Why aging induces deflation and secular stagnation

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Deflation, secular stagnation, and govt policy

- Summers (2020, IMF): In the post-crisis period, many countries had
  1. Deflation: low and in some cases negative inflation rates
  2. Low real interest rates
  3. Below trend GDP growth
     - Secular stagnation despite expansionary monetary and fiscal policy
- Our questions
  1. What was causing deflation and secular stagnation?
  2. Are deflationary and 'stagnationary' forces over?
- Our answer: 1. Aging, and 2. No

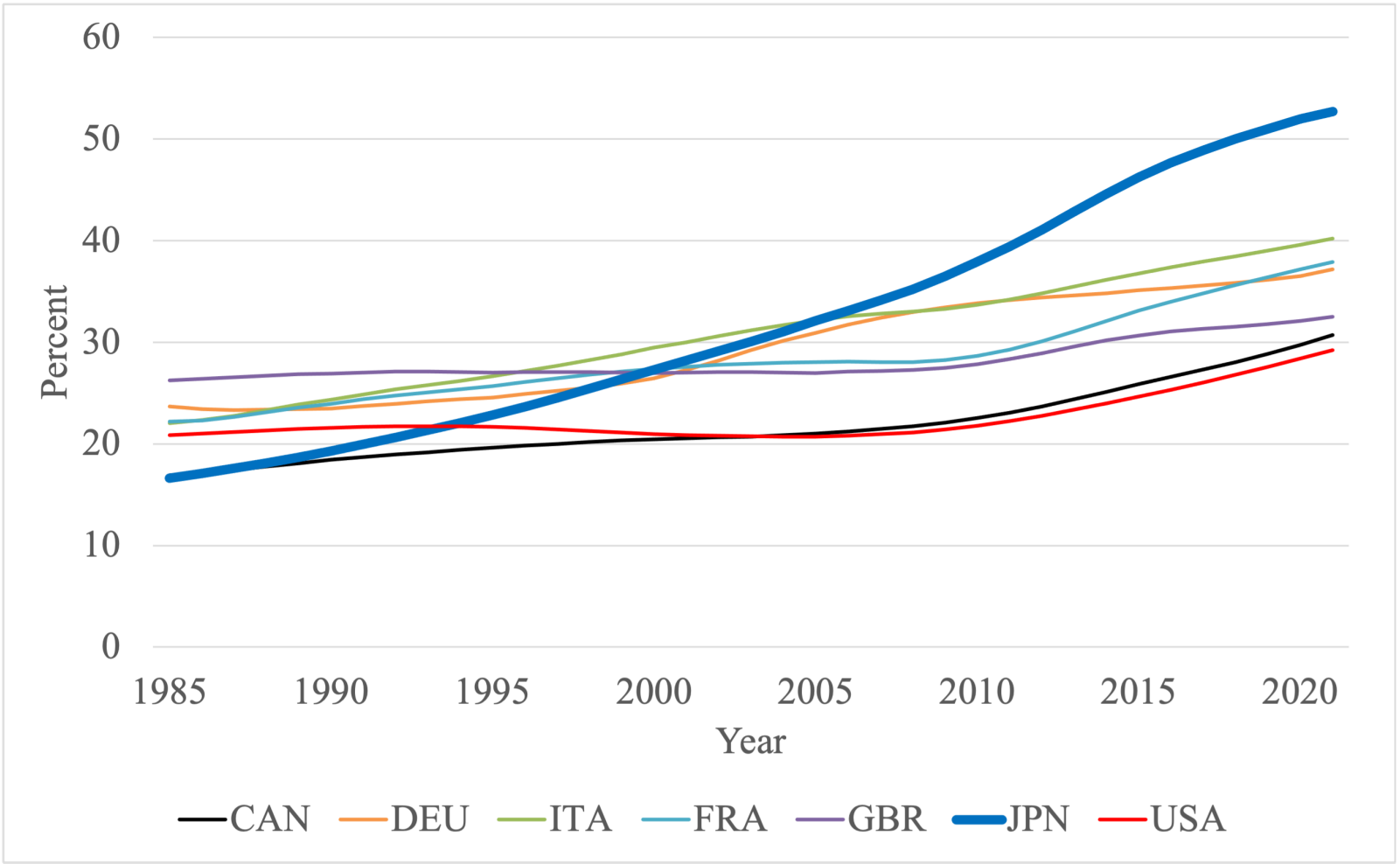
Why aging? and What we do

- Aging: a higher fraction of old individuals out of labor force
  - $\Rightarrow$ Greater stock of saving; greater demand for liquid assets
  - $\Rightarrow$ A decrease in the price level

$$\frac{\text{Nominal debt}}{P \downarrow} = \text{Demand for liquid assets} \uparrow$$

- $\neq$ New Keynesian narrative: natural rate $<$ real rate
- Propose a quantitative OLG model with rich nominal-real interactions
- Feed projected Japanese age distribution into the model
- Our model generates deflation and secular stagnation

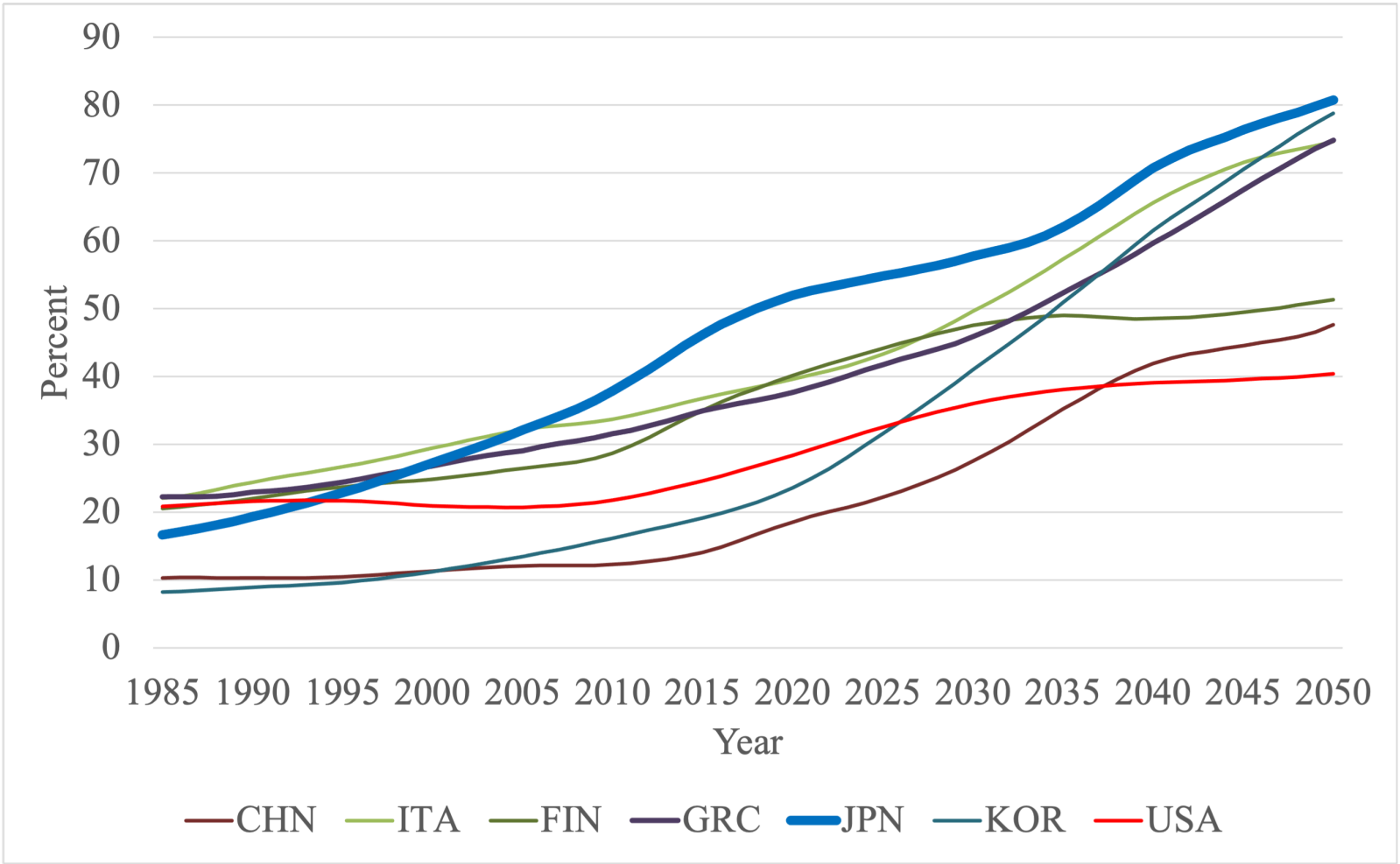
Why Japan? Rapid aging from 1985 to 2020



