Aging and Pension Reform in a Two-Region World: The Role of Human Capital

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Questions & General Setup

- Effects of population aging on
  - Factor prices
  - Welfare
- How do answers change
  1. With endogenous human capital
  2. Under different social security regimes / pension reforms
  3. More interesting: interaction of 1.) and 2.)

- Two-region open economy OLG model with endogenous
  - Consumption/saving decision
  - Labor supply
  - Human capital accumulation

Household Setup

- Agents start making decisions at age 16, retire at age 65 (benchmark) and live at most until age 90
- They choose each period
  - Consumption/saving
  - Labor supply
  - Time investment into human capital
- . . . and like consumption and leisure
- Receive labor income or pensions
  - Linear contribution rate τ to social security
  - Pensions are a fraction ρ of current net wages

▸ Formal Representation

Macroeconomic Setup & Government

- Aggregate production with physical capital and effective labor
- Effective labor $L_t = \sum_{j=0}^{jr-1} \ell_{t,j} N_{t,j} h_{t,j}$
- Factors earn marginal products
- Regional labor markets, international capital markets, exogenous technical progress

- Balanced budget PAYGO social security with two scenarios
  1. Benchmark Retirement: replacement rate ρ or contribution rate τ fixed
  2. Pension Reform: increase retirement age given τ/ρ – regime

Pension Reform & Calibration

- Increasing the Retirement Age
  - Simple rule: for additional 1.5 years of life expectancy at age 65 retirement increases by one year
  - Retirement age of 71 years

▸ U.S. Life Expectancy at Age 65

- Calibration
  - Demographics: United Nations
    - "Old": basically OECD
    - "Young": rest of the world
  - Targets: K/Y, avg. labor supply, I/Y, region-specific wage profiles, and region-specific growth of GDP/Capita

▸ Retirement Age & Wage Profiles

▸ WAPR

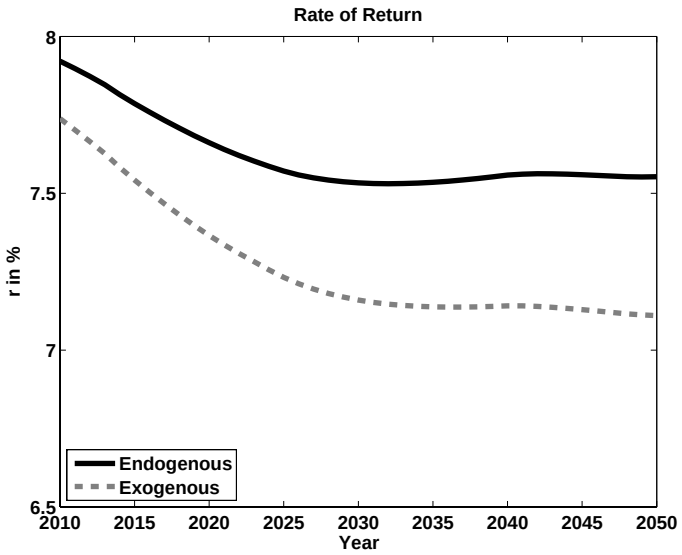
Thought Experiment & Results

- Thought experiment
  - Exogenous demographics induces economic transition
  - Two human capital specifications
    - Exogenous human capital
    - Endogenous human capital
    - $\Rightarrow$ during calibration identical, then diverging

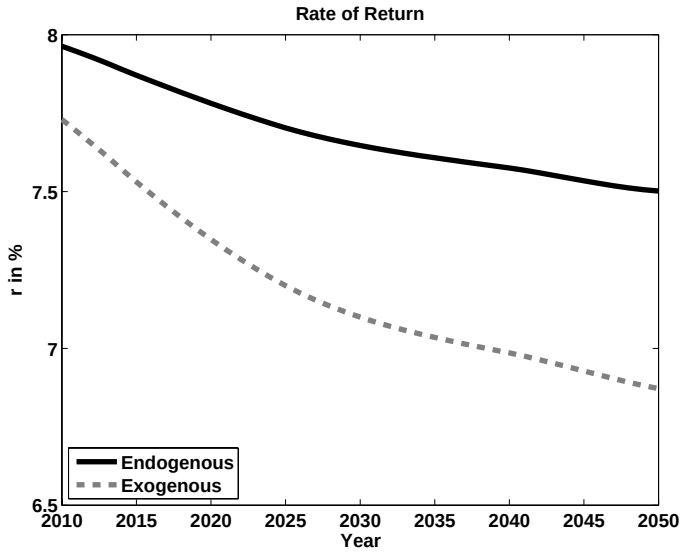
- Results
  - Macroeconomic variables
    - Rate of return
    - Detrended GDP per capita
  - Welfare of households alive in 2010
  - Effects of pension reform
  - Focus on
    - Endogenous vs. exogenous human capital
    - Results for "old" countries, open economy

