Why aging induces deflation and secular stagnation.

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These are our personal views and not necessarily those of the Bank of Japan.

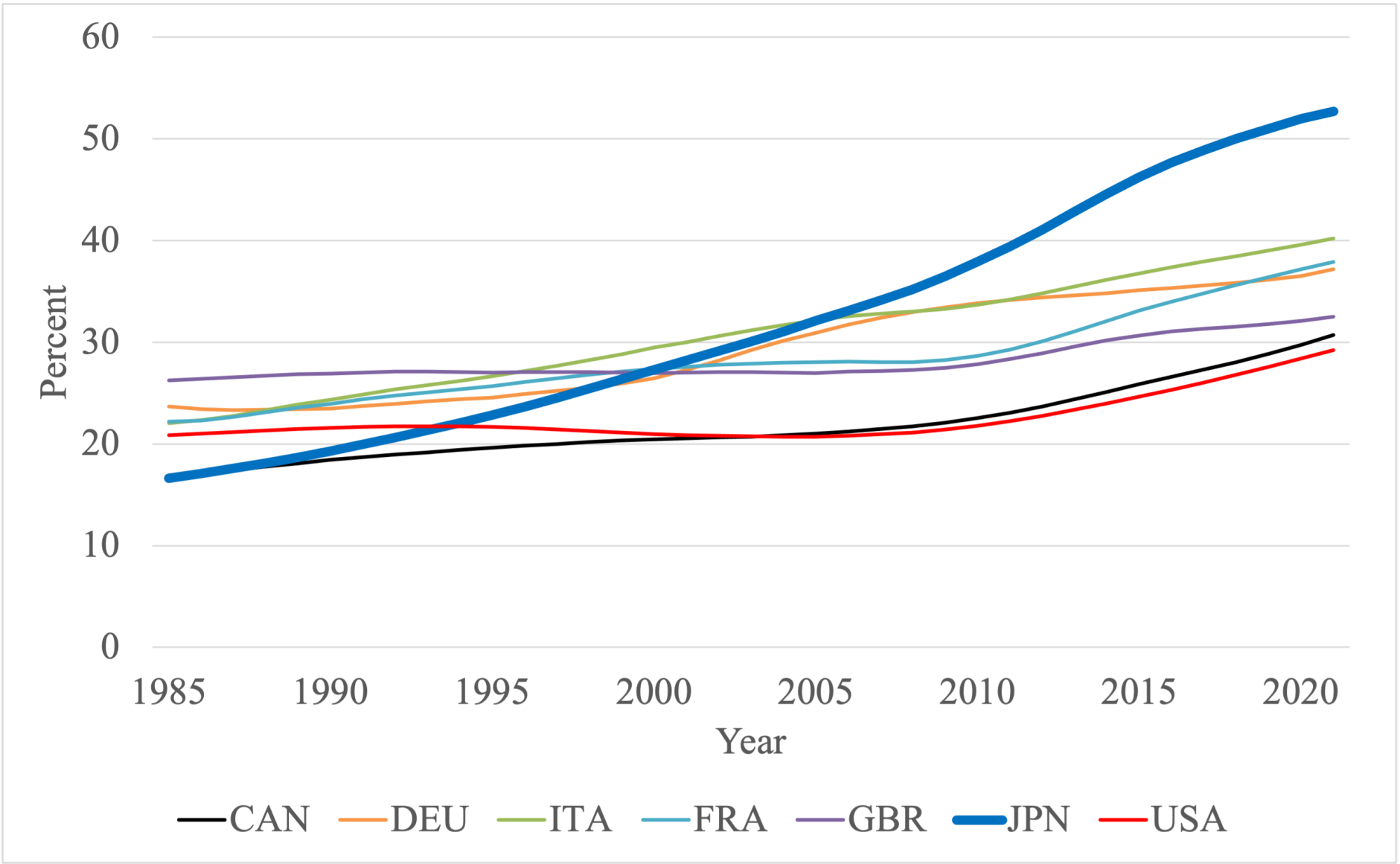
Deflation, Secular Stagnation and Govt Policy

- Motivation: (see Summers 2020, IMF)
  - Prior to the onset of COVID, many industrialized countries experienced protracted episodes of
    1. Deflation Low and in many cases negative inflation rates.
    2. Low real interest rates
    3. below trend GDP growth
  - These macro observations are puzzling because 4) monetary and 5) fiscal policy were unusually easy. Are conventional transmission channels of government policy broken?
- Questions
  - What produced low inflation and secular stagnation prior to 2020?
  - What disrupted the transmission channels of government policy?
  - Are low inflation and secular stagnation over?
- Our answer: Aging has been exerting quantitatively significant downward pressure on prices, real interest rates and real GDP growth in Japan and this pressure will continue for the next 15–20 years if monetary policy and fiscal policy respond in the standard way.