Note: The ratio of the 65+ population to the 20-64 population

Source: World Bank

Aging is projected to accelerate



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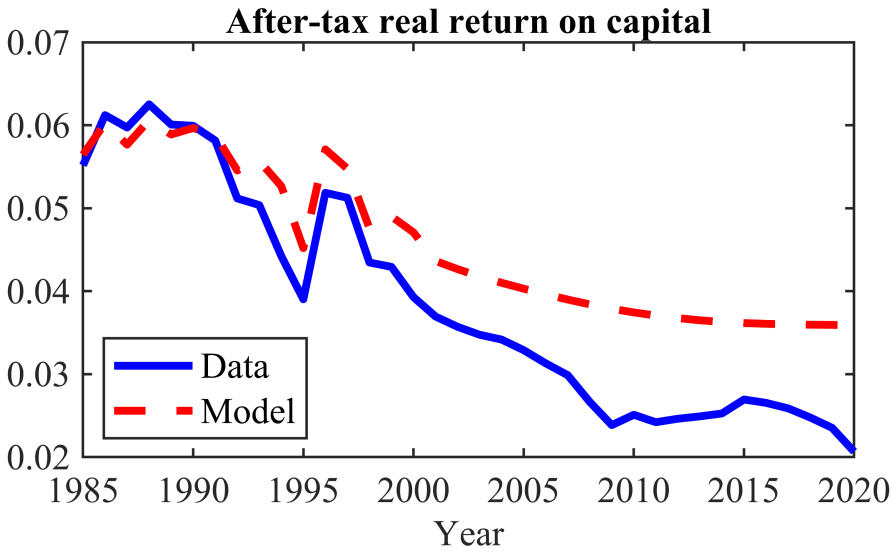
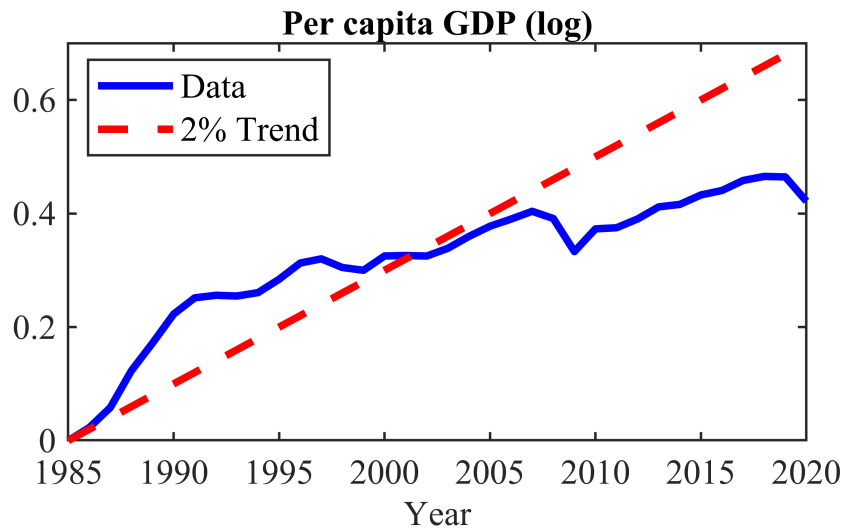
Why Japan? Deflation and secular stagnation

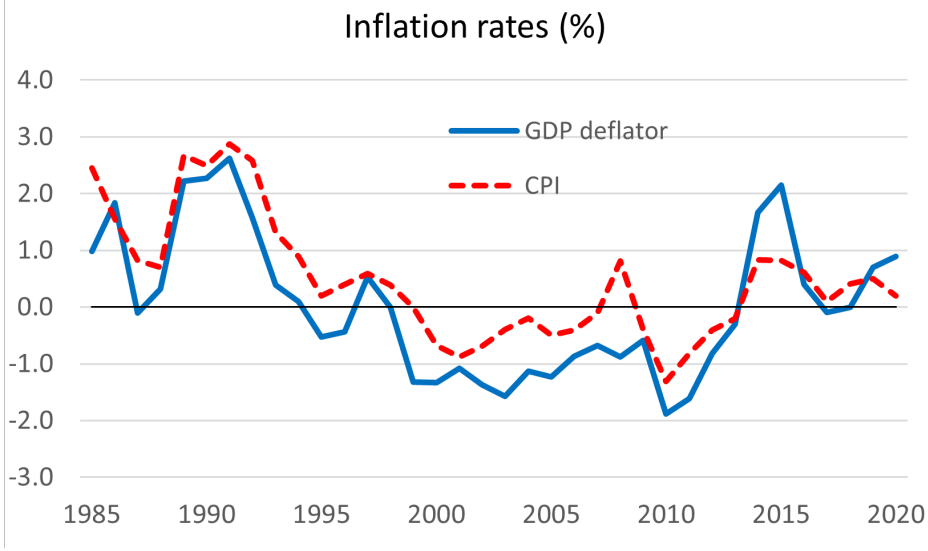


Note: Model is Braun, Ikeda, and Joines (2008)

