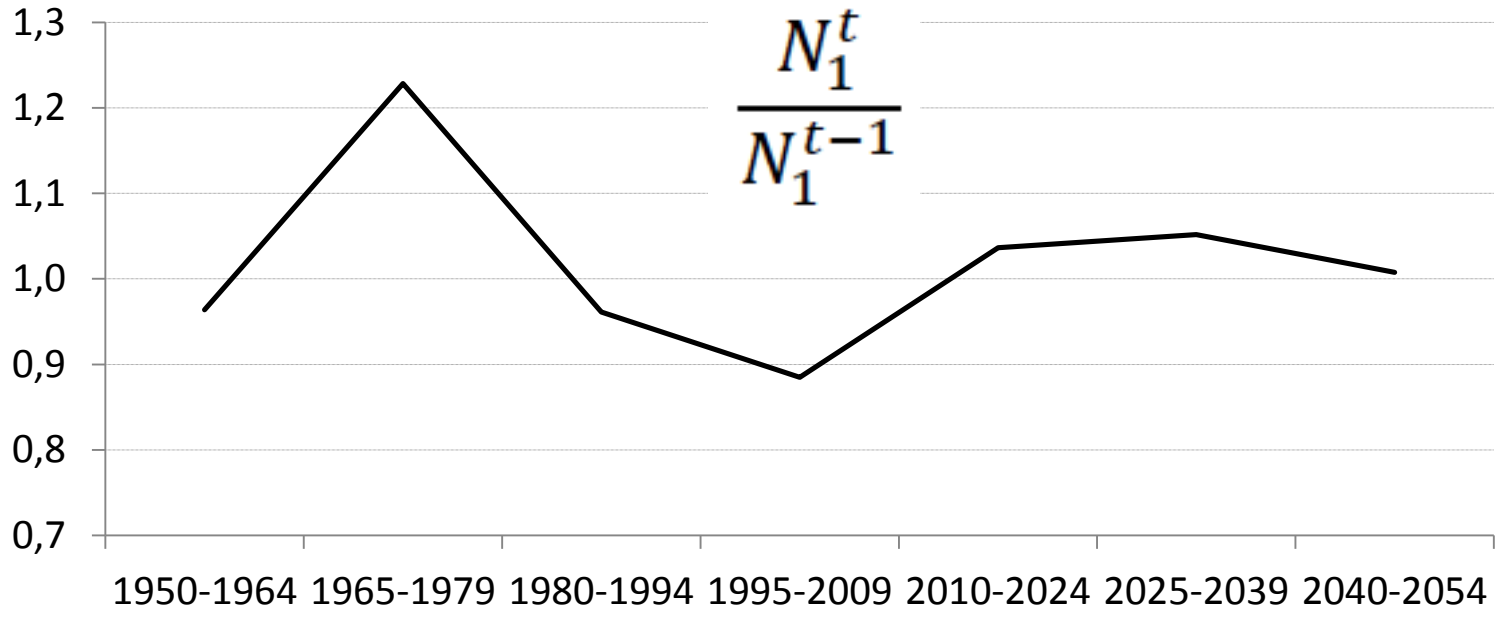
  - N_1^t => "fertility" rate n_t. $N_1^t = n_t N_1^{t-1}$

  - π_j^t is a function of survival probabilities => longevity

$$N_j^t = \pi_j^t N_1^t$$

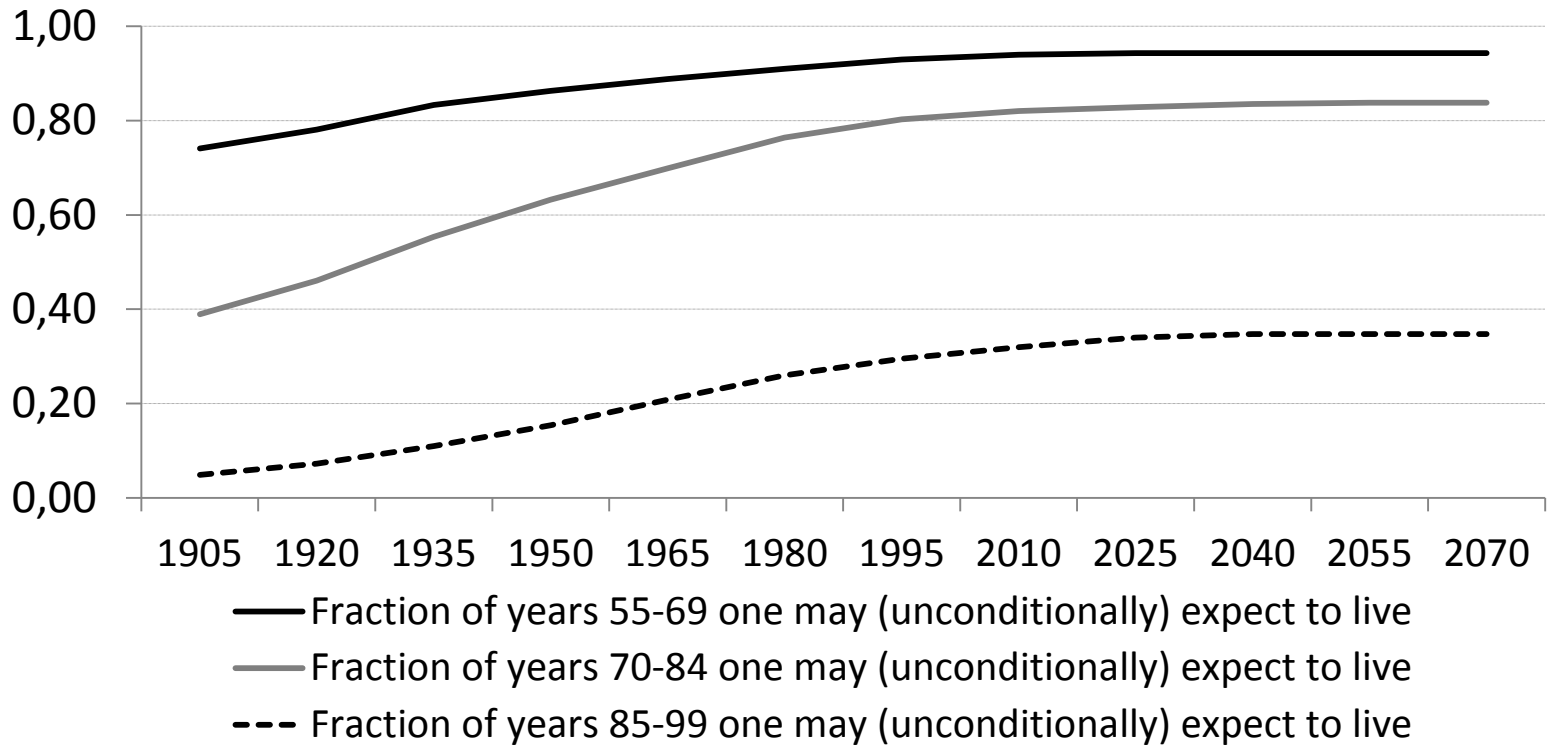
$\pi_j^t = 1$ for $j = 2, 3$ and $\pi_6^t < \pi_5^t < \pi_4^t < 1.$

- Demography in the model (exogenous force)
  - Evolution of the youngest cohort (“fertility”)



Data : Federal Planning Bureau, "Perspectives de population 2012-2060”

- Demography in the model (exogenous force)
  - Probability to live at higher age (55-69, 70-84 and 85-99). Longevity



The model and basic assumptions

2a) Households

- Each individual of ability type θ, born at time t maximizes

$$U_\theta^t = \ln\left(c_{1,\theta}^t + z_{3,\theta}^{t-2}\right) + \beta \ln c_{2,\theta}^t + \beta^2\left(\ln c_{3,\theta}^t + b_1 \ln z_{3,\theta}^t\right)$$
$$+ \beta^3 \pi_4^t \left(\ln c_{4,\theta}^t + v \frac{\left(1 - R_\theta^t\right)^{1-\rho}}{1-\rho} \right) + \beta^4 \pi_5^t \left(\ln c_{5,\theta}^t + b_2 \ln beq_{5,\theta}^{int,t}\right) + \beta^5 \pi_6^t \ln c_{6,\theta}^t$$

with $0 < \beta < 1$ and $b_1, b_2, v, \rho > 0$ $(\rho \neq 1)$.

- Bequests and transfers: ‘sense of duty’ vs. ‘joy of giving’
- Transfers => children’s consumption
- Role of the optimal retirement age

The model and basic assumptions

2b) Individuals: planned life-cycle, time allocation, budget

10 — 25 — 40 — 55 — 70 — 85 — 100

Period	t	$t+1$	$t+2$	$t+3$	$t+4$	$t+5$
Work	$1-\bar{e}-e_\theta^t$	1	1	R_θ^t	0	0
Study	$\bar{e}+e_\theta^t$	0	0	0	0	0
Leisure time	0	0	0	$(1-R_\theta^t)$	1	1
Consume	$c_{1,\theta}^t$	$c_{2,\theta}^t$	$c_{3,\theta}^t$	$c_{4,\theta}^t$	$c_{5,\theta}^t$	$c_{6,\theta}^t$
Transfer to children	0	0	$z_{3,\theta}^t$	0	$beq_{5,\theta}^{int,t}$	0

Note: $e_L^t = 0$.