Benchmark Retirement Age: Rate of Return

Figure: Rate of Return



Constant Replacement Rate

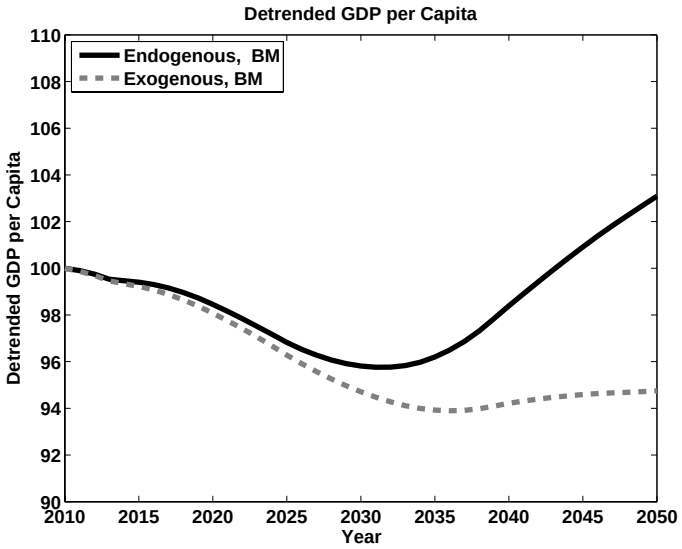


Constant Contribution Rate

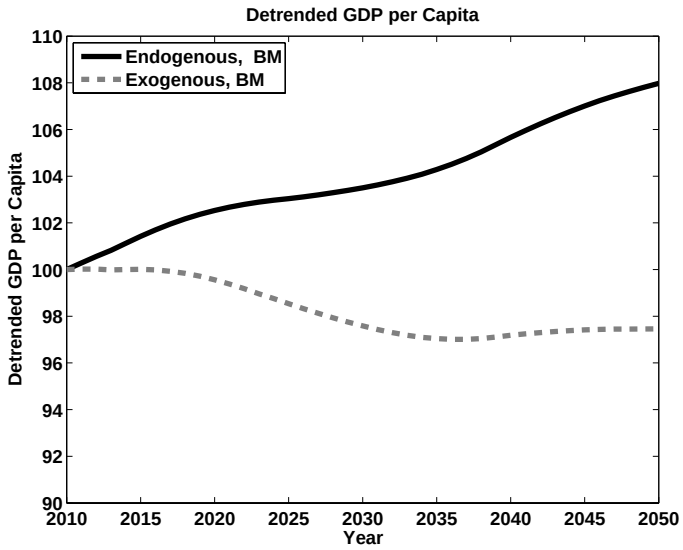
▸ Open vs. Closed

Benchmark Retirement Age: Detrended GDP per Capita

Figure: Detrended GDP per Capita



Constant Replacement Rate

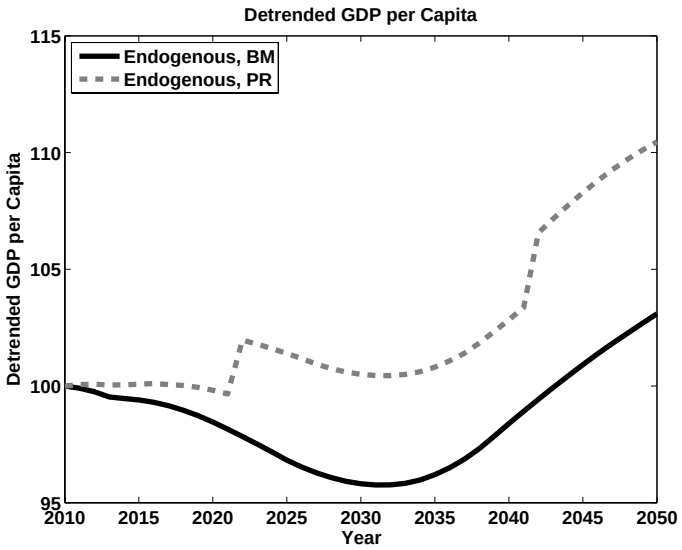


Constant Contribution Rate

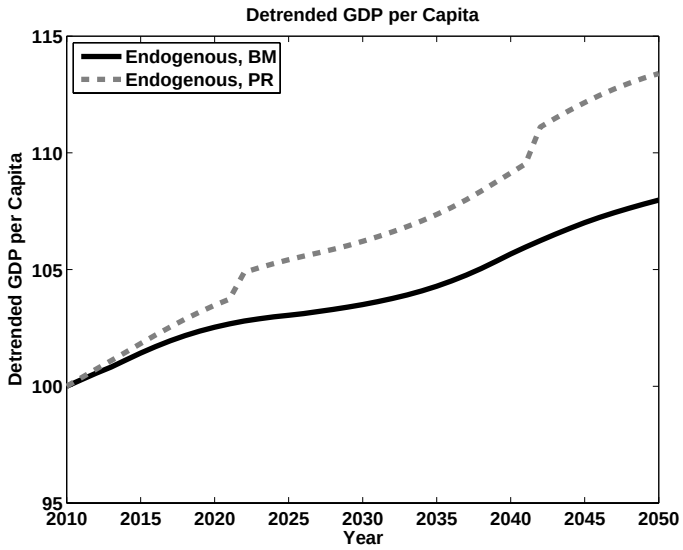
▸ Open vs. Closed

Pension Reform: Detrended GDP per Capita (1)

Figure: Detrended GDP per Capita



Constant Replacement Rate



Constant Contribution Rate

▸ Rate of Return

Pension Reform: Decomposition of Effects

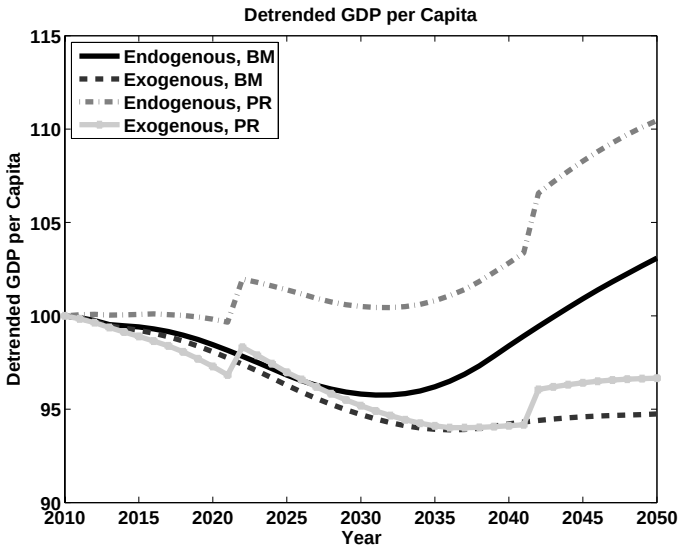
Effects of increasing retirement age on GDP/Capita