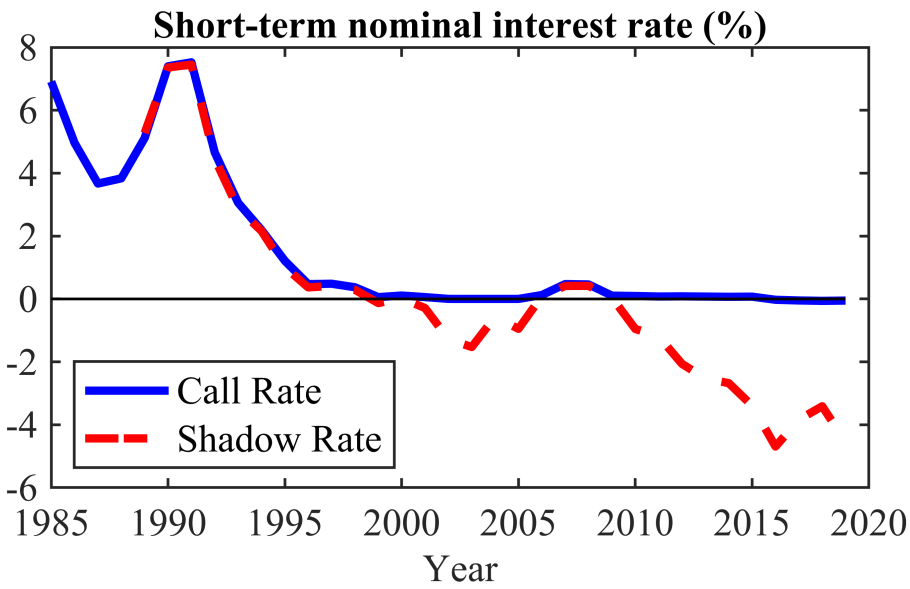


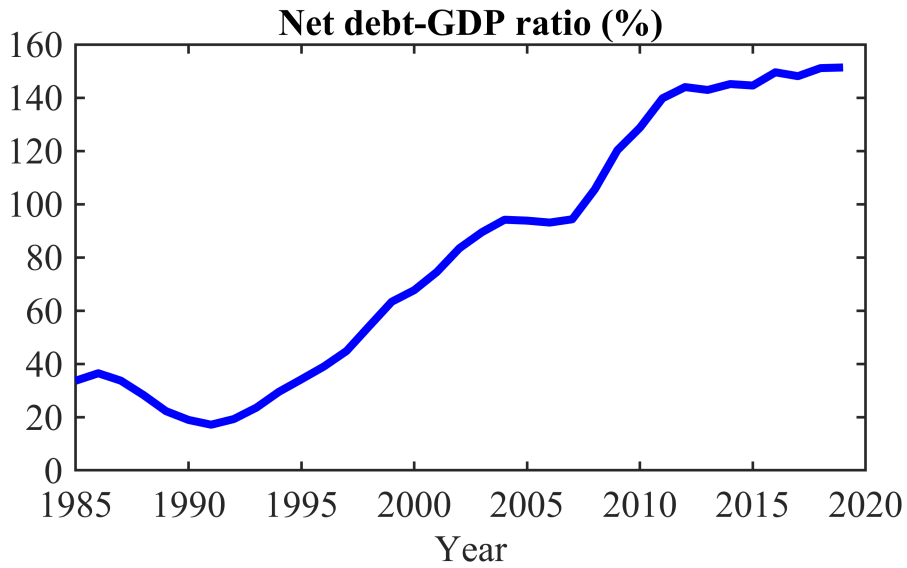
Between 1990 and 2020, secular declines and persistently low levels of

1. Real interest rate
2. Per capita GDP
3. Inflation rate



More data facts: government policy reactions





Note: Shadow rate is Ueno (2017).

1. Monetary policy: large, persistent decline in the nominal interest rate and unconventional monetary policy
2. Fiscal policy: large, persistent increase in the debt–GDP ratio

Road map

1. Quantitative OLG model
   - Overview
   - Demand theory of the price level (Hagedorn, 2021)
   - Model performance in the short run (Braun and Ikeda, 2021)
2. Main results: quantitative effects of aging
   - Partial equilibrium
   - General equilibrium
   - Anatomy of aging-driven secular stagnation
   - Robustness analysis

Quantitative OLG model: firms and govt

The model is based on Braun and Ikeda (2021)

Firms: Intermediate goods firms and final good firms

- Capital and labor input
- Nominal price rigidity (Rotemberg, 1996)

Government: monetary and fiscal authorities

- Taylor rule for the nominal interest rate
- Nominal debt; taxes; public pensions

Quantitative OLG model: households

Households: overlapping generations aged 21-120

- Representative cohorts
- Mortality risk
  - Death event known at beginning of final period of life
  - No accidental bequests
- Asset demand
  - Illiquid assets (capital; equity)
  - liquid assets (private iou's, gov. bonds)
  - Convex costs of adjustment on illiquid assets
  - Natural borrowing constraint
- Labor supply
  - Age profile of efficiency units of work is hump–shaped
  - Working households join a labor union
  - Hours worked identical for all workers

Household consumption-saving problem

Age j household observes death event $z_j \in \{0,1\}$ and chooses consumption c_j, liquid assets d_j, and illiquid assets a_j to maximize

$$U_j(a_{j-1},d_{j-1},z_j) = \max_{\{c_j,a_j,d_j\}} \left\{ \frac{\eta_j \left(c_j/\eta_j\right)^{1-\sigma}}{1-\sigma} - \frac{\upsilon}{1+\frac{1}{\nu}} h_j^{1+\frac{1}{\nu}} \right.$$
$$\left. +\beta z_j \left[(1-\psi_{j+1}) U_{j+1}(a_j,d_j,0) + \psi_{j+1} U_{j+1}(a_j,d_j,1)\right] \right\},$$

subject to

$$(1+\tau^c)c_j + a_j + \chi(a_j,a_{j-1},z_j) + d_j$$
$$\leq \tilde{R}^a a_{j-1} + \frac{\tilde{R}}{\pi} d_{j-1} + (1-\tau^w) w \epsilon_j h_j + b_j + \xi$$

Mandatory retirement: $\epsilon_j = 0$ for $j \geq J_r$

Demand Theory of the Price Level

- Hagedorn (2021); Hu, et al. (2021)
- Govt sets the amount of nominal debt D^n every period

  $\neq$ FTPL where govt sets real surpluses

- Debt market clearing condition: supply = demand

$$\frac{D^n}{P} = \sum_{j=1}^{J} \sum_{z_j \in \{0,1\}} d_j(z_j) N_j$$

Given D^n, demographics $\{N_j\}_{j=1}^J \Rightarrow$ demand $\Rightarrow$ price P

Model performance in steady state

Steady-state age profiles of net wort and assets

	Net Worth		Liquid assets		Illiquid assets	
Age	Model	Data	Model	Data	Model	Data
Under 30	0.01	0.65	-0.63	-0.08	0.64	0.73
30–39	0.88	1.60	-0.85	-0.58	1.73	2.18
40–49	2.85	2.58	0.19	-0.31	2.65	2.90
50–59	5.54	4.52	2.23	0.76	3.31	3.76
60–69	7.27	6.29	3.63	1.70	3.64	4.60
70+	4.16	6.01	0.94	1.77	3.22	4.25