Accumulation of net wealth vs borrowing / bequests / taxes and pensions / inequality (differences in ability, transfers and bequests)

The model and basic assumptions

2c) Households: human capital

$$\tilde{h}^t_{1,\theta} = \epsilon_\theta h_0 \qquad \forall\, \theta = H, M, \text{ with } 0 < \epsilon_L < \epsilon_M < \epsilon_H = 1$$

$$\tilde{h}^t_{2,\theta} = \tilde{h}^t_{1,\theta}[1 + \phi_\theta (e^t_\theta)^\sigma] \qquad \forall \theta = M, H, \text{ with } 0 < \sigma \leq 1, \phi_\theta > 0$$

$$\tilde{h}^t_{2,L} = \tilde{h}^t_{1,L}$$

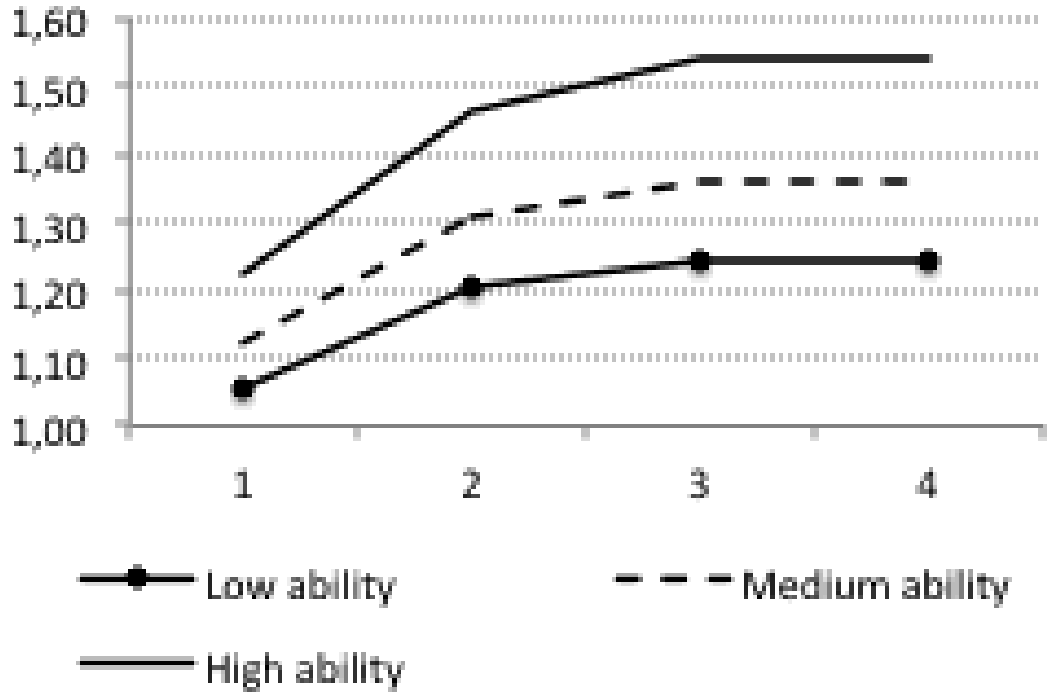
$$\tilde{h}^t_{j,\theta} = \tilde{h}^t_{2,\theta} \qquad \forall j = 3,4 \text{ and } \forall \theta = L, M, H$$

$$h^t_{j,\theta} = \tilde{h}^t_{j,\theta} \xi_{j,\theta} \qquad \forall j = 1,2,3,4 \text{ and } \forall \theta = L, M, H$$

- e_θ^t is the time spent in higher education (M,H)
- a skill-dependent age-productivity profile

Inequality both within and between generations (ability)!

Age-productivity profile (exogenous) $\xi_{j,\theta}$



The model and basic assumptions

2d) Households: budget constraints

10-24 j

$$(1+\tau_c)c^t_{1,\theta} + \Omega^t_{1,\theta} = w_{\theta,t}h^t_{1,\theta}(1-\bar{e}-e^t_\theta)$$

25-39 j

$$(1+\tau_c)c^t_{2,\theta} + \Omega^t_{2,\theta} = w_{\theta,t+1}h^t_{2,\theta} + (1+r_{t+1})\Omega^t_{1,\theta} + \frac{N_1^{t-2}(1-\pi_4^{t-2})}{N_1^t}\, beq^{acc,t-2}_{4,\theta}$$

40-54 j

$$(1+\tau_c)\left(c^t_{3,\theta} + \frac{N_1^{t+2}}{N_1^t} z^t_{3,\theta}\right) + \Omega^t_{3,\theta} = w_{\theta,t+2}h^t_{3,\theta} + (1+r_{t+2})\Omega^t_{2,\theta} + \pi_5^{t-2} beq^{int,t-2}_{5,\theta} + \frac{N_1^{t-2}(\pi_4^{t-2}-\pi_5^{t-2})}{N_1^t} beq^{acc,t-2}_{5,\theta}$$

55-69 j

$$(1+\tau_c)c^t_{4,\theta} + \Omega^t_{4,\theta} = w_{\theta,t+3}h^t_{4,\theta}R^t_\theta + (1+r_{t+3})\Omega^t_{3,\theta} + (1-R^t_\theta)p^t_{4,\theta} + \frac{N_1^{t-2}(\pi_5^{t-2}-\pi_6^{t-2})}{N_1^t\pi_4^t} beq^{acc,t-2}_{6,\theta}$$

70-84 j

$$(1+\tau_c)c^t_{5,\theta} + \frac{N_1^{t+2}}{N_1^t} beq^{int,t}_{5,\theta} + \Omega^t_{5,\theta} = (1+r_{t+4})\Omega^t_{4,\theta} + p^t_{5,\theta}$$

85-99 j

$$(1+\tau_c)c^t_{6,\theta} = (1+r_{t+5})\Omega^t_{5,\theta} + p^t_{6,\theta}$$

The model and basic assumptions

2e) Households: optimisation

Consumption (six periods) versus savings

Education at tertiary level (for H and M, period 1)

Transfer of goods to children when they are young (period 3)

Retirement age (period 4)

Intentional bequest (period 5)

The model and basic assumptions

3) Firms

$$Y_t = K_t^{\alpha}(A_t H_t)^{1-\alpha}$$

$$A_t = (1 + x_t)A_{t-1}$$

$$H_t = \left(\eta_L H_{L,t}^{1-\frac{1}{s}} + \eta_M H_{M,t}^{1-\frac{1}{s}} + \eta_H H_{H,t}^{1-\frac{1}{s}}\right)^{\frac{s}{s-1}}$$

- Firms optimally choose K and three ability types of labour:

$$r_t = \alpha\left(\frac{A_t H_t}{K_t}\right)^{1-\alpha} - \delta$$

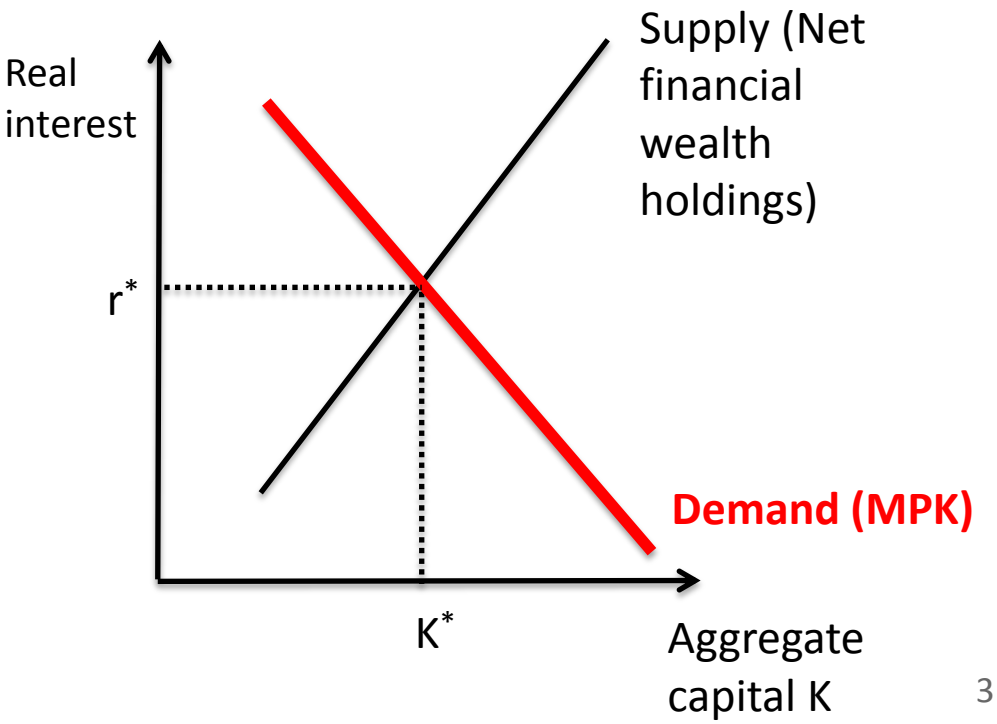
$$(1-\alpha)A_t^{1-\alpha}\left(\frac{K_t}{H_t}\right)^{\alpha}\eta_\theta\left(\frac{H_t}{H_{\theta,t}}\right)^{\frac{1}{s}} = \frac{w_{\theta,t}}{1-\tau_w} \quad \forall\theta = H, M, L$$