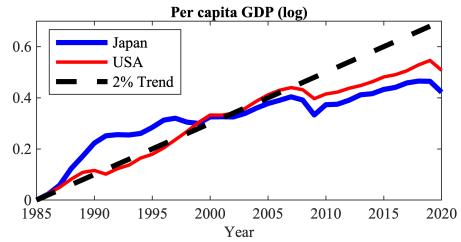
Aging: what is it and why might it be important?

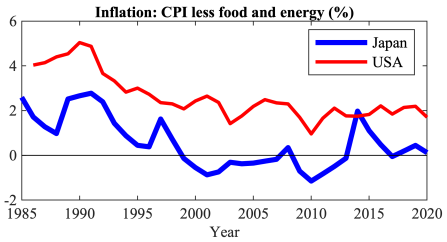
- Aging: A transition from a population–age distribution with a high fraction of working–age individuals to one with a high fraction of older individuals out of the labor force.
- Four factors influencing the age-distribution in advanced economies.
  - Aging of the post WW II babyboomer cohorts
  - Fertility rates are declining.
  - Life expectancy has increased.
  - Immigration flows.
- Why do changes in the age distribution matter for macroeconomic outcomes?
  - The age distribution influences
    - the ratio of the working population to the total population.
    - the skill distribution and average labor productivity of the working-age population.
    - aggregate demand for liquid and illiquid assets and leverage.
    - fiscal expenditures.

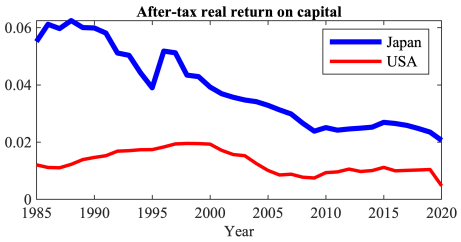
Aging in historical data: Group of Seven: old-age dependency ratios

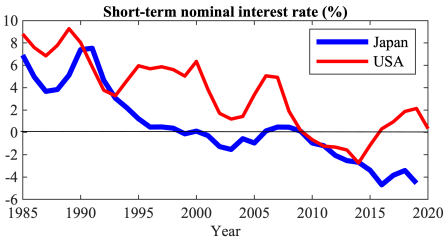


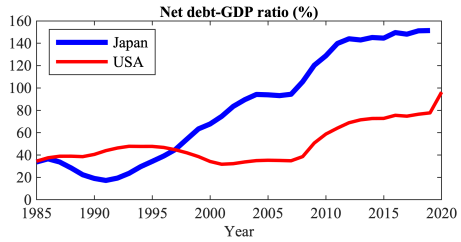
Macro outcomes in rapid and slow aging countries: Japan and USA