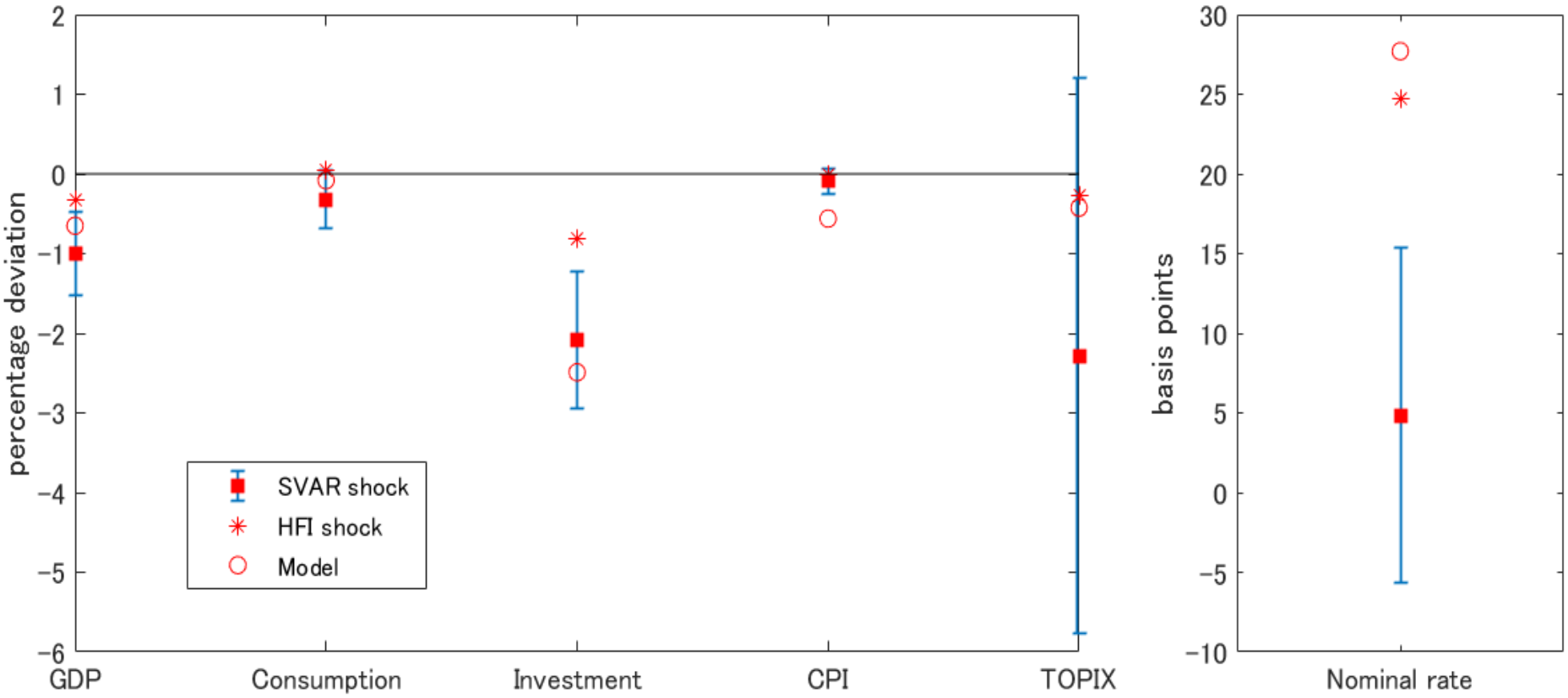
Note: Relative to income of households aged 50–59

Source: Braun and Ikeda (2021)

- Net worth is hump–shaped
- Leverage: Young borrow liquid assets to purchase illiquid assets
- Old have large positive holdings of liquid and illiquid assets

Model performance in the short run

Impulse responses to a 1% tightening in MP in the impact year



Notes: Cumulative responses in the impact year, HFI identification based on Kubota and Shintani (2021). SVAR identification based on Ikeda et al. (2020). Vertical lines are 90% confidence intervals. The source is Braun and Ikeda (2021).

Long-run simulation (this paper)

- One period = 1 year; starting from 2014
- Population by age for years 2014–2060 from IPSS
  1. Year 2014 age–asset distribution
  2. survival probabilities 2014–2060
  3. birth rates 2014–2060.
- Other conditioning assumptions
  - Nominal per capita government debt fixed in all periods
  - Government budget constraint closed by adjusting lump–sum tax
  - Central bank follows monetary policy rule

$$\log(R_t/R) = 0.35 \times \log(R_{t-1}/R) + (1 - 0.35) \times 2 \times \log(\pi_t)$$

Partial equilibrium: asset demand glut

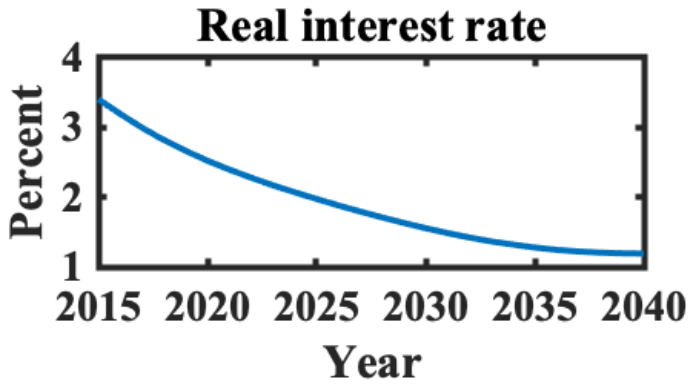
Changes in population distribution due to

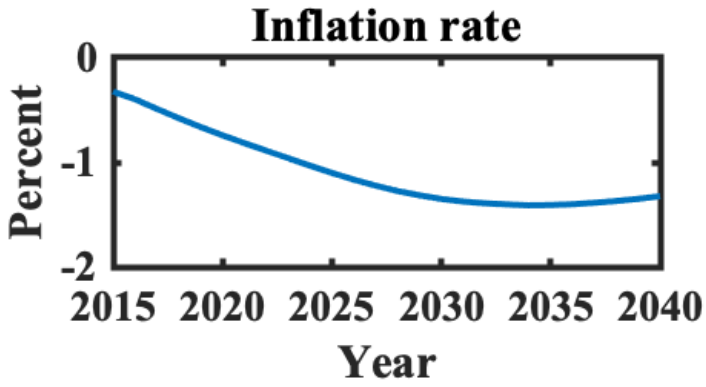
1. Aging of babyboomers: initial distribution
2. Longer life expectancy: higher survival rates
3. Lower fertility rates: birth rate of households aged 21

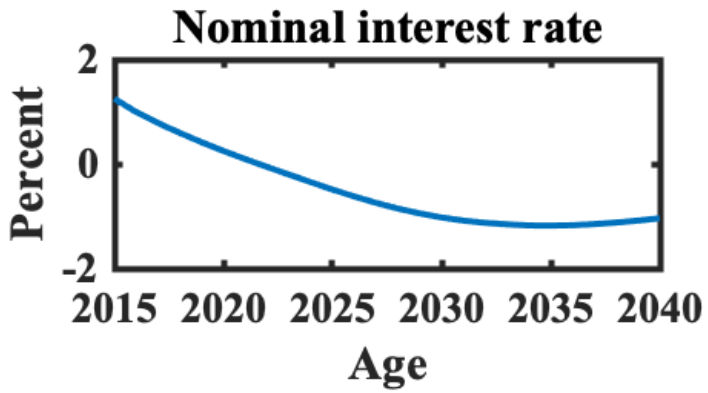
Year of maximum increase in assets (percentage change from 2014)