- Exogenous human capital
  1. "Mechanical" effect $\Rightarrow$ more working people
  2. Higher labor supply if $\tau \downarrow$

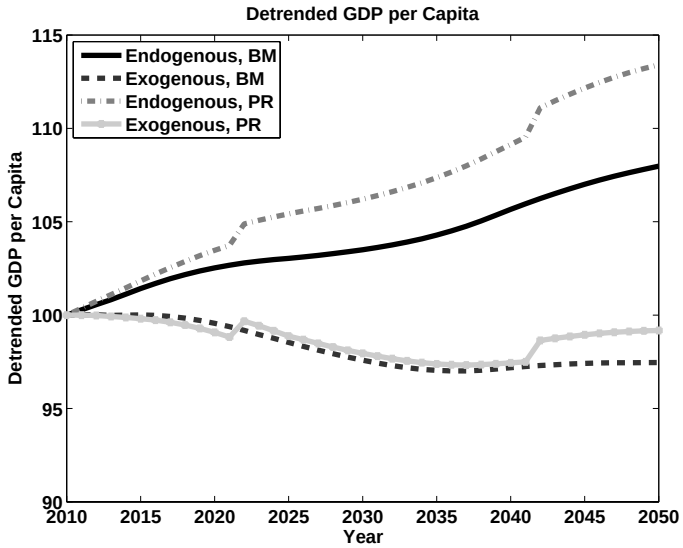
- Endogenous human capital
  1. "Mechanical" effect $\Rightarrow$ more working people
  2. Higher investment into human capital
  3. Higher labor supply (to make use of 2.)
  4. Higher labor supply and human capital if $\tau \downarrow$
     $\Rightarrow$ effects are not additive

Pension Reform: Detrended GDP per Capita (2)

Figure: Detrended GDP per Capita



Constant Replacement Rate



Constant Contribution Rate

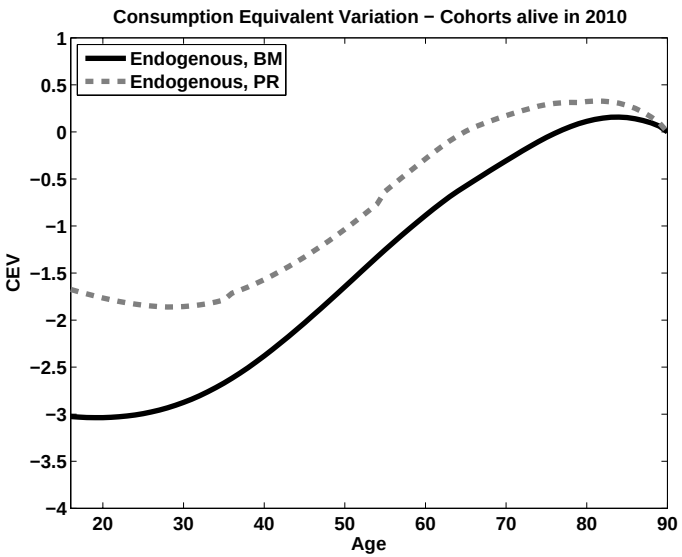
Welfare Evaluation – Concept

- Define a base year (here 2010)
- Compute (remaining) lifetime utility V_{GE} given GE prices
- "Freeze" prices/transfers from base year and recompute V_{2010}
- Welfare difference expressed as Consumption Equivalent Variation (CEV)
- Positive numbers are welfare gains from GE effects

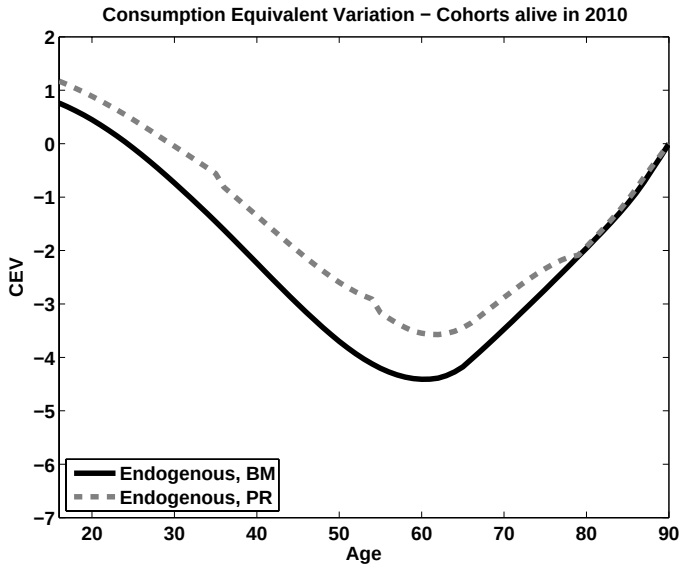
▸ Welfare Evaluation - Graph

Welfare Effects of Reform: Agents alive in 2010

Figure: Welfare: Agents alive in 2010



Constant Replacement Rate



Constant Contribution Rate

▸ Open vs. Closed

Welfare Effects of Reform: Agents alive in 2010

Table: Maximum Welfare Losses - Agents alive 2010

	Open Economy			
Pension System	Constant ρ		Constant τ	
	Endog.	Exog.	Endog.	Exog.
Benchmark	-3.0%	-3.6%	-4.4%	-6.5%
Pension Reform	-1.9%	-3.0%	-3.6%	-6.0%
Difference	36.7%	16.7%	18.2%	7.7%

Welfare Effects of Reform: Agents alive in 2010

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Conclusions & Policy Implications

- Investment into human capital substantially dampens
  - effects of aging on factor prices
  - welfare losses