The model and basic assumptions

3) Firms

- Firms optimally choose K and three ability types of labour:

$$r_t = \alpha \left(\frac{A_t H_t}{K_t}\right)^{1-\alpha} - \delta$$

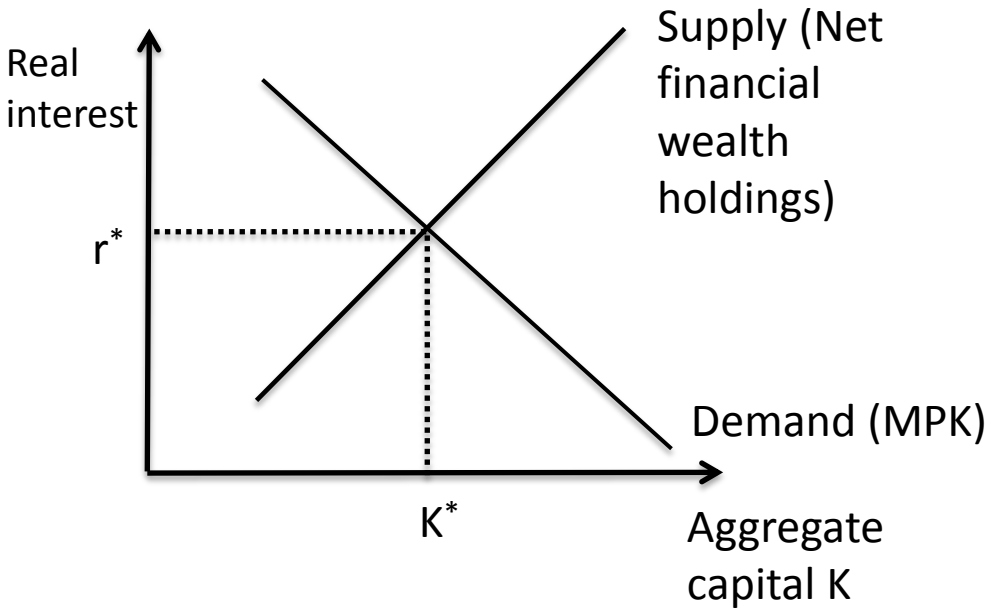


The model and basic assumptions

4) Government $PP_t + G_t = T_{c,t} + T_{w,t}$

5) To close the model

- The (flexible) real interest rate will be determined by:



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Data, calibration and backfitting

- We basically use Belgian data for 1995-2007 to calibrate a set of key parameters in the model…

  See next three slides.

- We impose the time path of exogenous variables
  - the rate of technical progress
  - two demographic variables: “fertility”, longevity
  - a set of policy parameters (labour income tax rate, consumption tax rate, pension replacement rates)

Data and calibration

Technical parameters

- Capital share of total output = 0.375
- Elasticity of substitution between different ability types of labour = 1.5
- $\eta_L = 0.19$, $\eta_M = 0.33$, $\eta_H = 0.48$

$$H_t = \left(\eta_L H_{L,t}^{1-\frac{1}{s}} + \eta_M H_{M,t}^{1-\frac{1}{s}} + \eta_H H_{H,t}^{1-\frac{1}{s}} \right)^{\frac{s}{s-1}}$$

- Yearly depreciation rate of physical capital: time varying from 4,25% in 1960 to 10,1% in 2010 onwards – See Kamps (IMF, 2002)

Data and calibration

Effective human capital

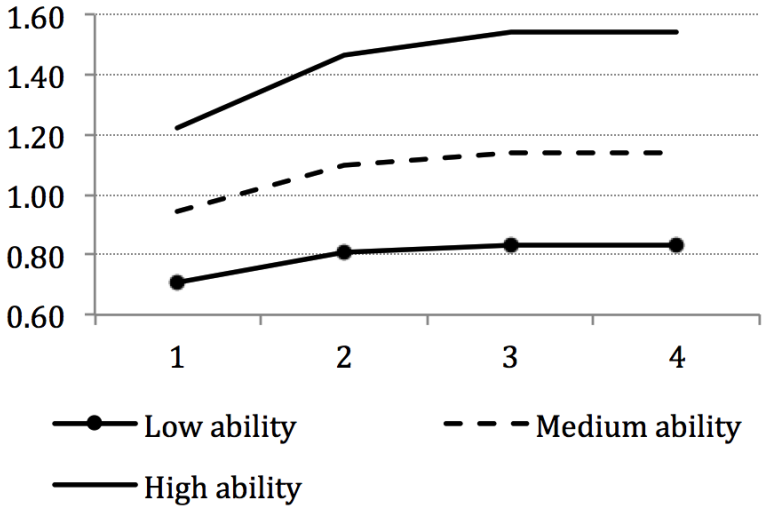
$$\tilde{h}^t_{1,\theta} = \epsilon_\theta h_0 \quad \forall\, \theta = H, M, L \quad \text{with } 0 < \epsilon_L < \epsilon_M < \epsilon_H = 1$$

$$\tilde{h}^t_{2,\theta} = \tilde{h}^t_{1,\theta}[1 + \phi_\theta (e^t_\theta)^\sigma] \quad \forall \theta = M, H, \text{with } 0 < \sigma \leq 1, \phi_\theta > 0$$

- $\varepsilon_H = 1$, $\varepsilon_M = 0.84$, $\varepsilon_L = 0.67$ (Pisa)
- $\sigma = 0.3$ (literature)
- $\varphi_M = 0.89$, $\varphi_H = 1.20$

  (calibrated to match true aggregate participation in tertiary education)

- Age-productivity profile



Data and calibration

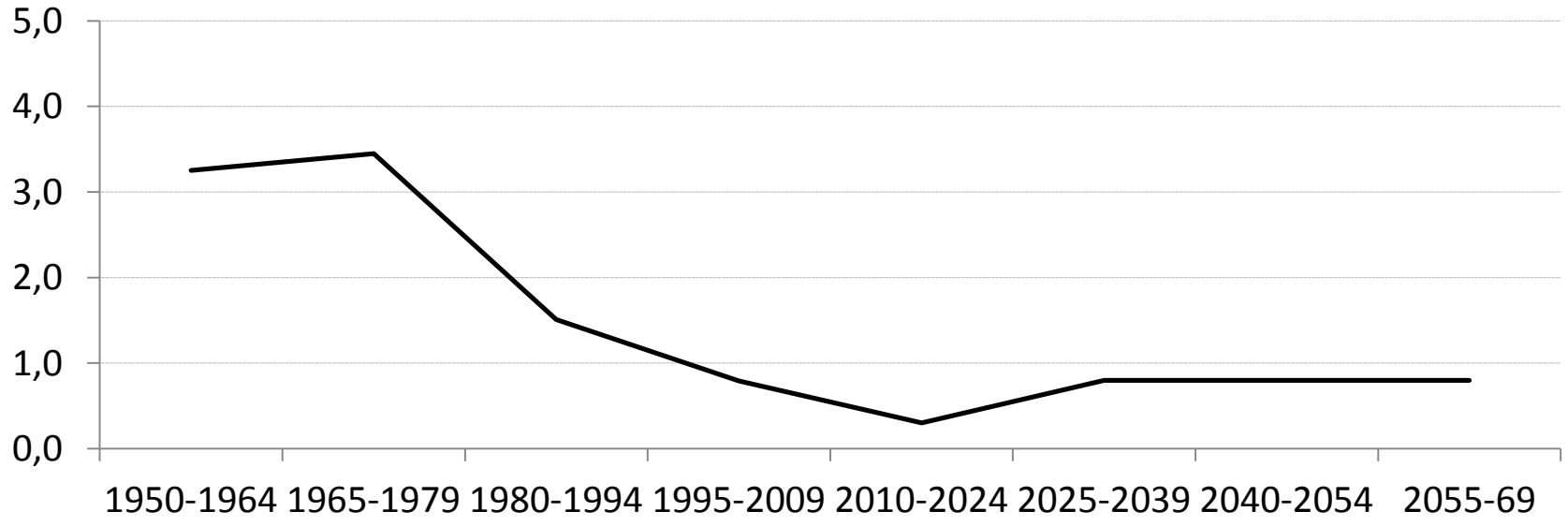
Preference parameters

- v = 0.45 (relative utility value of leisure vs. consumption in period 4 (calibrated to match observed effective retirement age)
- ρ = 1.5 (1/ρ = elasticity to substitute leisure for labour in period 4)
- b_{1L} = 0.23, b_{1M} = 0.33, b_{1H} = 0.39 (calibrated to match observed expenditures for children as fraction of household cons.)
- b_2 = 0.33 (calibrated to match ratio of bequests / GDP = 10% , Piketty)