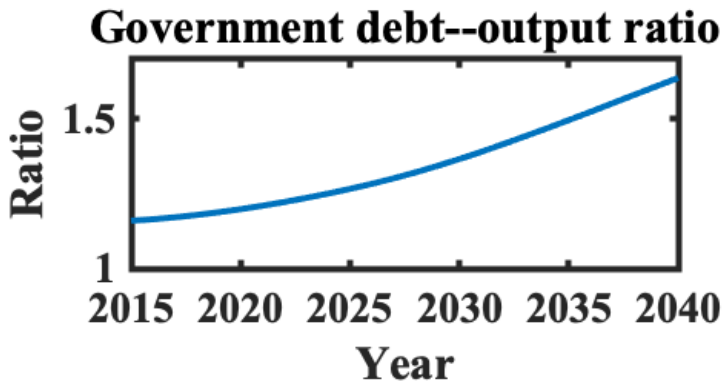
Demographic Scenario	Liquid assets	Year	Illiquid assets	Year
Aging of Babyboomers	19.83	2038	2.32	2029
Longer life expectancy	0.63	2045	0.07	2044
Lower fertility rates	24.12	2065	6.18	2067
Baseline	27.1	2043	5.24	2053

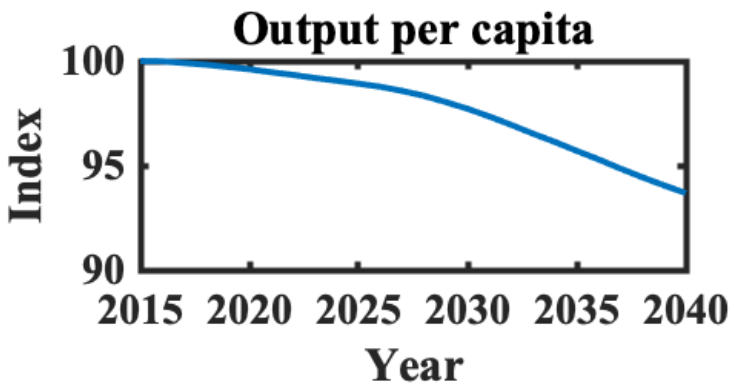
General equilibrium: interest rates, inflation and output



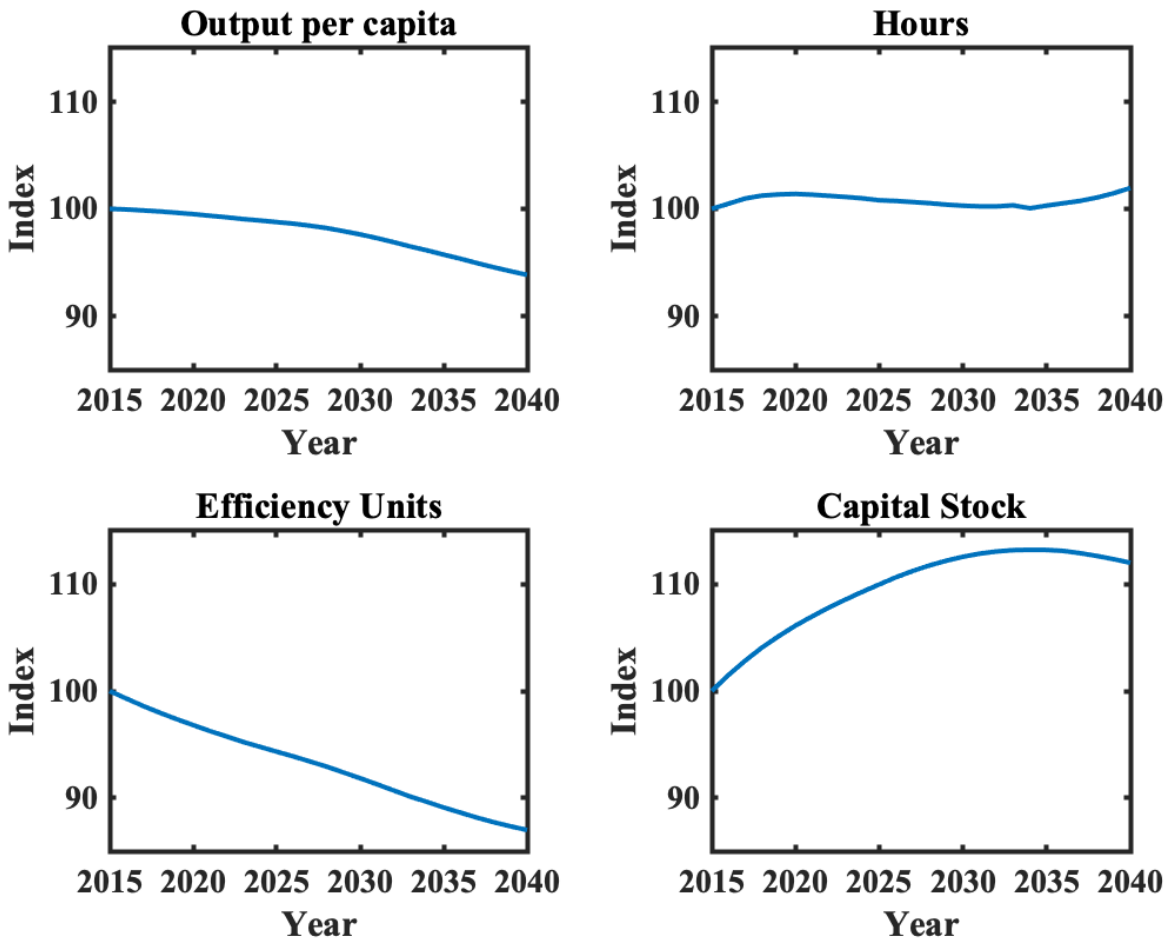








Why does output decline?



- (Raw) hours per worker flat
- Hours in efficiency units exhibits steady decline due to aging
- Capital deepening (real interest rate declines)

Anatomy of aging-driven secular stagnation

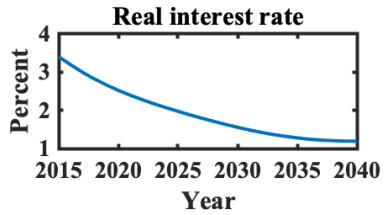
- Demographic transition: aggregate labor input h declines in future
- Future real rates are lower: $R^k \propto \alpha k^{\alpha-1} h^{1-\alpha}$
- Increases in demand for liquid and illiquid assets
  - $k\uparrow \rightarrow R^k\downarrow$
  - Demand for liquid assets is particular strong and price level falls

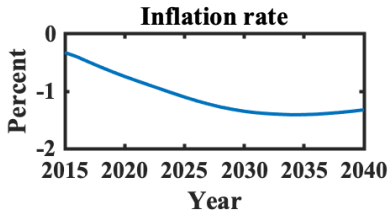
$$\frac{D_t^n}{P_t\downarrow} = \text{demand for liquid assets}\uparrow$$

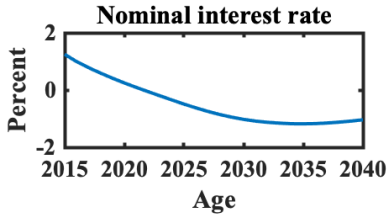
- Monetary policy: $P\downarrow \rightarrow R\downarrow$. Reaction of MP spreads out the response of the price level over time and depresses real interest rates.
- Asset substitution channel: $R\downarrow \rightarrow$ demand for $k \uparrow \rightarrow R^k \downarrow$