PI: Important to keep this adjustment channel flexible

- A generous pension system is more redistributive but lowers welfare of future generations
- Higher retirement age can substantially increase welfare, especially when distortions are already high

PI: Small distortions are magnified: human capital is "multiplier" $\Rightarrow$ effects are not additive

PI: Inequality best decreased by increasing retirement age

- Warning: we assumed a frictionless world $\Rightarrow$ results are only upper/lower bounds of "true" effects

Model Parameters

Table: Model Parameters

			"Young"	"Old"
Preferences	σ	Inverse of Inter-Temporal Elasticity of Subst.	2.00	
	β	Pure Time Discount Factor	0.985	
	ϕ	Weight of Consumption	0.370	
Human Capital	ξ	Scaling Factor	0.176	0.166
	ψ	Curvature Parameter	0.576	0.586
	δ^h	Depreciation Rate of Human Capital	1.4%	0.9%
	h_0	Initial Human Capital Endowment	1.00	1.00
Production	α	Share of Physical Capital in Production	0.33	
	δ	Depreciation Rate of Physical Capital	3.5%	
	g^A	Exogenous Growth Rate		
		Calibration Period	1.5%	1.9%
		Final Steady State	1.9%	1.9%

Notes: "Young" and "Old" refer to the region. Only one value in a column indicates that the parameter is identical for both regions.

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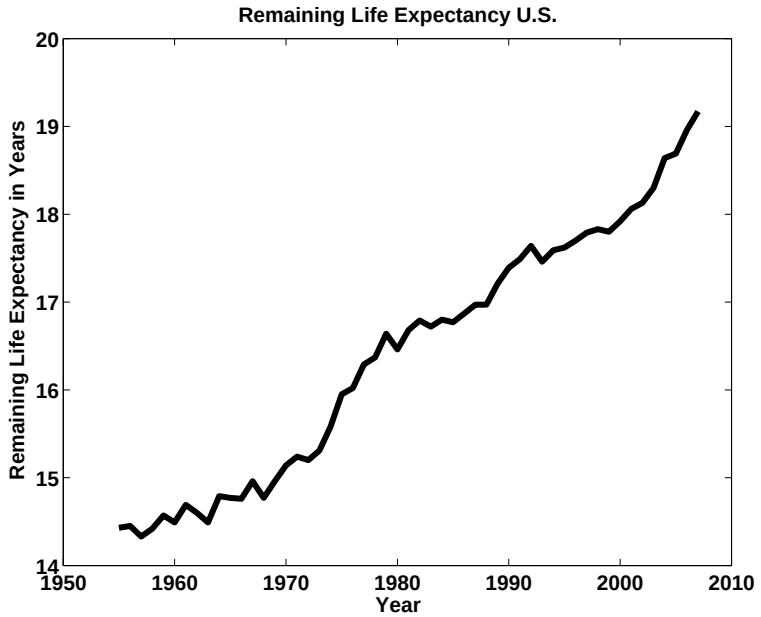
U.S. Life Expectancy

Figure: U.S. Life Expectancy at Age 65



Sources: Human Mortality Database (2011).

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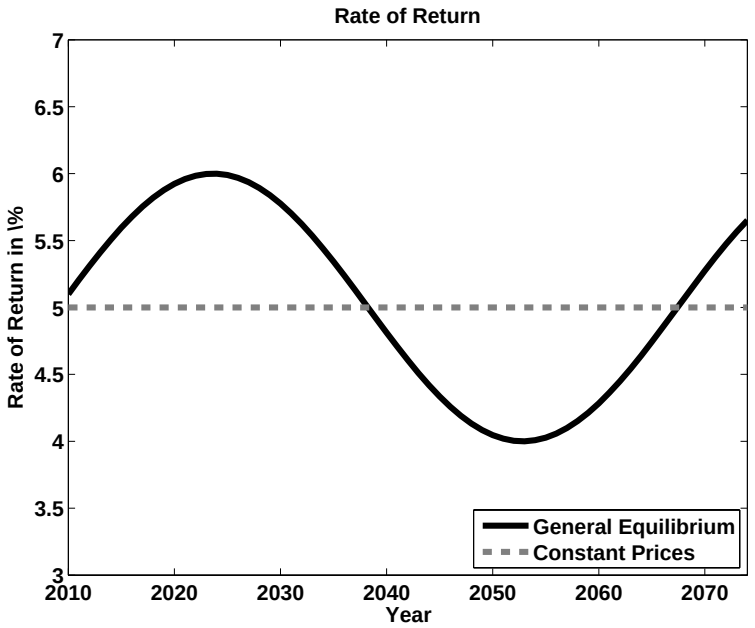
Welfare Evaluation – Graph