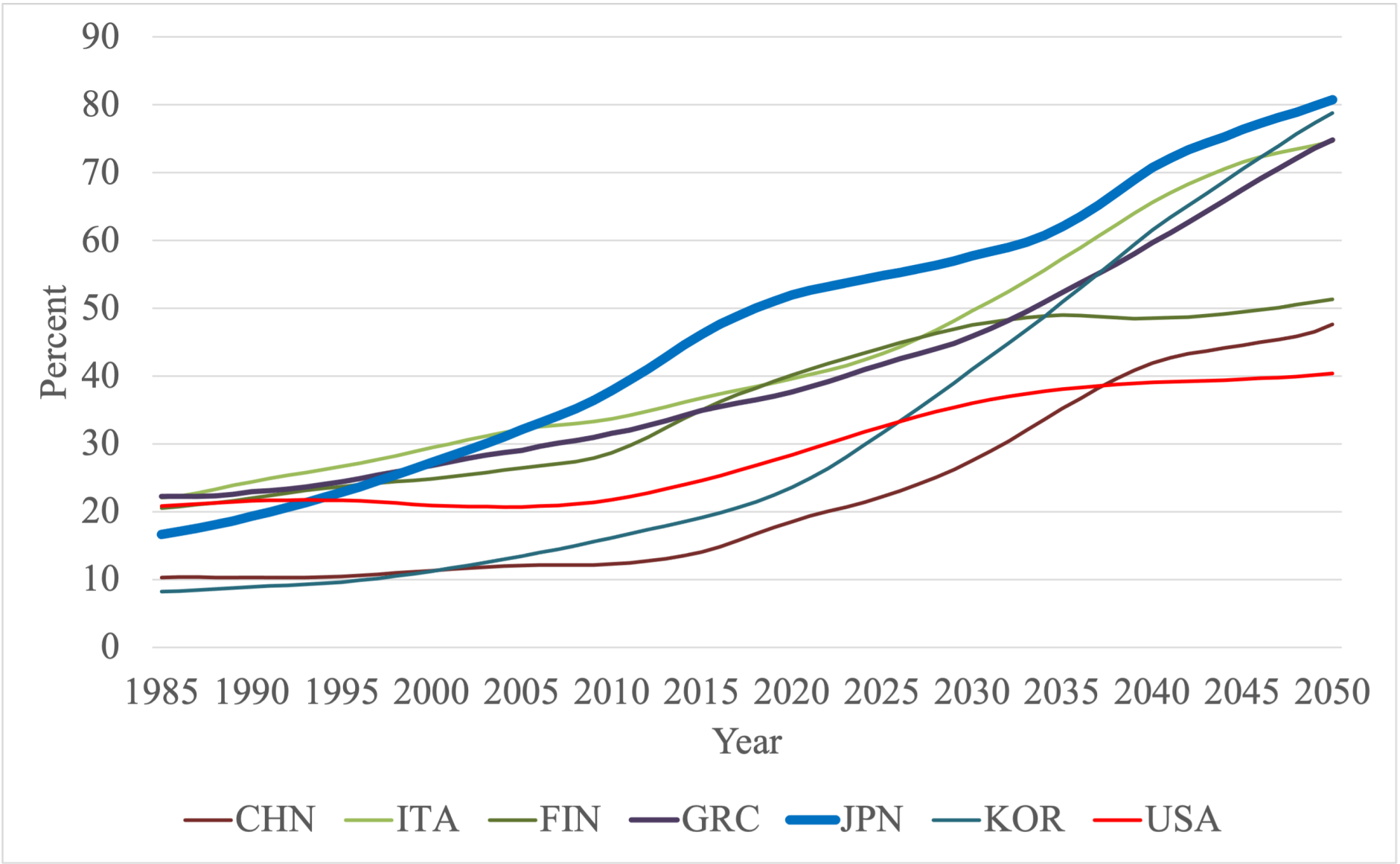




- Relative to USA, Japan has earlier and larger declines in
  1. Per capita GDP relative to trend
  2. Inflation rate
  3. Real interest rate
4. Monetary Policy
   Nominal interest rate is zero longer in Japan and effective rate is persistently negative.
5. Fiscal Policy Increase in Debt–GDP ratio is larger in Japan.

Aging is projected to accelerate

Old age dependency ratio *projections* in rapidly aging countries and USA



Support our claim with a model where I can relate the actors in the model to my family.

Main features of our general equilibrium lifecycle model

- Rich age structure.
- Households supply labor and solve nontrivial asset allocation problems.
- Detailed model of fiscal policy
  - Social security and taxes redistribute resources across age groups.
  - Government debt is a nominal asset.
  - Macro shocks create fiscal imbalances and fiscal policy response influences real and nominal macro variables.
- Monetary policy Central bank sets the nominal interest rate on government debt.
- Aggregate shocks and government policy have heterogeneous and persistent effects on me, my mother-in-law and my three sons.

Conduct impulse response analysis to an aging shock to assess its quantitative significance.

Road map of my talk

1. Explain why money matters in our model 2-period flexible price OLG model
   - Demand Theory of the Price Level (DTPL) How is the price level determined in our model?
   - Tobin Effect Asset substitution channel of monetary policy. How does it work?
   - FTPL Why do we use DTPL instead of FTPL to determine the price level?
2. Describe our quantitative OLG model
3. Model assessment Our model has sensible implications for how monetary policy affects households and macro aggregates.
4. Quantitative results IRFs to Japan's demographic transition
   - Partial equilibrium: asset demand glut.
   - General equilibrium.
     - Aging induces persistent downward pressure on real interest rates, real GDP and inflation rate and why.
     - How reactions of monetary and fiscal policy influence the macro and micro outcomes.

Let's use a *flexible price* 2–period OLG model to illustrate some key economic mechanisms

- Households active for 2-periods: N_t young; N_{t-1} old; $n_t = N_t/N_{t-1}$.
- Households inelastically supply one unit of labor when young, consume and pay taxes when old.
- Two assets: physical capital and nominal government bonds $\{k_t, d_t^n\}$.
- Firms perfectly competitive.
- Central bank sets the nominal interest rate R_t.
- Fiscal authority issues nominal government debt and collects lumpsum taxes $\{d_t^n, \xi_t\}$ to finance debt issue.

asset Demand Theory of the Price Level (DTPL)

Given nominal govt debt and nominal interest rate, $\{d_t^n, R_t\}$, capital and price level, $\{k_{t+1}, P_t\}$ are determined by Fisher equation

$$R_t \frac{P_t}{P_{t+1}} = R_{t+1}^k \equiv \alpha k_{t+1}^{\alpha-1} \tag{1}$$

and asset market clearing condition

$$\underbrace{\frac{d_t^n}{P_t} + n_{t+1} k_{t+1}}_{\text{supply}} = \underbrace{(1-\alpha) k_t^{\alpha}}_{\text{demand}} . \equiv w_t \tag{2}$$

Lumpsum tax, ξ_t determined by government budget constraint.

- Consider a steady state with $d_{t+1}^n = d_t^n = 1$ and $\pi_t = \pi_{t+1} = 1$.
  - Asset Substitution Effect: Higher R lowers k and lowers P.
  - Lower fertility rate lowers P but not π. Per capita k doesn't change but per capita output falls.