Exogenous variables

Average annual rate of technical progress (x) in %

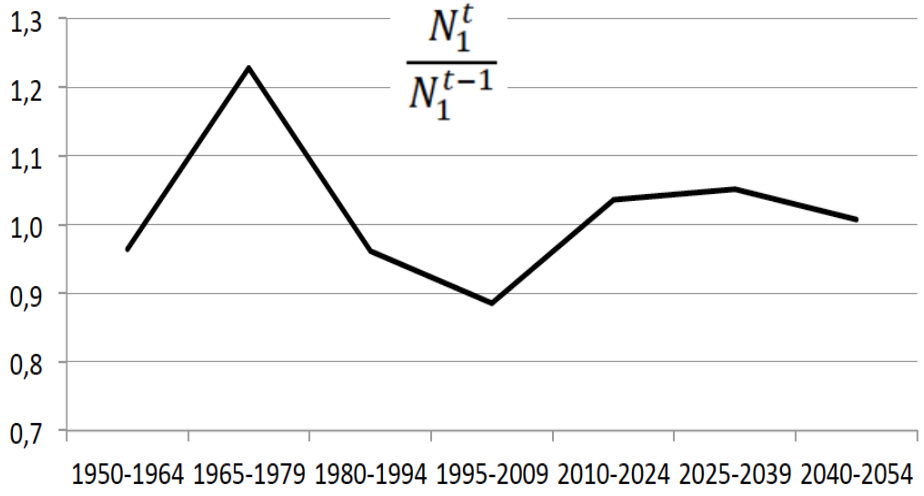
1950-2010 : actual data (PWT)
2010-... Our projection

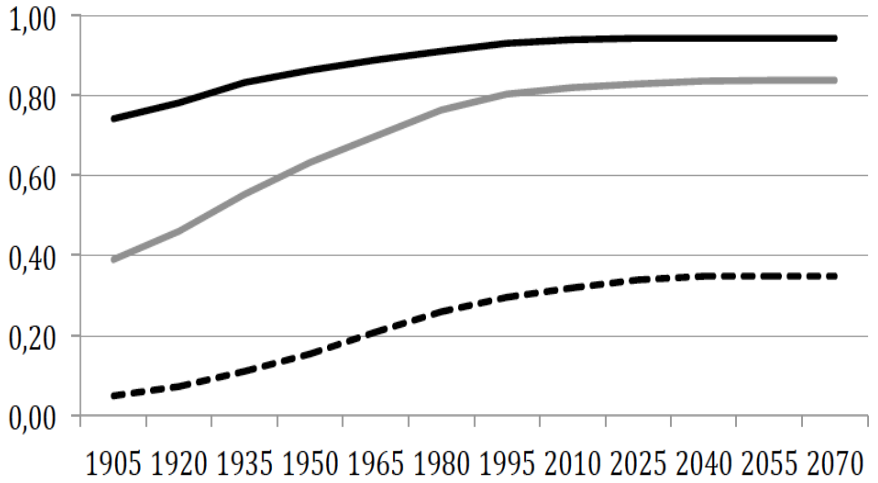


Exogenous variables

- Demography in the model

  - Evolution of the youngest cohort (“fertility”)
  - The probability to live at higher ages



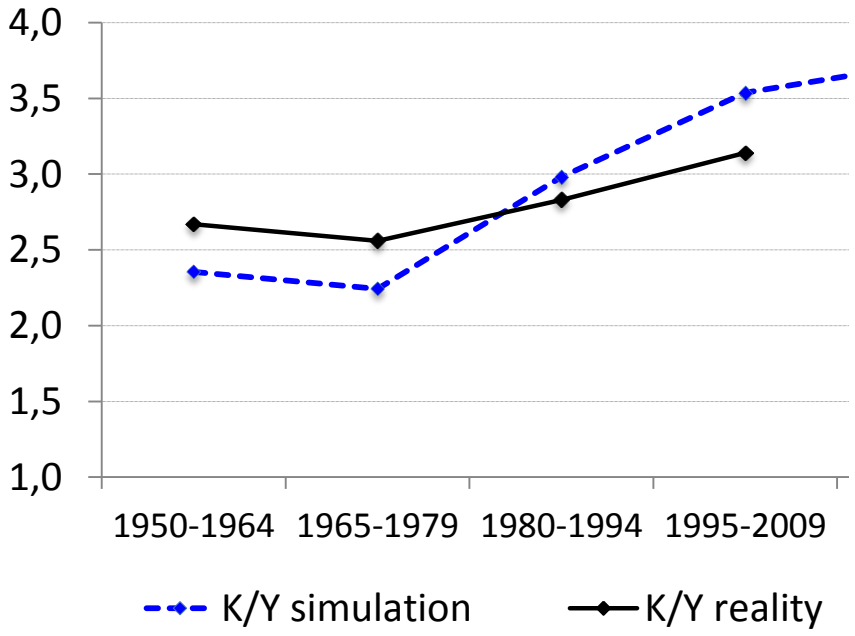


Data, calibration and backfitting

- We basically use Belgian data for 1995-2007 to calibrate a set of key parameters in the model…
- we impose the time path of exogenous variables
  - the rate of technical progress
  - two demographic variables: “fertility”, longevity
  - a set of policy parameters (labour income tax rate, consumption tax rate, pension replacement rates)
- What is the quality of the model to match the evolution of key macroeconomic variables for Belgium for the period 1950-2009 (backfitting)?

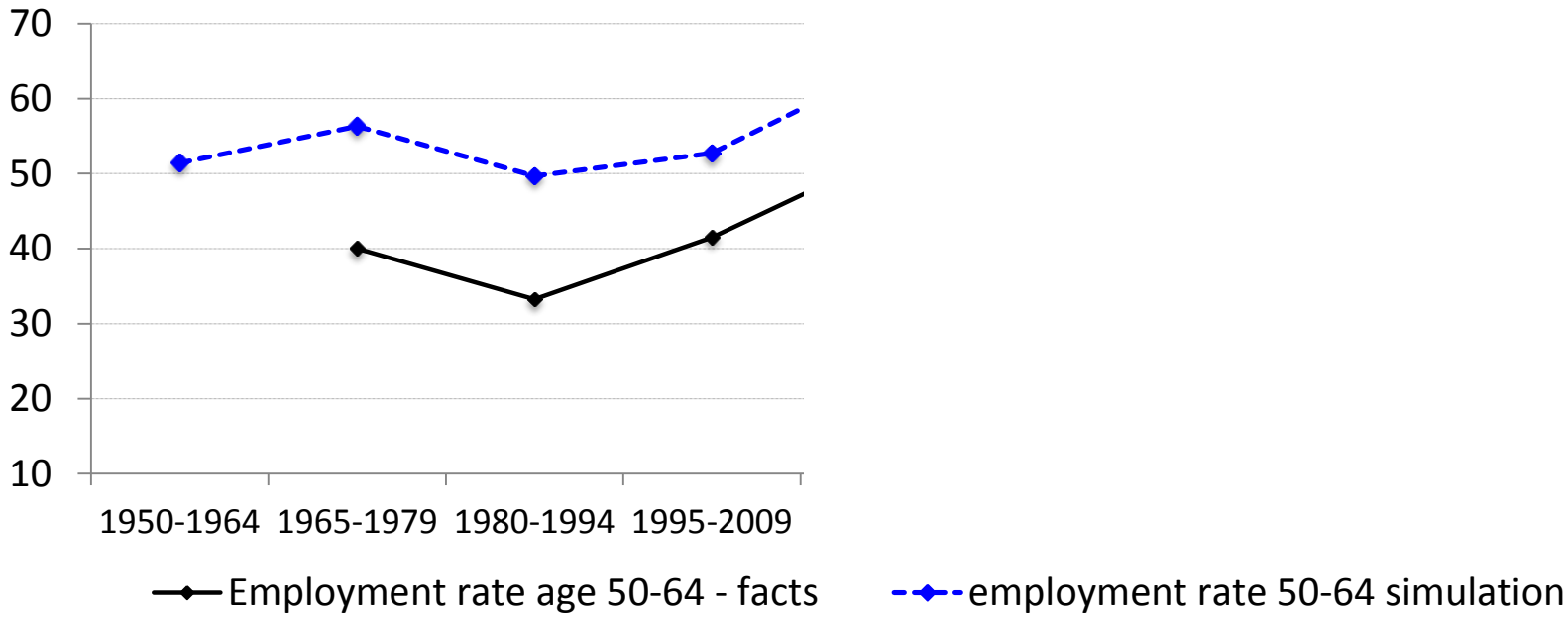
Backfitting: capacity of the model to match the historical path of key variables? (fully flexible model - baseline)