Figure: Constant vs. Variable Prices



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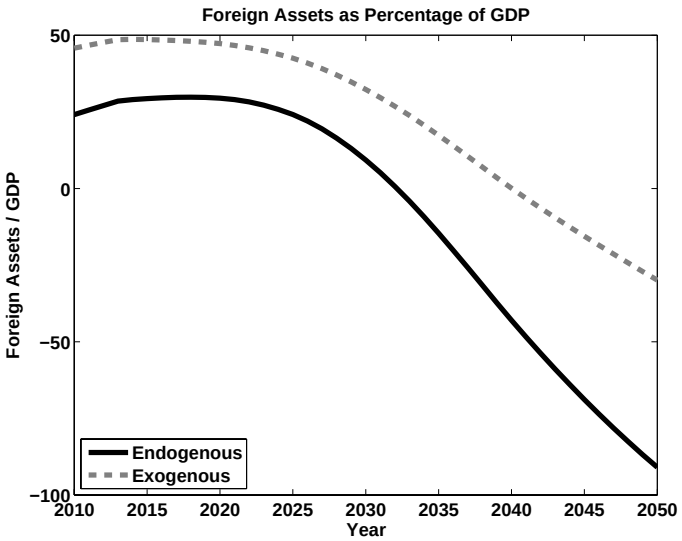
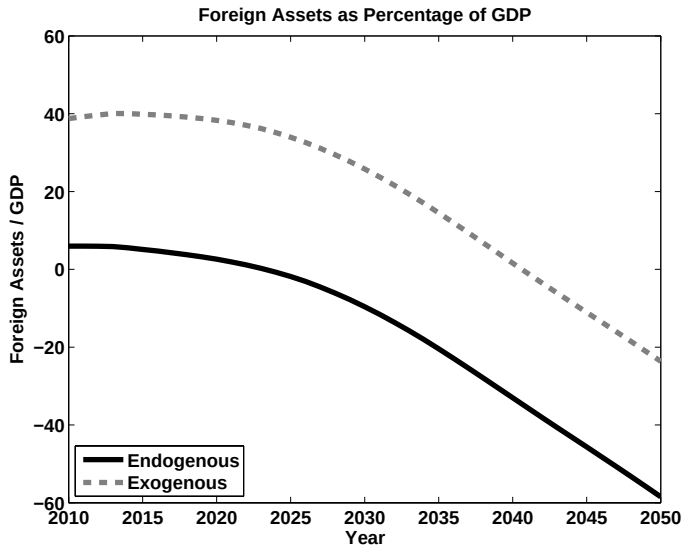
Benchmark Retirement Age: Net Foreign Assets

Figure: Net Foreign Assets



Constant Replacement Rate



Constant Contribution Rate

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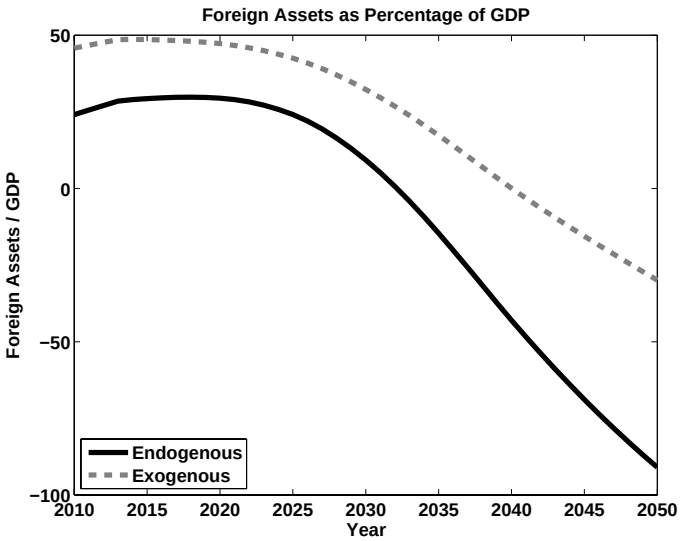
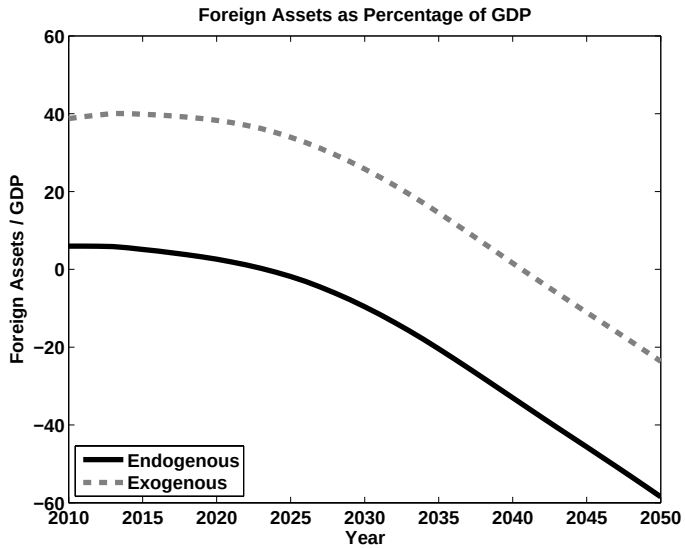
Benchmark Retirement Age: Net Foreign Assets

Figure: Net Foreign Assets



Constant Replacement Rate



Constant Contribution Rate

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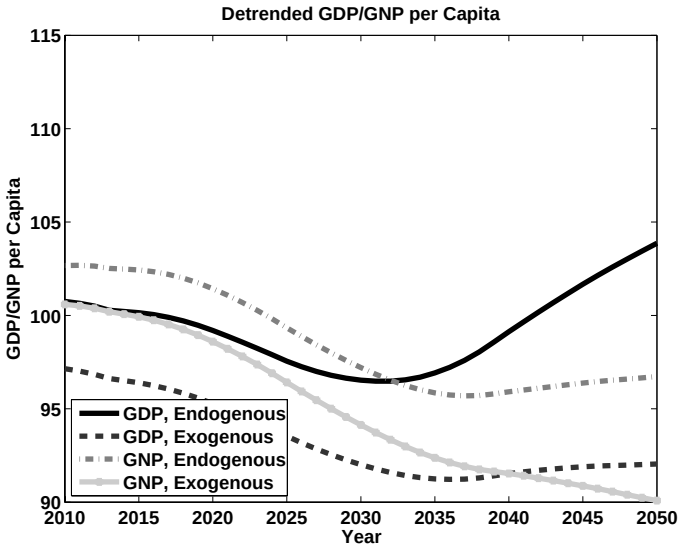
Benchmark Retirement: Comparison GDP/GNP per Capita