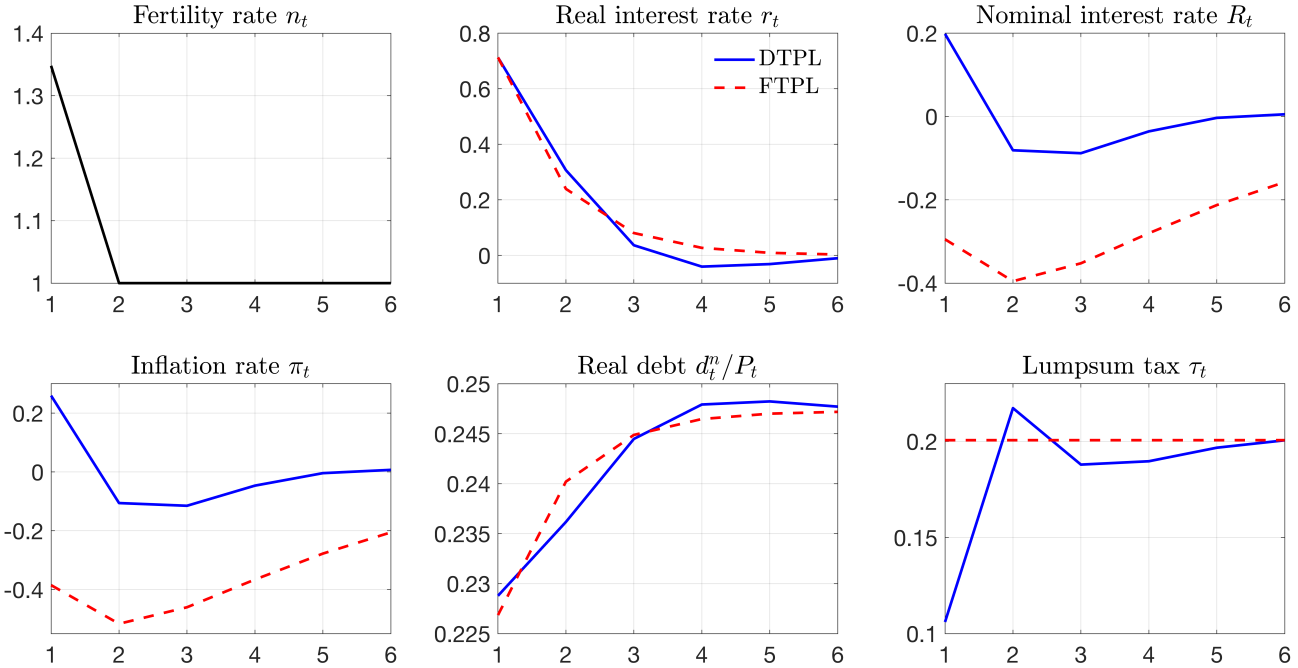
DTPL versus FTPL.

- In DTPL and FTPL capital and price level $\{k_{t+1}, P_t\}$ are equilibrium objects but different exogeneity assumptions.
- DTPL (our maintained assumption)
  - Nominal government debt is exogenous.
  - Fisher equation and asset market clearing condition determine $\{k_{t+1}, P_t\}$.
  - Government budget constraint determines per capita lumpsum taxes.
- FTPL
  - Per capita lumpsum taxes are exogenous.
    - Present value government budget constraint determines initial price level.
    - Asset market clearing condition determines k_t
    - Fisher equation determines π_t.
    - Government budget constraint determines govt debt d_t^n.
- FTPL comparative steadystate analysis with exogenous nominal interest rate.
  - Steadystate with a lower fertility rate has a higher steady state k, a lower real return on capital and a higher π.

DTPL and FTPL impulse response functions permanent decline in the fertility rate.

- If we take the perspective that the economy is transitioning from a steady state with a high fertility rate to one with a low fertility rate, then FTPL is a non starter. Inflation has to increase during the transition. If central bank uses a Taylor rule, stabilize inflation rate, R has to increase too.
- Suppose instead the news in initial period is that fertility is high today but will be lower in all future periods.
- Under this assumption we can do a clean comparison of the responses of DTPL and FTPL to lower fertility because terminal steady states have same k, same lumpsum taxes and same real government debt.
- Suppose also that monetary policy (MP) interest rate rule is $\log(R_t/R) = \phi_\pi \log(\pi_t)$.