- Capital/output ratio



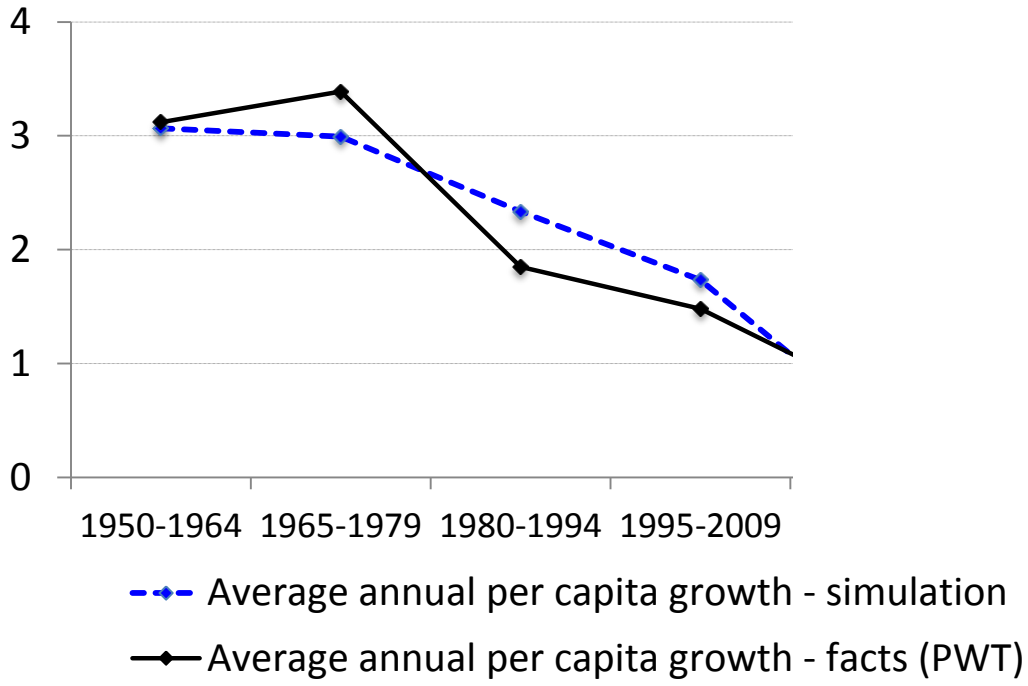
Backfitting: capacity of the model to match the historical path of key variables? (fully flexible model - baseline)

- Employment rate among workers of age 50 - 64



Backfitting: capacity of the model to match the historical path of key variables? (fully flexible model - baseline)

- Annual growth rate of real per capita GDP (%)



Backfitting: capacity of the model to match the historical path of key variables? (fully flexible model - baseline)

- Model predictions for inequality : 1995-2009

Market income (among all households at working age)

Gini model : 0,435 Actual data (Solt, 2014) : 0,45

Net financial wealth (all living households)

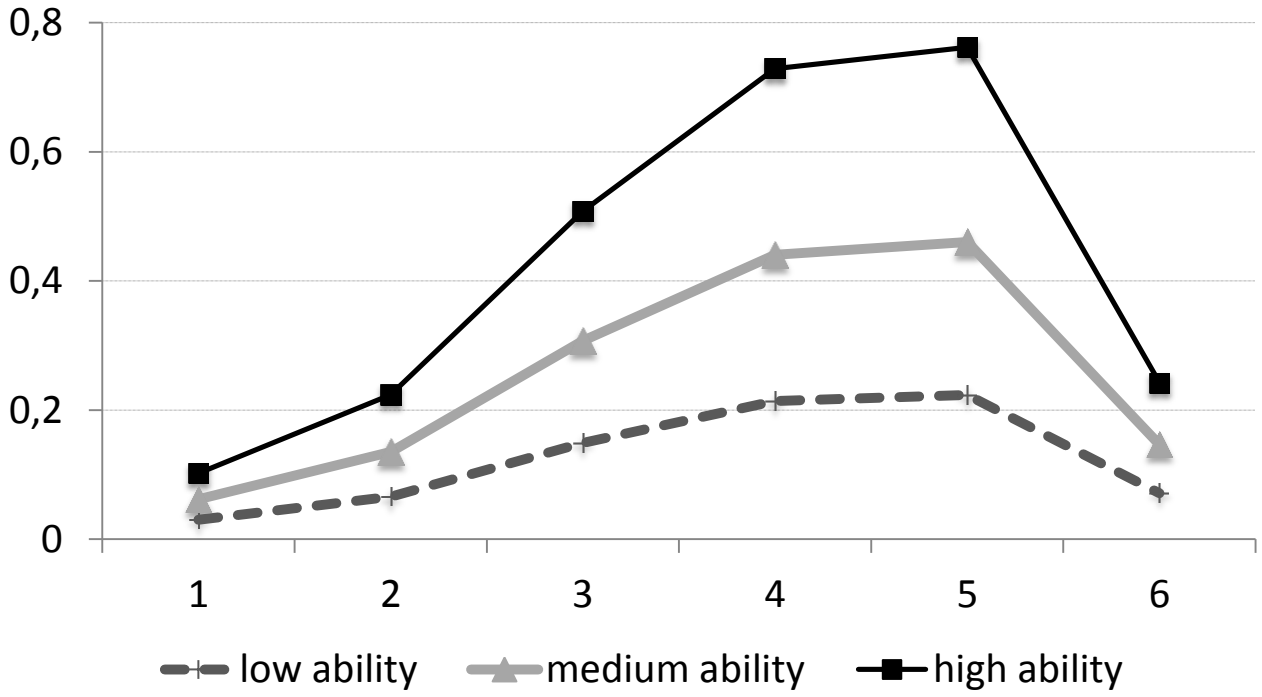
Share of the top 10% (model) : 37% Data (K&M) : 44,2%

Share of the bottom 50% (model) : 3,5% Data (K&M) : 10,0%

K&M: Kuypers and Marx (2014). Data for 2010.

Backfitting: capacity of the model to match the historical path of key variables? (fully flexible model - baseline)

- Model predictions for consumption over 6 periods of life (if alive) by individuals with different ability (individual entering the model in 1950)



Overview of the presentation

0. Motivation
1. Literature : two perspectives on secular stagnation
2. Model
   - Construction
   - Data, calibration and backfitting
3. Model simulations
4. Conclusions

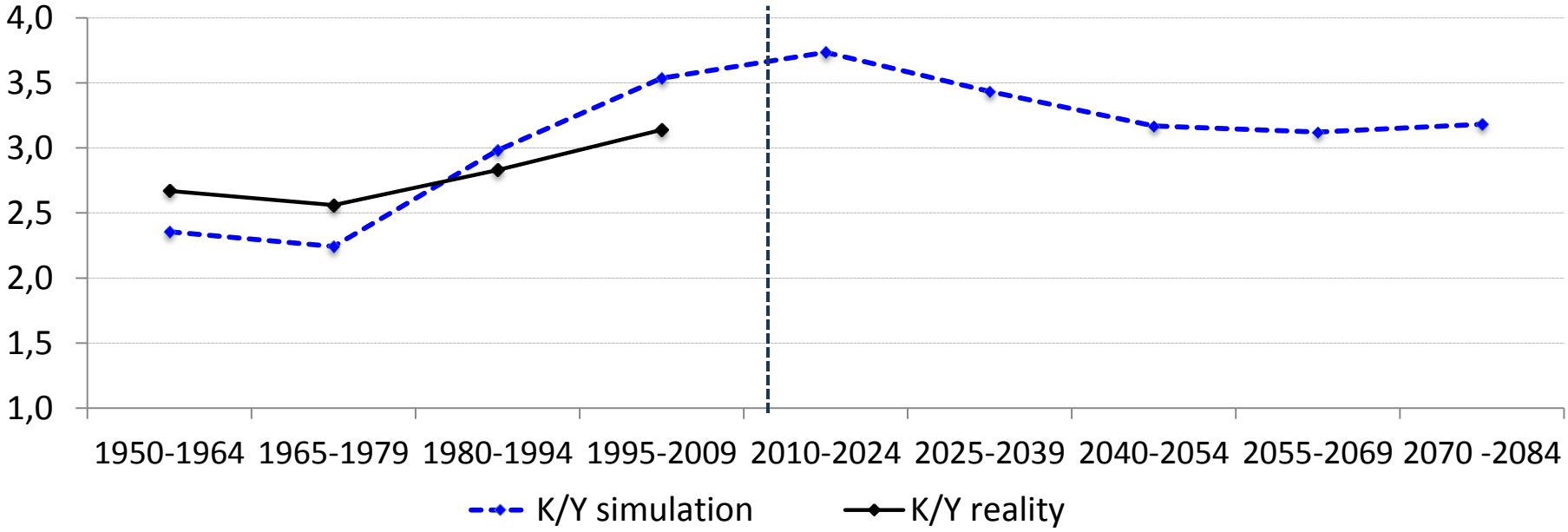
Model simulations: some baseline simulations

A. Baseline scenario (fully flexible model, imposing the projections for the rate of technical change and demographic change).