Figure: Comparison GDP/GNP per Capita



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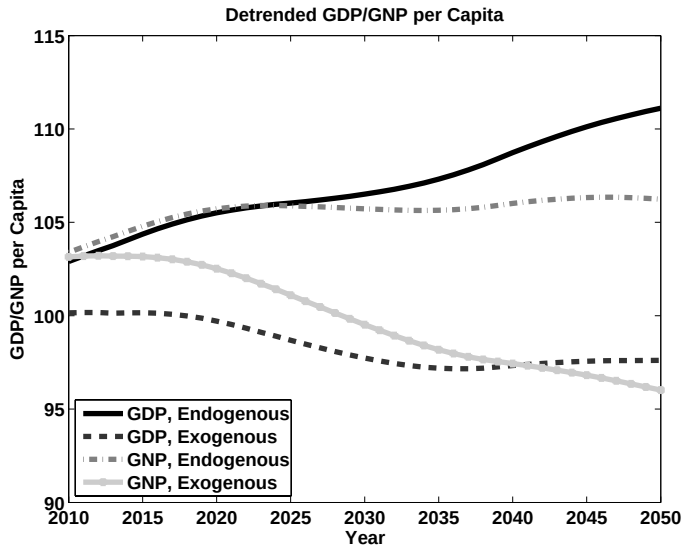

Constant Contribution Rate

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(Inter)National Capital Markets

- Compute equilibrium transition path for closed economies
- We then "surprise" agents by opening up the economy in 1975
- Compute the transition to the open economy steady-state
- Agents alive in 1975 re-optimize for their remaining lifetime, newborns use prices and transfers from open economy

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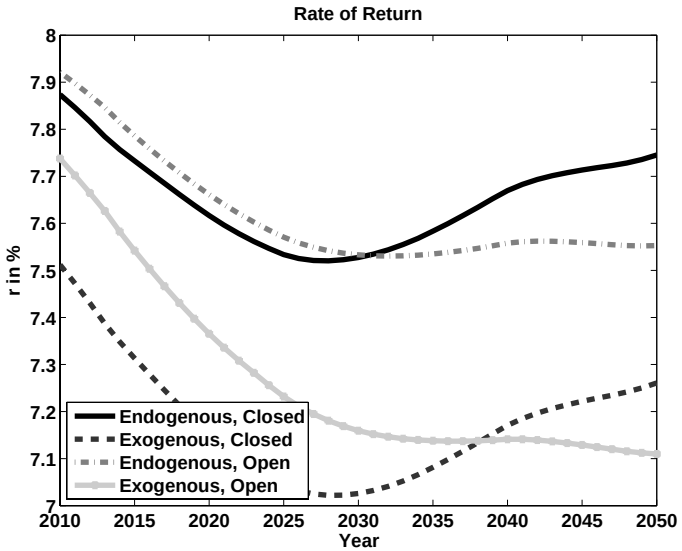
Benchmark Retirement Age: Rate of Return

Figure: Rate of Return



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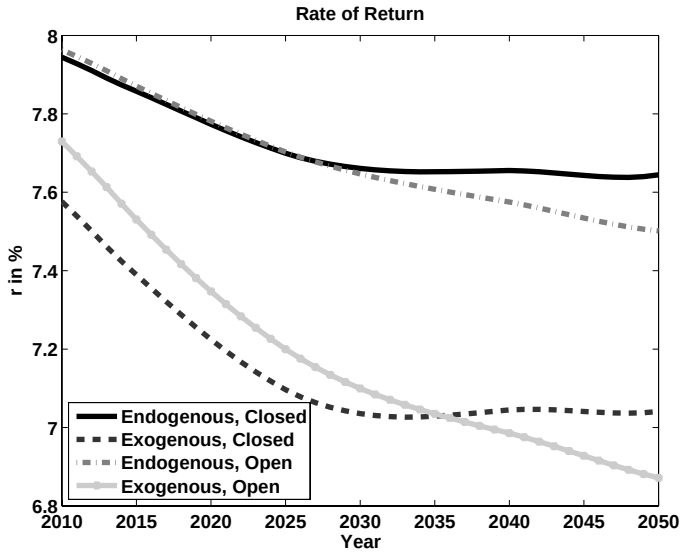

Constant Contribution Rate

▸ Back

▸ Net Foreign Assets

Household Setup – Formal Representation

Formally, agents maximize

$$\max \sum_{j=0}^{J} \beta^j \pi_j \frac{1}{1-\sigma} \{c_j^{\phi} \underbrace{(1-\ell_j-e_j)}_{\textit{leisure}}^{1-\phi}\}^{1-\sigma}$$

subject to

$$\begin{aligned} a_{j+1} &= \begin{cases} (a_j + tr_t)(1+r_t) + w_{t,j}^n - c_j & \text{if } j < jr \\ (a_j + tr_t)(1+r_t) + p_t - c_j & \text{if } j \geq jr \end{cases} \\ w_{t,j}^n &= \ell_j h_j w_t (1-\tau_t) \end{aligned}$$