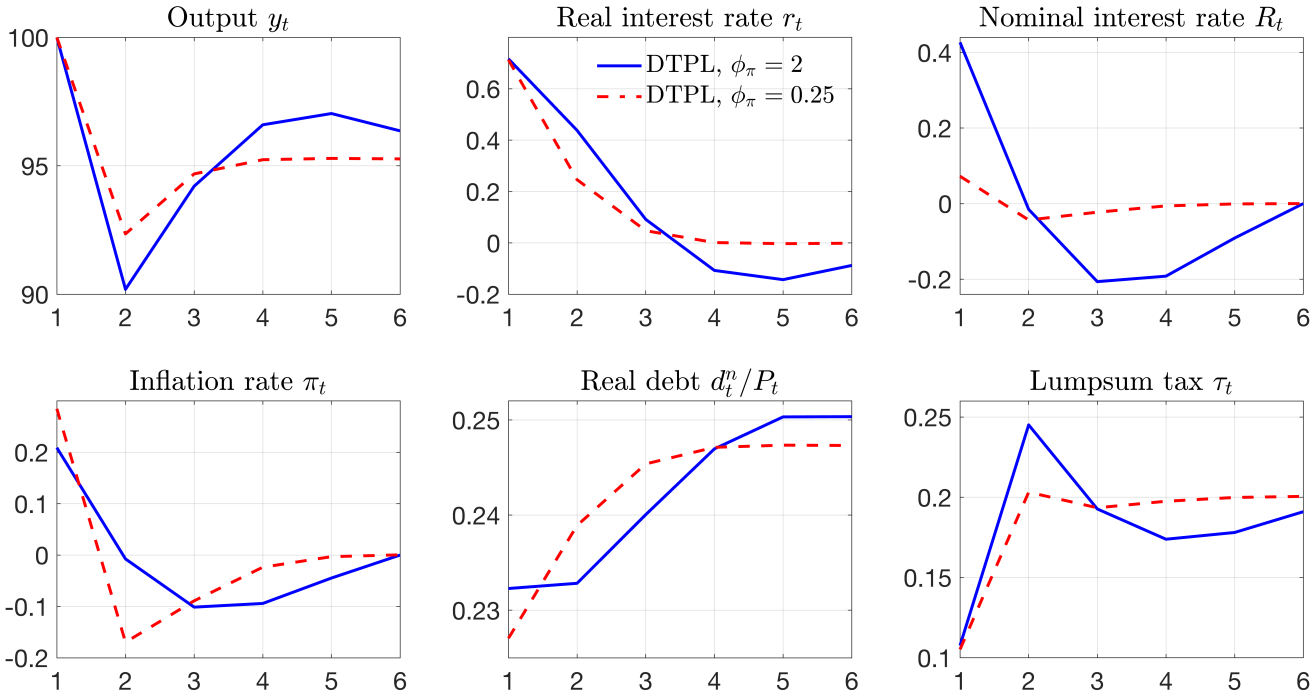
Are dynamic responses to fertility shock consistent with secular stagnation observations?



- Both specifications reproduce Summer's observation that secular stagnation is associated with a fall in the real interest rate (labor is becoming scarce).
- Both DTPL and FTPL predict increases in real government borrowing.
- Both specifications imply that output is increasing from period 3.
- FTPL comovement problem. inflation and nominal interest rate are increasing under FTPL whereas they fell in Japan and other advanced economies prior to COVID.
- DTPL: responses of inflation and nominal interest rate are consistent with Summer's secular stagnation observations.

Under DTPL monetary policy rule influences real allocations

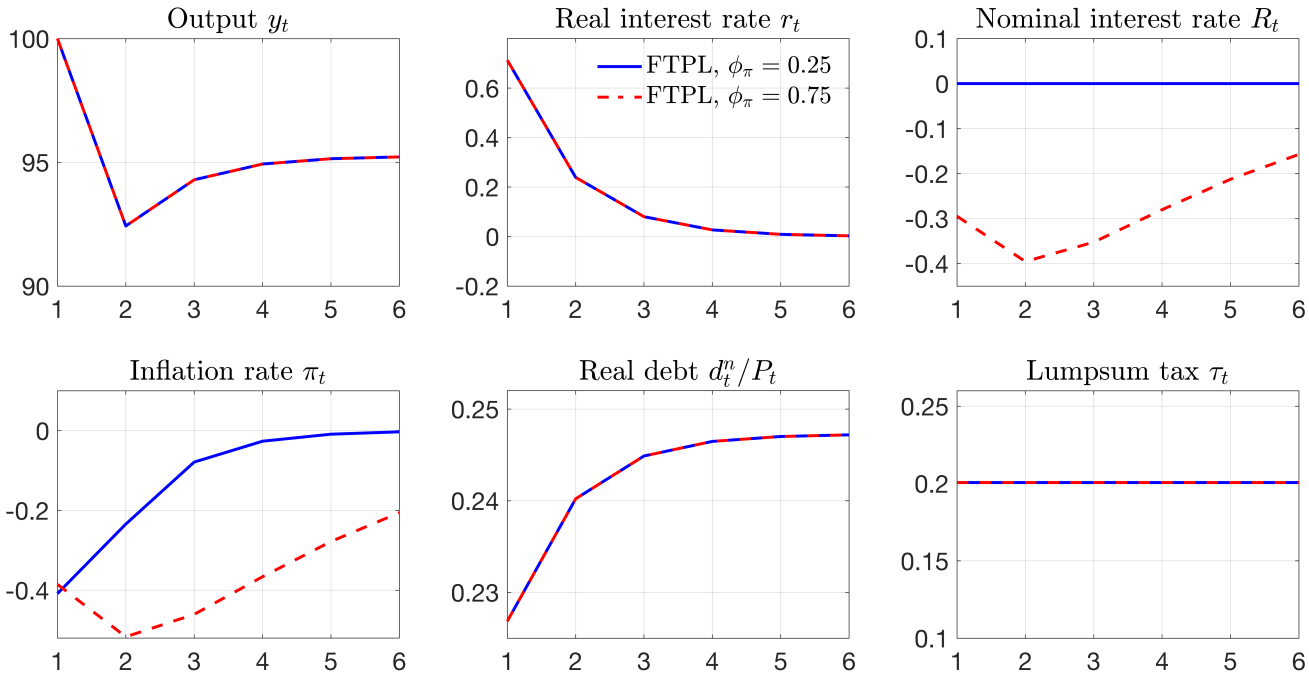
Dynamic responses to a fertility shock: DTPL and monetary policy rule with small and large ϕ_π