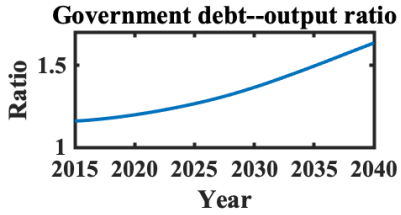
Contribution of nominal rigidities

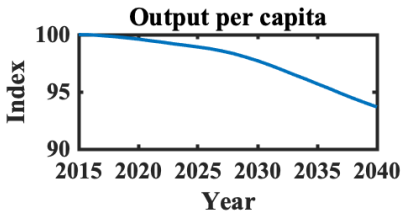
Costly price adjustment



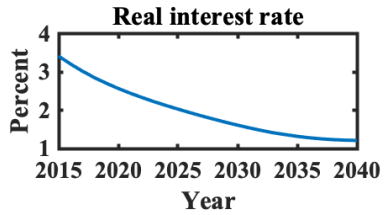


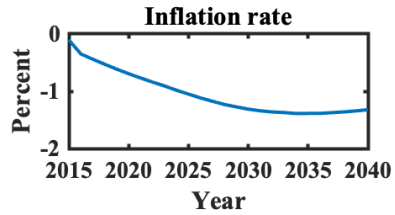


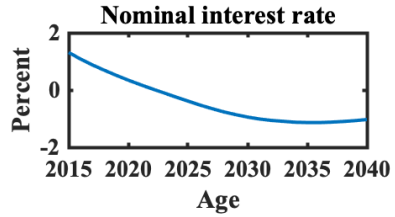


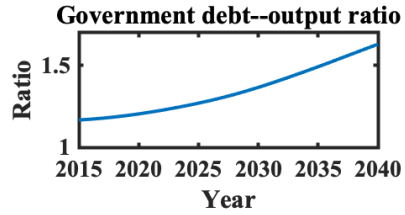


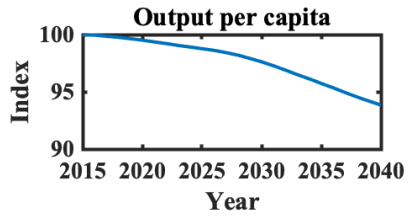
Flexible prices







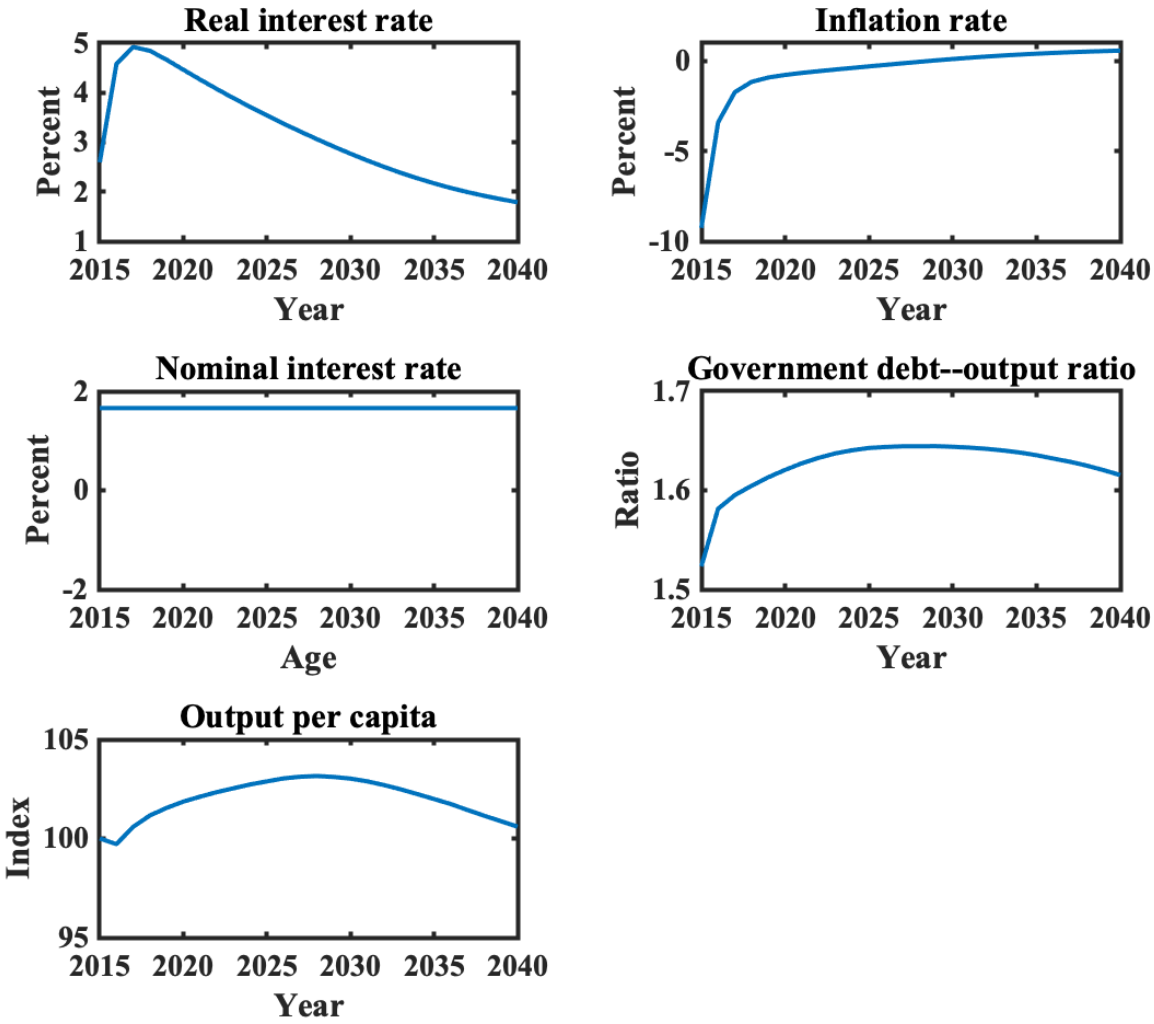




- Nominal rigidities are not important for secular stagnation

Does the reaction of monetary policy matter at all?

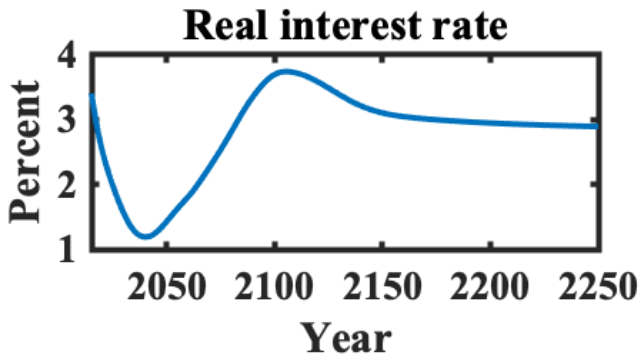
- Suppose instead nominal interest rate is fixed $\forall\ t$