human capital formation using Ben-Porath (1967) technology

$$h_{j+1} = h_j(1-\delta^h) + \xi(h_j e_j)^{\psi}$$

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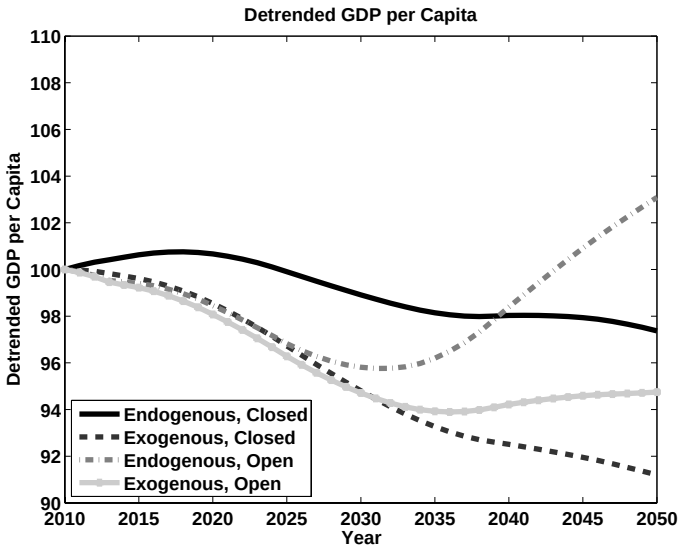
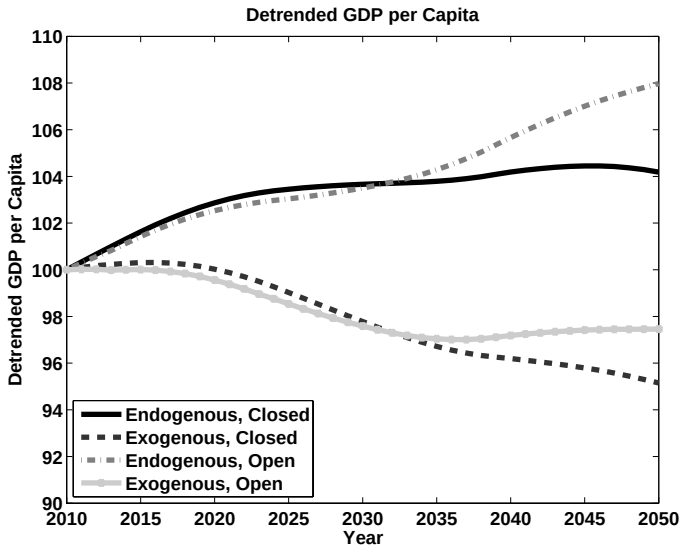
Benchmark Retirement Age: Detrended GDP per Capita

Figure: Detrended GDP per Capita



Constant Replacement Rate



Constant Contribution Rate

▸ Net Foreign Assets

▸ Comparison GDP/GNP

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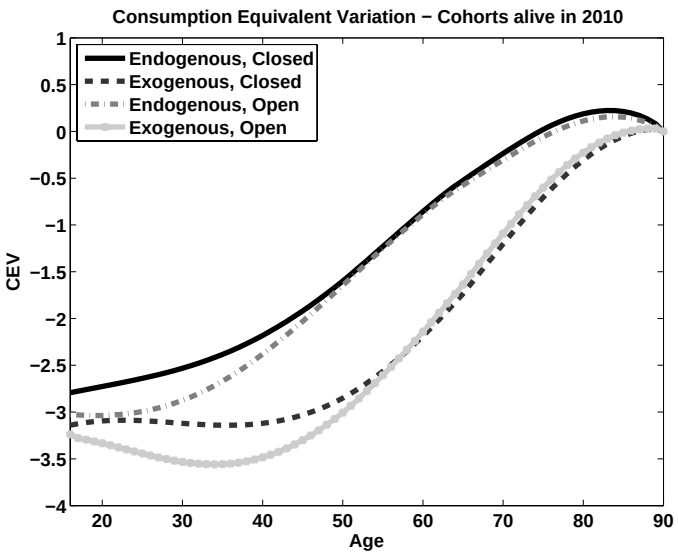
Figure: Welfare: Agents alive in 2010



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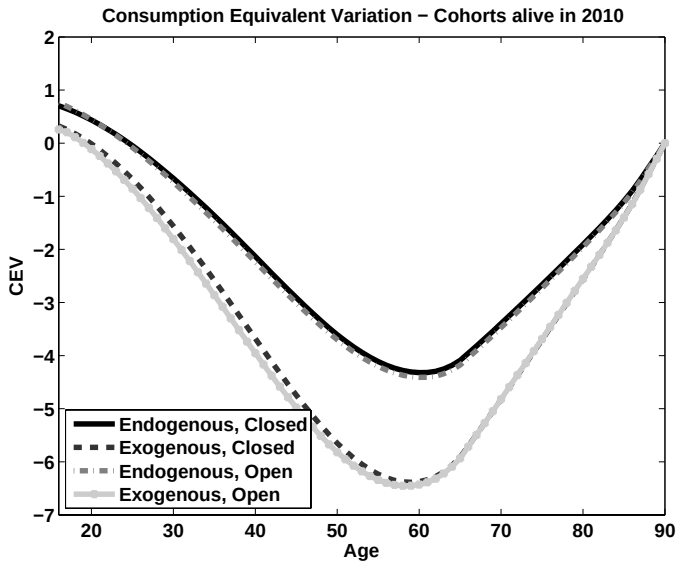