- Specification with $\phi_\pi = 2$ has more endogenous propagation than $\phi_\pi = 0.25$
  - Smaller but more persistent inflation response.
  - Less revaluation of government debt and more variation in taxes.
  - More persistent response in real interest rate.
  - Real interest rate, inflation rate and nominal interest rate move together persistently.
- More aggressive MP response depresses output more in periods 2 and 3!

Under FTPL monetary policy rule doesn't influence real allocations.

Dynamic responses to a fertility shock: FTPL and Monetary policy with small and large ϕ_π.



- Real interest rate and real govt debt are independent of ϕ_π
- Inflation rate and nominal interest rate responses differ but always approach terminal steady state from below.

Motivation for our quantitative model

1. Show that aging produces quantitative significant pressure on inflation, output, real interest rates.
2. Document (apparent) breakdown of monetary and fiscal policy.
3. Demonstrate that our quantitative model of money provides a unified theory of monetary policy in the short-run and medium term.

The *quantitative model* (100 period OLG model with nominal rigidities and imperfect substitutability of assets)

Environment

- Model period 1 year.
- Age distribution evolves according to a non-homogeneous markov chain. Inputs are fertility rate and time-varying survival rates based on government population projections (IPSS).

Firms and Government

- **Firms**: Intermediate goods firms and final good firms
  - Nominal price rigidity (one parameter) (Rotemberg, 1996)
  - Capital and labor input
- **Government: monetary and fiscal authorities**
  - Monetary Policy Taylor rule (two parameters)
  - Fiscal Authority Issues nominal debt; taxes labor and asset income; public pensions

Quantitative 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
- Dynamic asset allocation decisions
  - Illiquid assets (capital; equity)
  - liquid (private iou's, gov. bonds)
  - Leverage is constrained by natural borrowing constraint.
  - Endogenous liquidity premium (convex cost of purchasing and selling illiquid assets. (two parameters))
- Labor supply
  - Working households join a labor union
  - Hours worked and reference real wage is identical for all workers
  - Age profile of efficiency units of work is hump-shaped.

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 $j \geq J_r$

Households: comments on consumption-savings decisions

- Two parameters govern extent of financial frictions.
- Central bank sets the nominal interest rate on liquid securities, $d_{j,t}$ (private IOU's and government debt).
- Households purchase shares in mutual fund, $a_{j,t}$, that holds the market portfolio of illiquid assets:
  - equity in intermediate good firms,
  - physical capital.
- Natural borrowing constraint on $d_{j,t}$.
- $a_{j,t} > 0$ due to liquidity premium.
- No utility from illiquid assets.

Households: intuition for consumption-saving plans

Adjustment costs are important for reproducing steady-state age profiles of illiquid and liquid assets.
FONC for age j household (if death year is not observed):

$$\Delta a_j = \frac{1}{\gamma_a} s + \psi_{j+1} \frac{1}{r} \Delta a_{j+1} - \frac{1}{r}(1 - \psi_{j+1}) a_j$$

where γ_a : size of adj. costs; s : spread; r : real liquid interest rate; ψ_{j+1} : surv. prob.

term 1 Want to accumulate illiquid assets because spread is positive.

term 2 Investing in illiquid assets today enhances welfare if you survive beyond tomorrow.

term 3 Investing today reduces welfare if you die tomorrow.