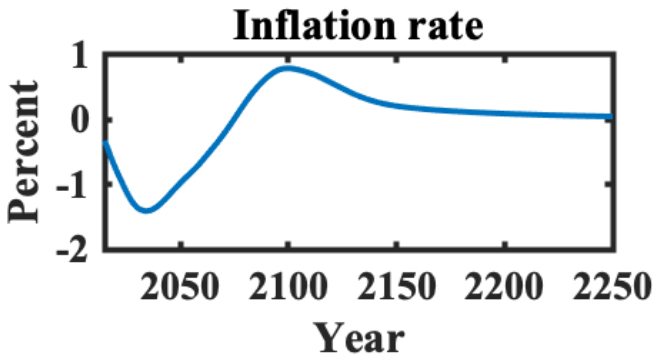


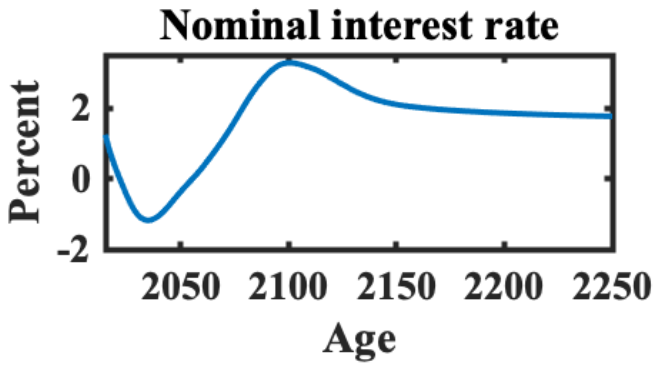
- Yes! Severe deflation; real rate initially increases; output increases

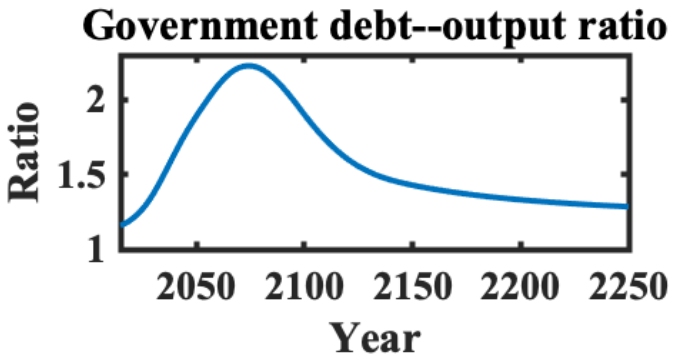
Unpleasant monetarist arithmetic

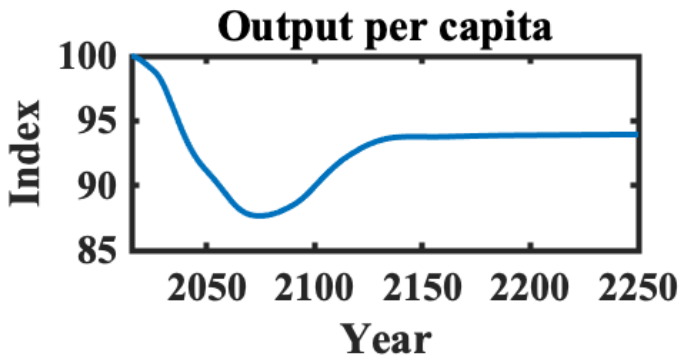
- Deflation followed by inflation (Goodhart and Pradhan, 2017)



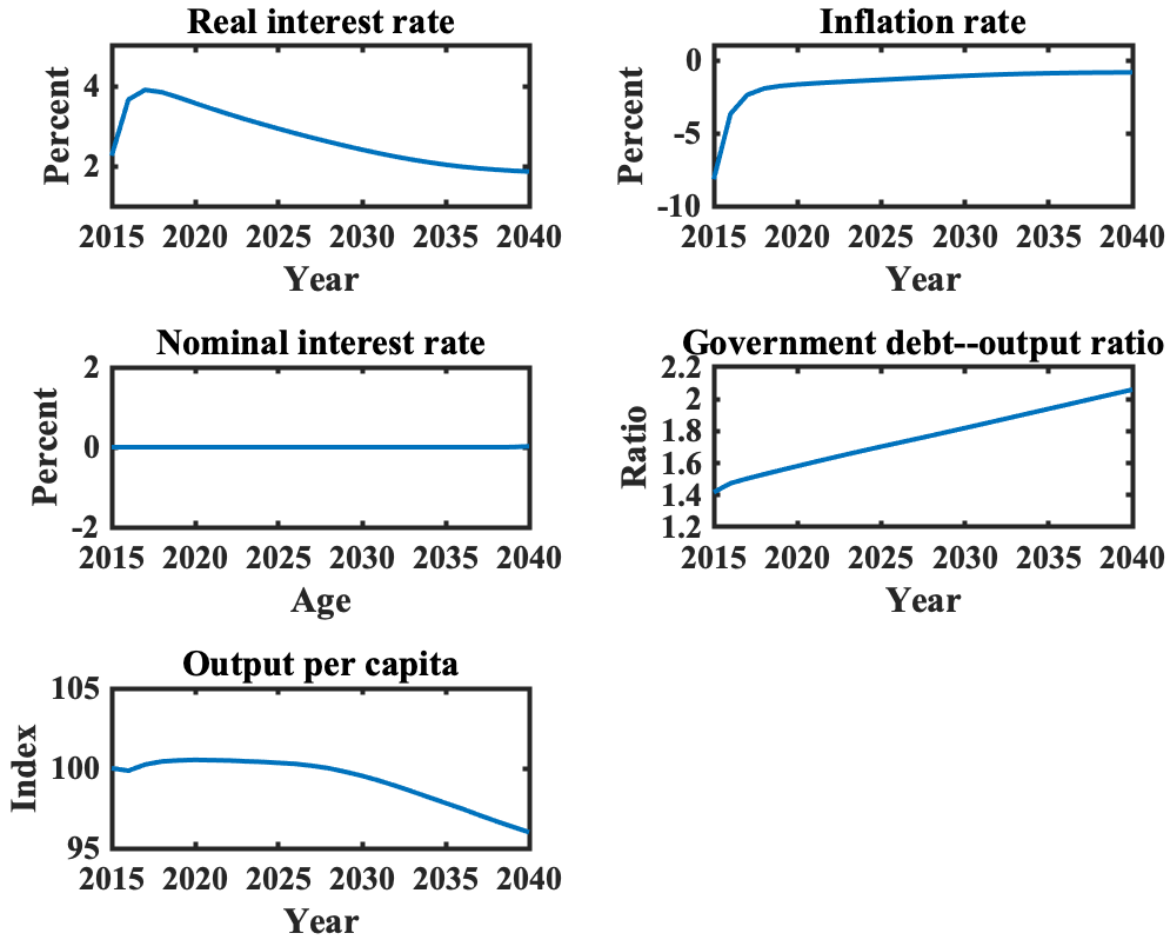








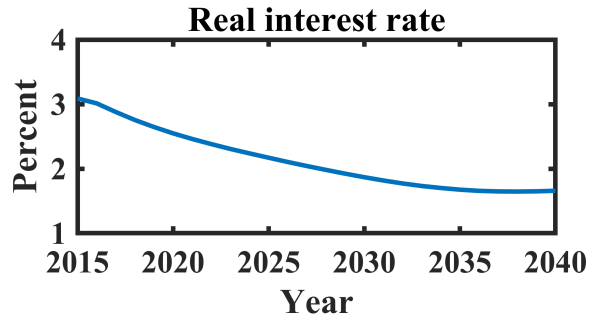
Robustness: impose the effective lower bound