Constant Contribution Rate

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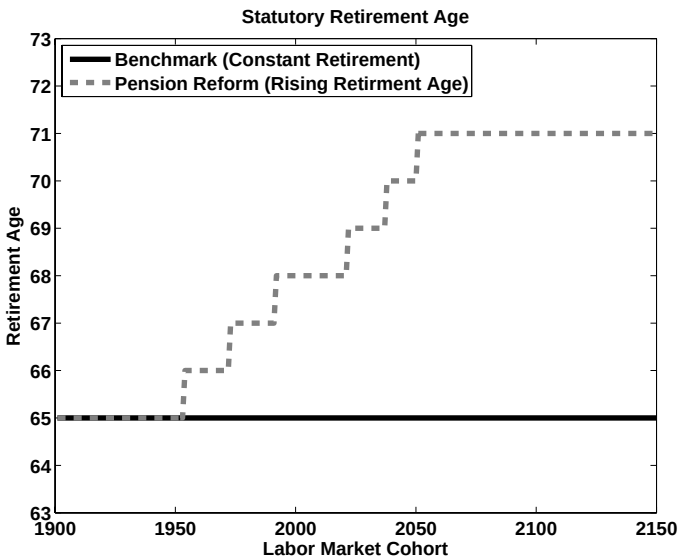
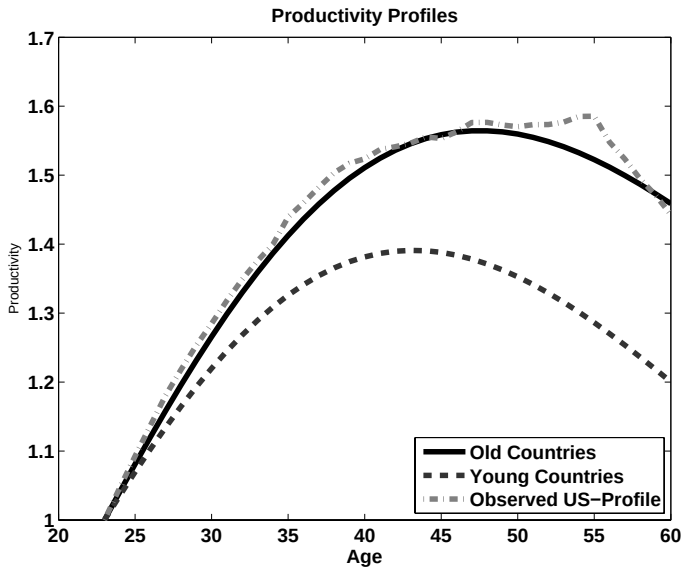
Retirement Age & Wage Profiles



Retirement Age



Life Cycle Productivity

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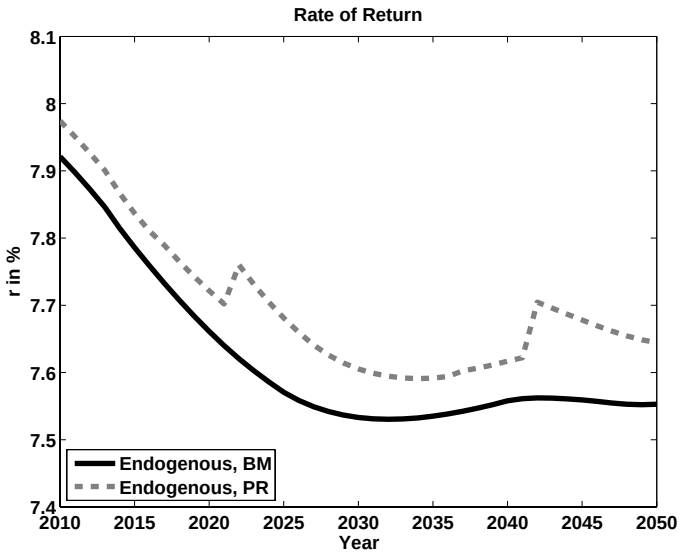
Pension Reform: Rate of Return

Figure: Rate of Return



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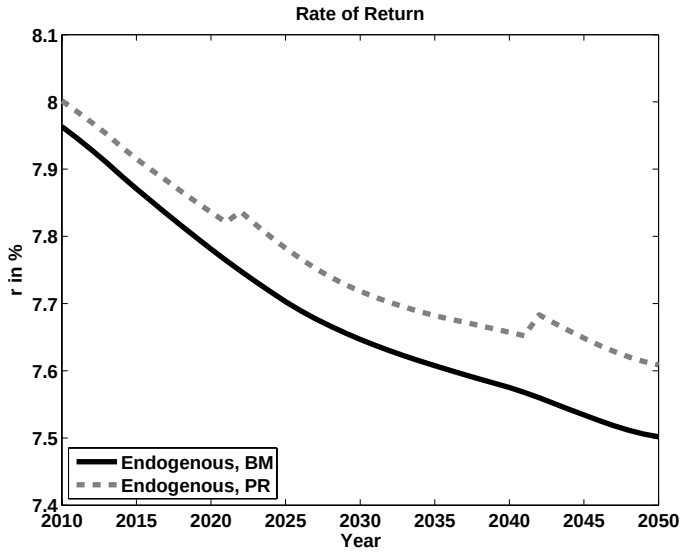

Constant Contribution Rate

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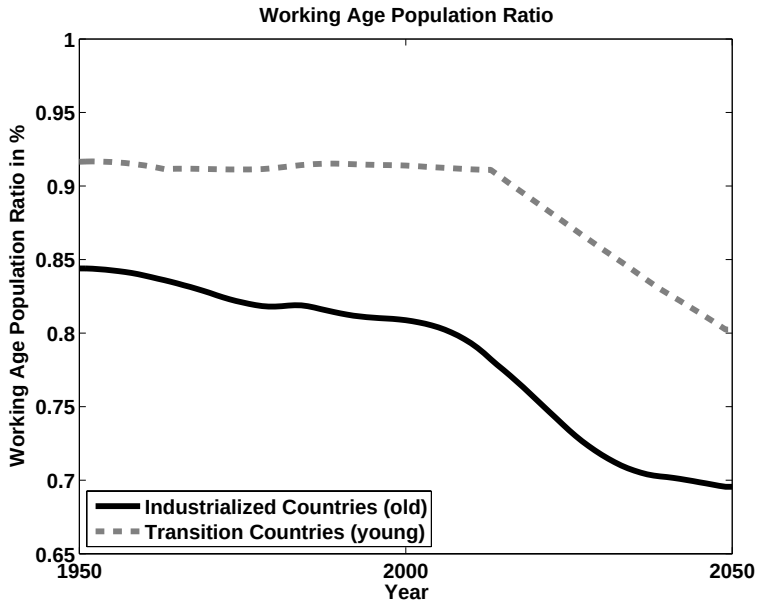
Figure: Working Age Population Ratio



Sources: United Nations (2007) and own computations.
"Old" includes USA, Canada, Japan, Australia, New Zealand, Switzerland, Norway and the EU15
"Young" all other countries

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