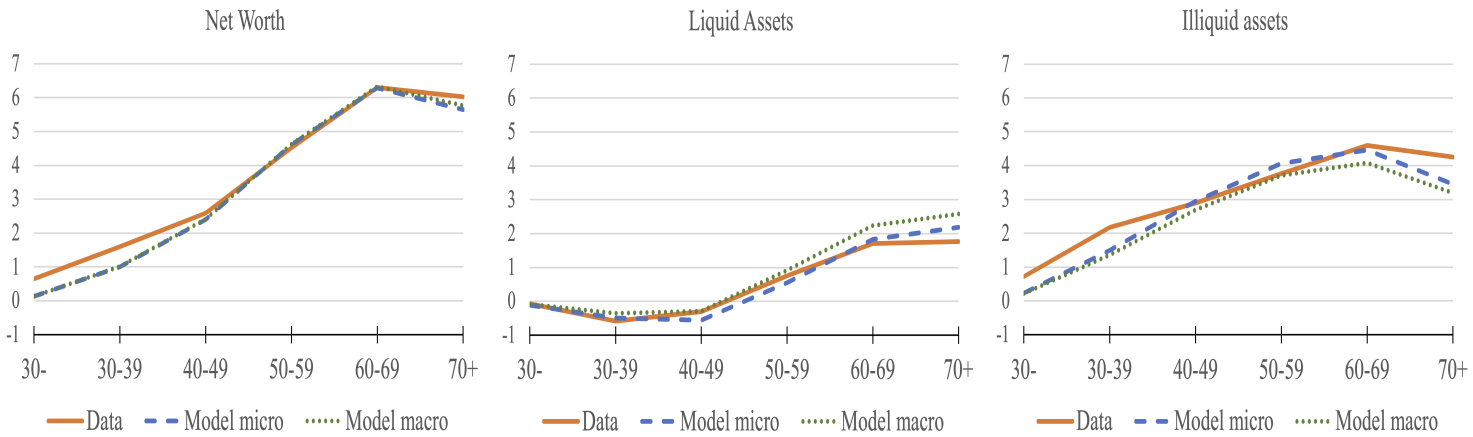
- Young households borrow liquid assets because spread is positive.
- Middle age households hold both liquid assets and illiquid assets because income drops at retirement and mortality risk is higher.
- Oldest households have large share of illiquid assets in their portfolio.

Parameterization and Assessment: Our model is a good quantitative model of monetary policy in the short run.

- Braun and Ikeda (2025) document the short run responses of monetary policy in our quantitative model.
  - Good aggregate properties (macro and financial variables).
  - Good micro properties (age profiles of consumption and disposable income).
  - Two transmission channels of MP. Nominal rigidities and asset substitution. Model resolves longstanding NK puzzles about response of investment in RANK and HANK.

- Aging slow persistent and predictable: operates at medium-term frequencies. We use (essentially) the same model here to analyze an aging shock.
- We will see that asset substitution channel of monetary policy is important for aging shock.

More on Assessment: Braun and Ikeda (2025).
1. Model reproduces SS age profiles of Net worth, liquid and illiquid assets

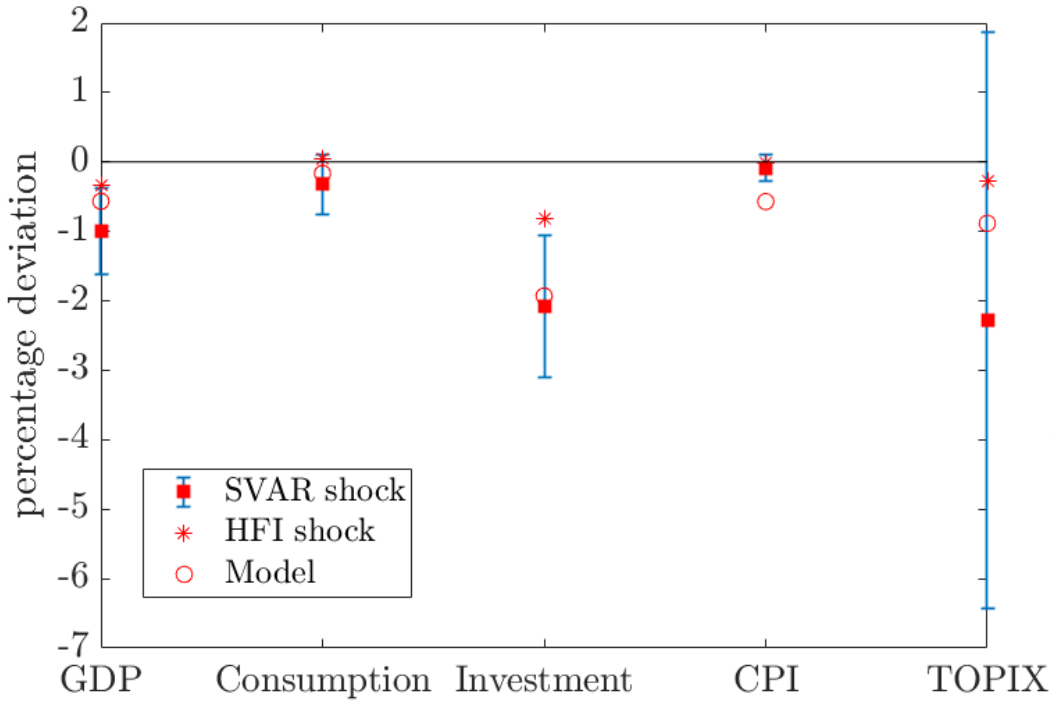


1. Hump-shaped age-profile of net worth in data and model.
2. Younger households take leveraged long positions in illiquid assets in both data and model.
3. Older households hold positive amounts of liquid and illiquid assets in data and model.
4. Asset levels remain high until late in life. 76 year olds in the model have net worth that is 5 times peak earnings.