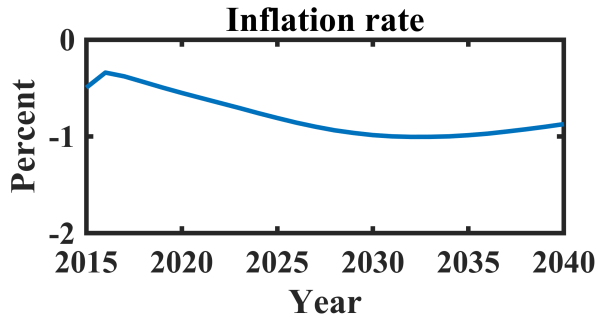


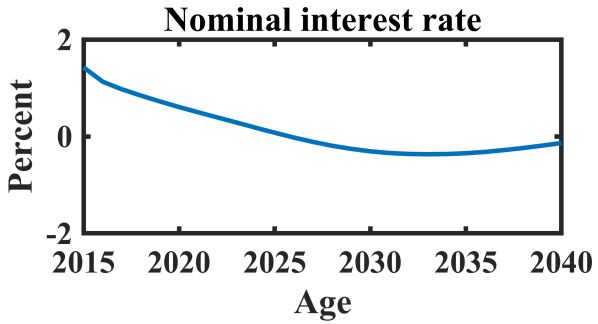
- Severe deflation; output puzzle; higher debt–output ratio
- UMP has been effective (see e.g. Ikeda et al., 2020).

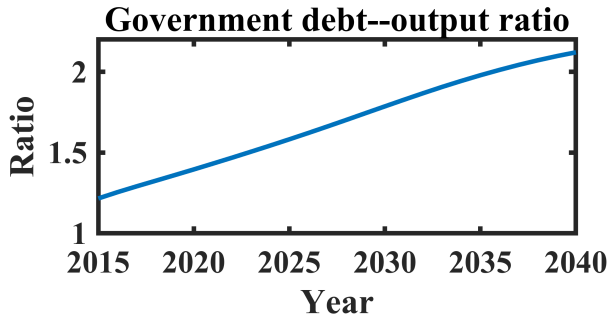
Robustness: an increase in nominal govt debt

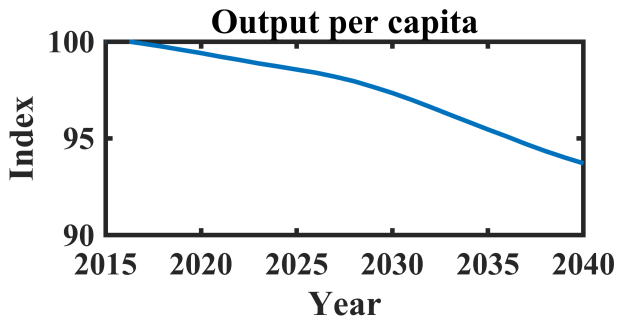
- Accommodate higher liquid asset demand
- Debt-output ratio 1.6 $\rightarrow$ 2.1 in 2040. Deflation floor is -1 percent.





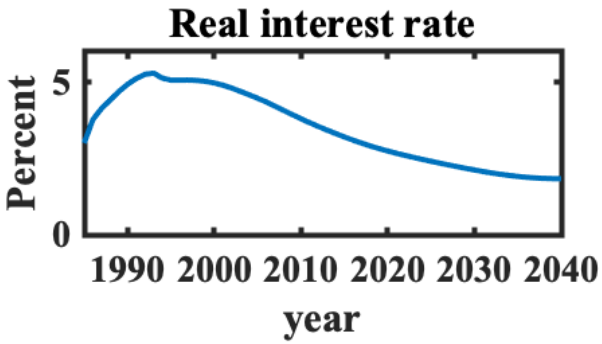


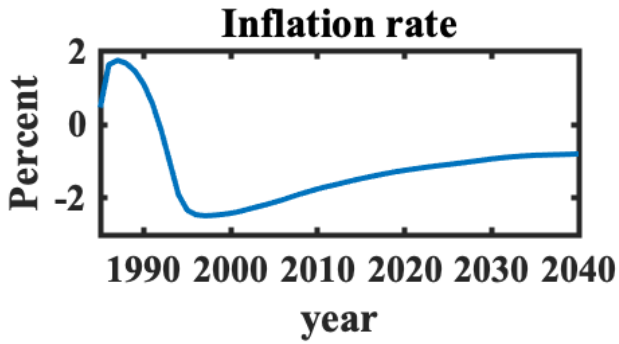


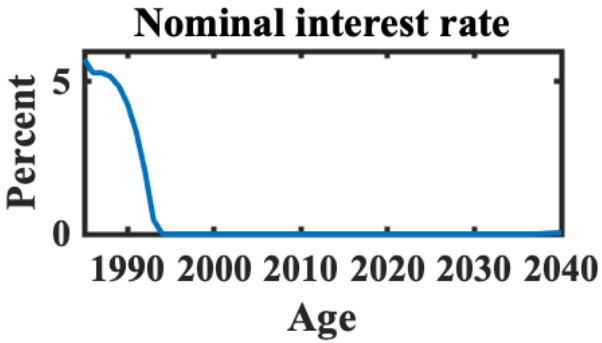


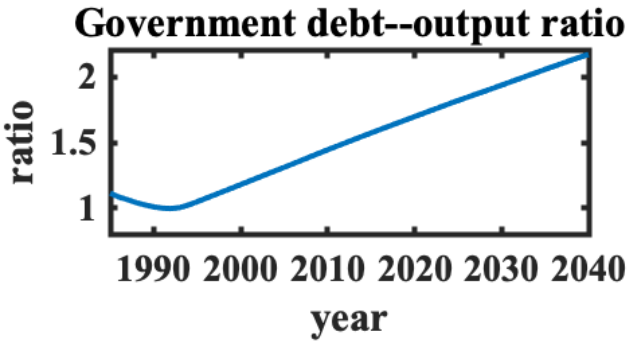
Robustness: starting year

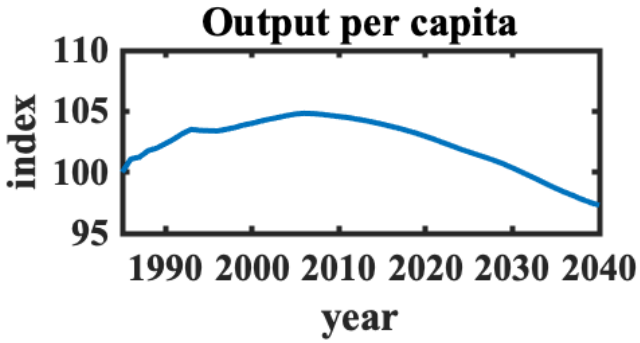
- Demographic transition is starts from 1983 and ELB is imposed.











Concluding remarks

- Demographic transition can induce "secular stagnation"
- MP rule has large macro effects during the demographic transition
- Why MP matters is asset substitution, not NK channels, not FTPL
- Our results are consistent with the following narrative:
  - Savings glut; safe asset shortage; weak investment
  - MP and FP have accommodated deflationary pressure induced by aging
  - UMP has been reasonably successful in addressing the ELB
  - An increase in debt-output ratios

Thank you!

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