All simulations are assuming unchanged policies!

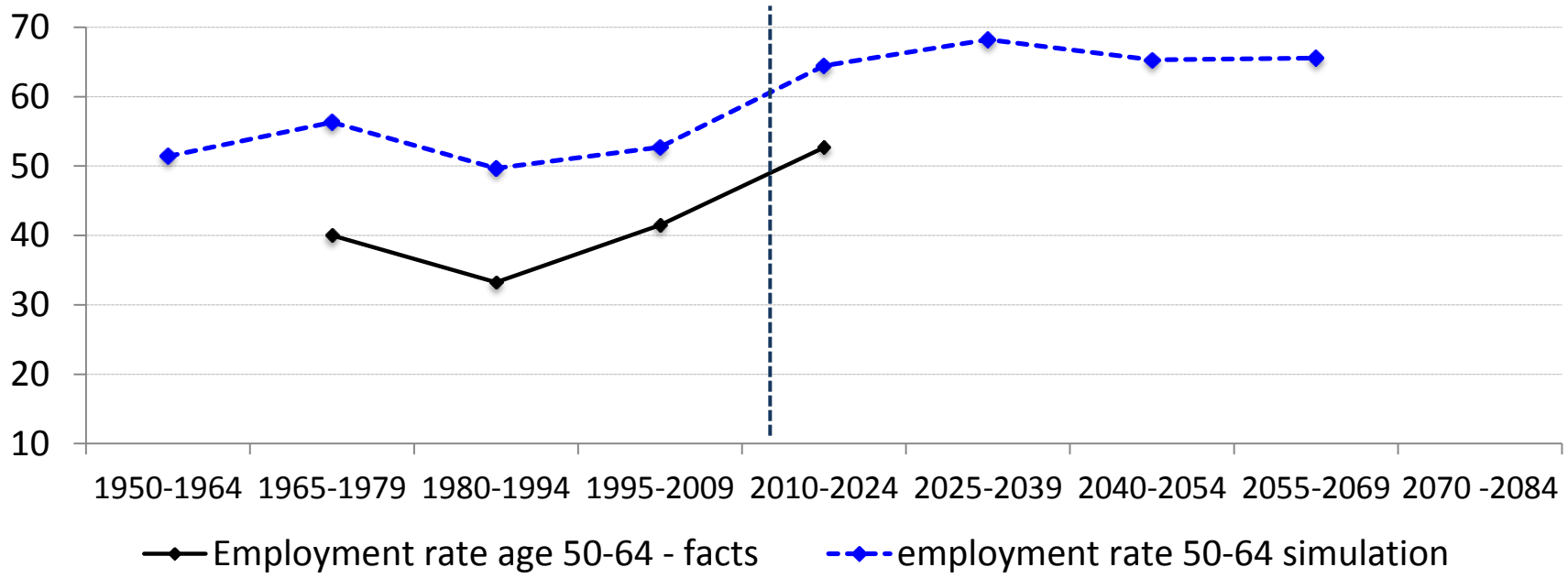
Baseline simulations (fully flexible model)

- Capital/output ratio



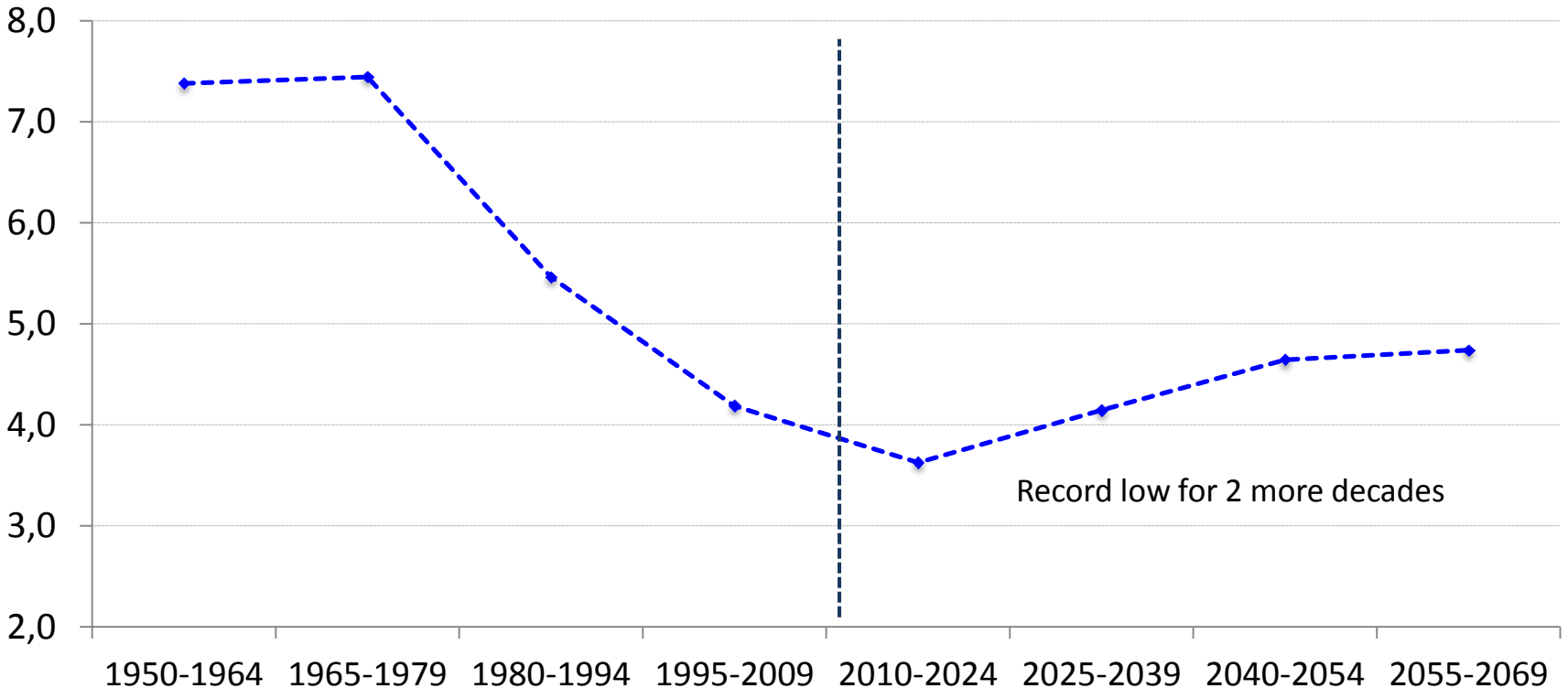
Baseline simulations (fully flexible model)

- Employment rate among workers 50 - 64



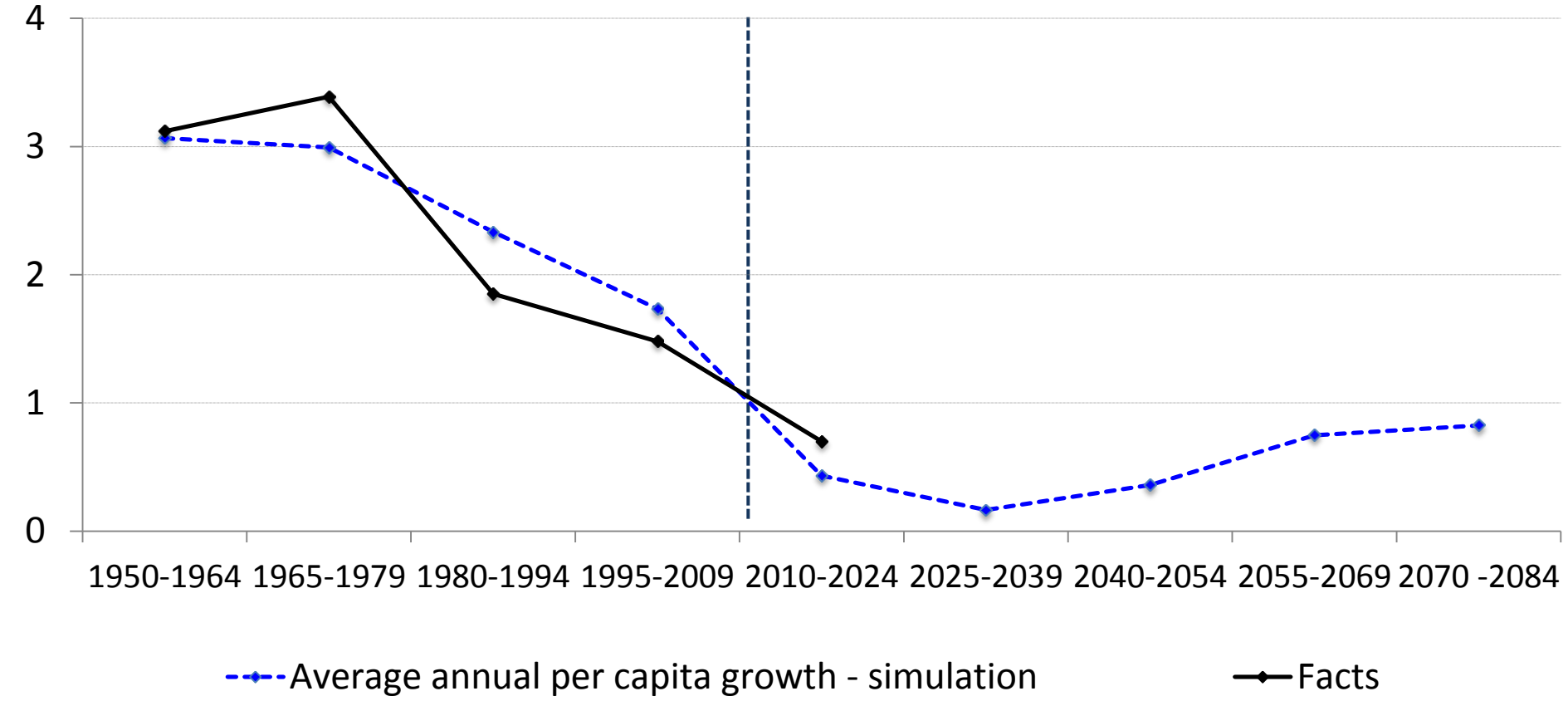
Baseline simulations (fully flexible model)

- Net real return on private capital (interest rate)



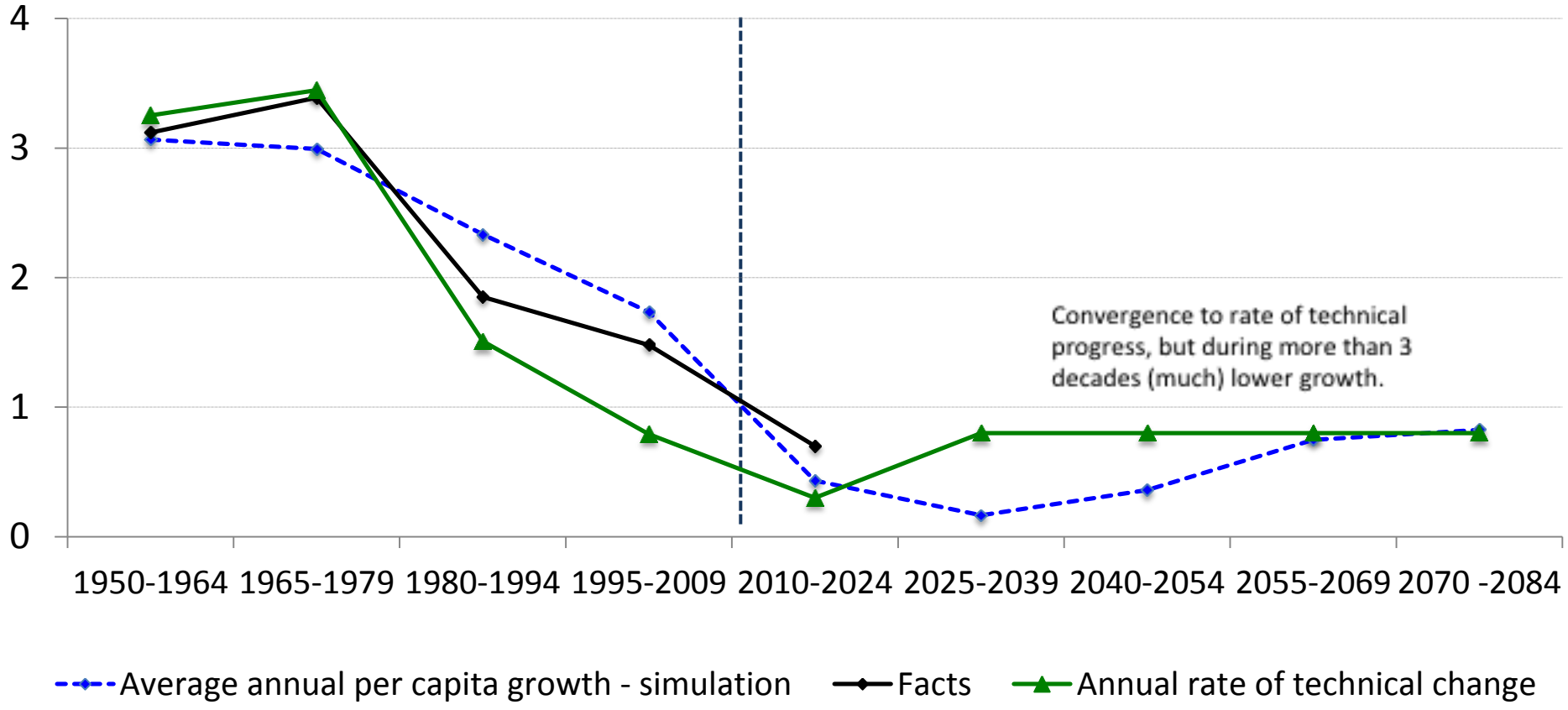
Baseline simulations (fully flexible model)

- Annual growth rate of real per capita GDP (%)



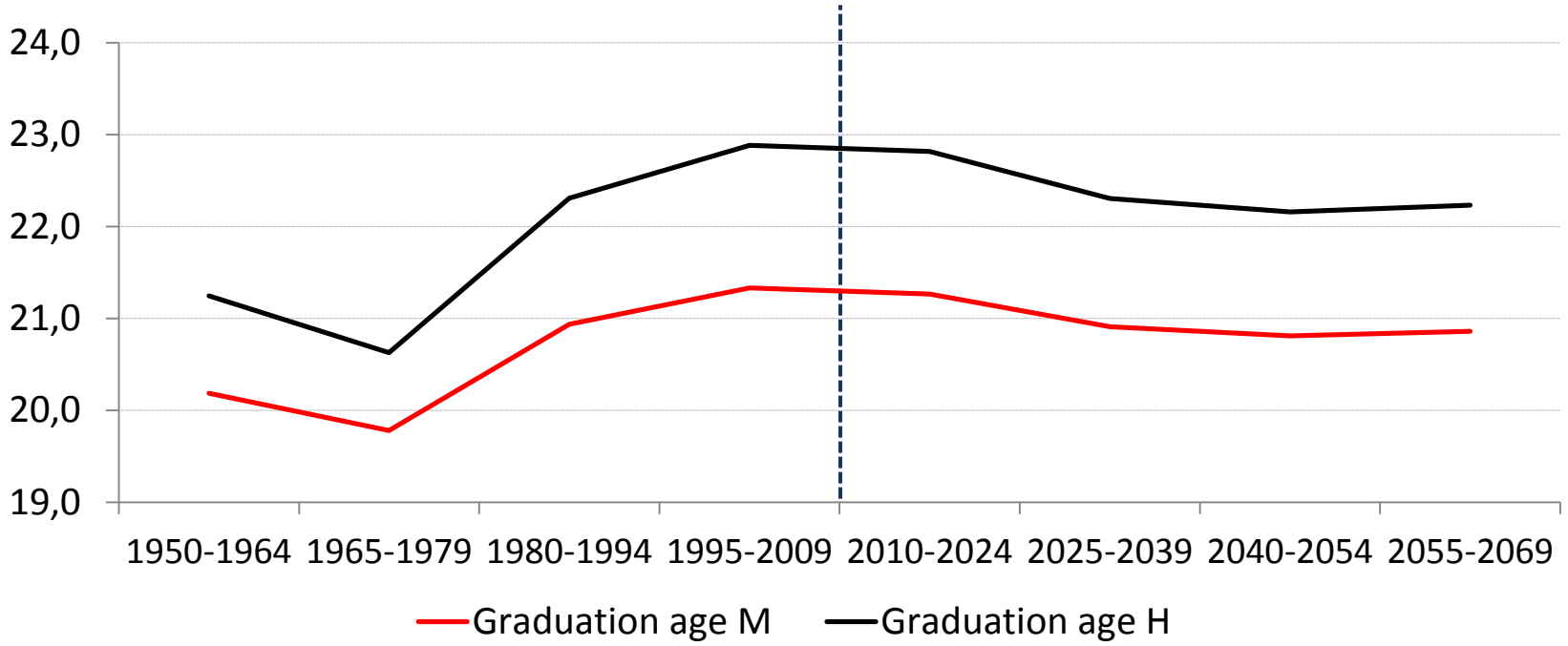
Baseline simulations (fully flexible model)

- Annual growth rate of real per capita GDP (%)



Baseline simulations (fully flexible model)

- Age to which high and medium ability individuals study



Model simulations: secular stagnation?

0. Scenario Zero when only the rate of technical change (TFP growth) changes. Green line.

A. Baseline scenario (fully flexible model after imposing projections for rate of technical change and demography – Blue line

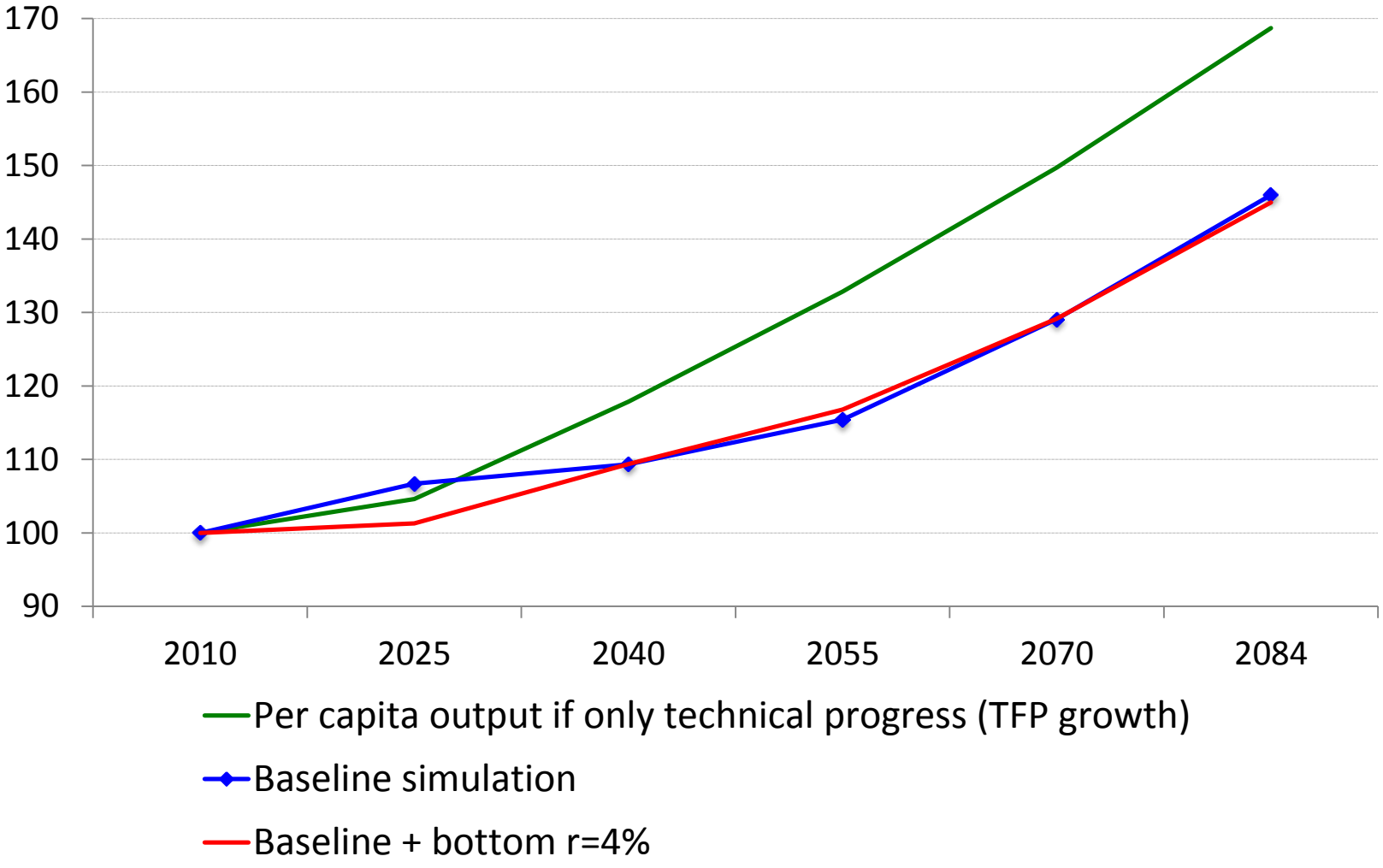
B. Two alternative scenarios:

B.1. Baseline but introducing a bottom to the interest rate (4,0%) Red line

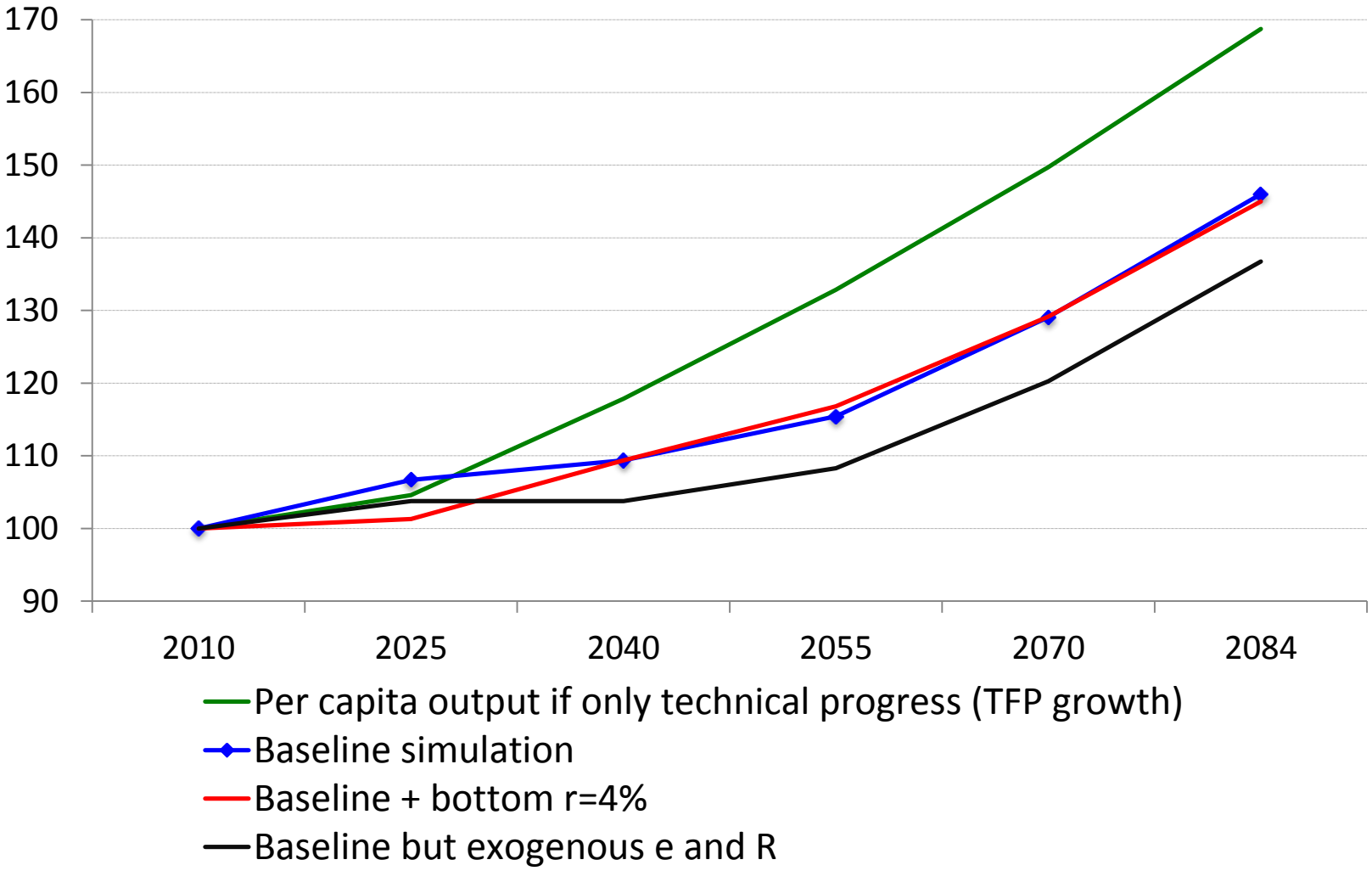
B.2. Baseline but keeping education of young and employment of 55+ constant. Black line

Focus on per capita output

Alternative simulations (output per capita, index 2010=100)



Alternative simulations (output per capita, index 2010=100)



Conclusions

Are OECD countries stuck in a very long period of low economic growth and rock-bottom real interest rates?

If we take policies as constant, we are inclined to say yes. We then expect:

- Per capita growth rates below the rate of technical change for three or four more decades.
- Potential per capita output may remain quite flat.
- Record low interest rate (rate of return to capital) for two more decades.

- If a floor to the interest rate exists, and 'bites'...
- ... this could push output below its (low) fully flexible potential level for two or three decades (second perspective to secular stagnation)

Rising employment and education rates during transition has serious impact.
We find no clear effect from (rising) inequality, nor from borrowing constraints.

Policy implications

- Rate of technical change is key! → Innovation, R&D
- Public investment → higher aggregate investment, higher return (MPK) to private capital.
- Promotion of employment (in the model: older workers / broader: older workers + all low skilled)
- Education … but maybe not too much room left for strong further expansion…

Further research?

- ‘Able but poor’ individuals (now we do not have them in the model) and the role of borrowing constraints.

- Public debt and fiscal consolidation … even more excess saving.

- Wrong expectations and private deleveraging after financial crisis… even more excess saving.

- Different life expectancy for individuals with high, medium or low ability