Summary of Braun and Ikeda (2025)

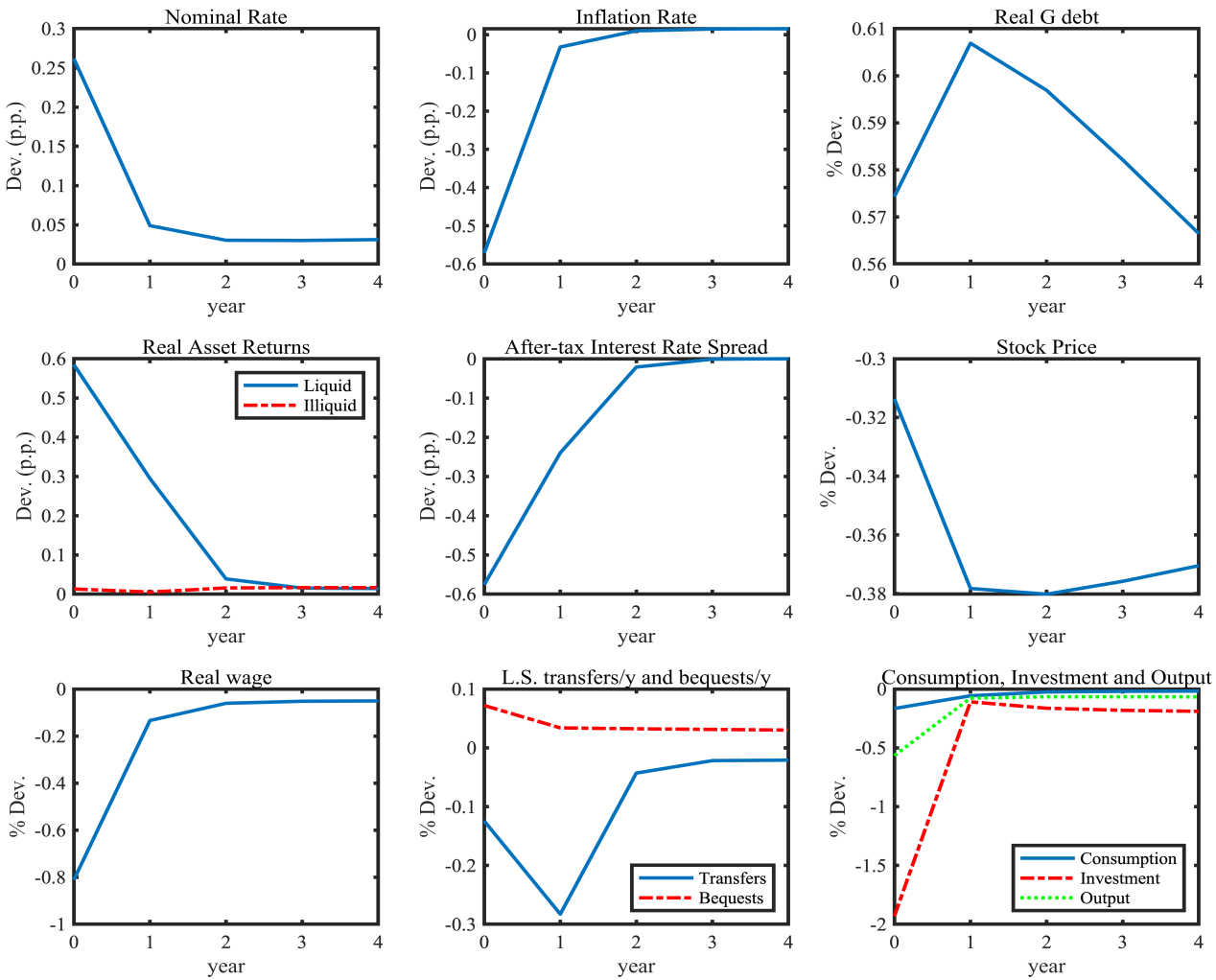
2. Model reproduces impact responses (year 0) to tighter MP (shock size is +0.01) model and data

Figure: Impulse responses by age to a tightening in monetary policy: data and model



Notes: The two data responses are cumulative effects over four quarters with the exception of TOPIX, which is the response of the stock price index in the impact quarter.

Model: Other aggregate responses to a tighter MP (shock size is +0.01)

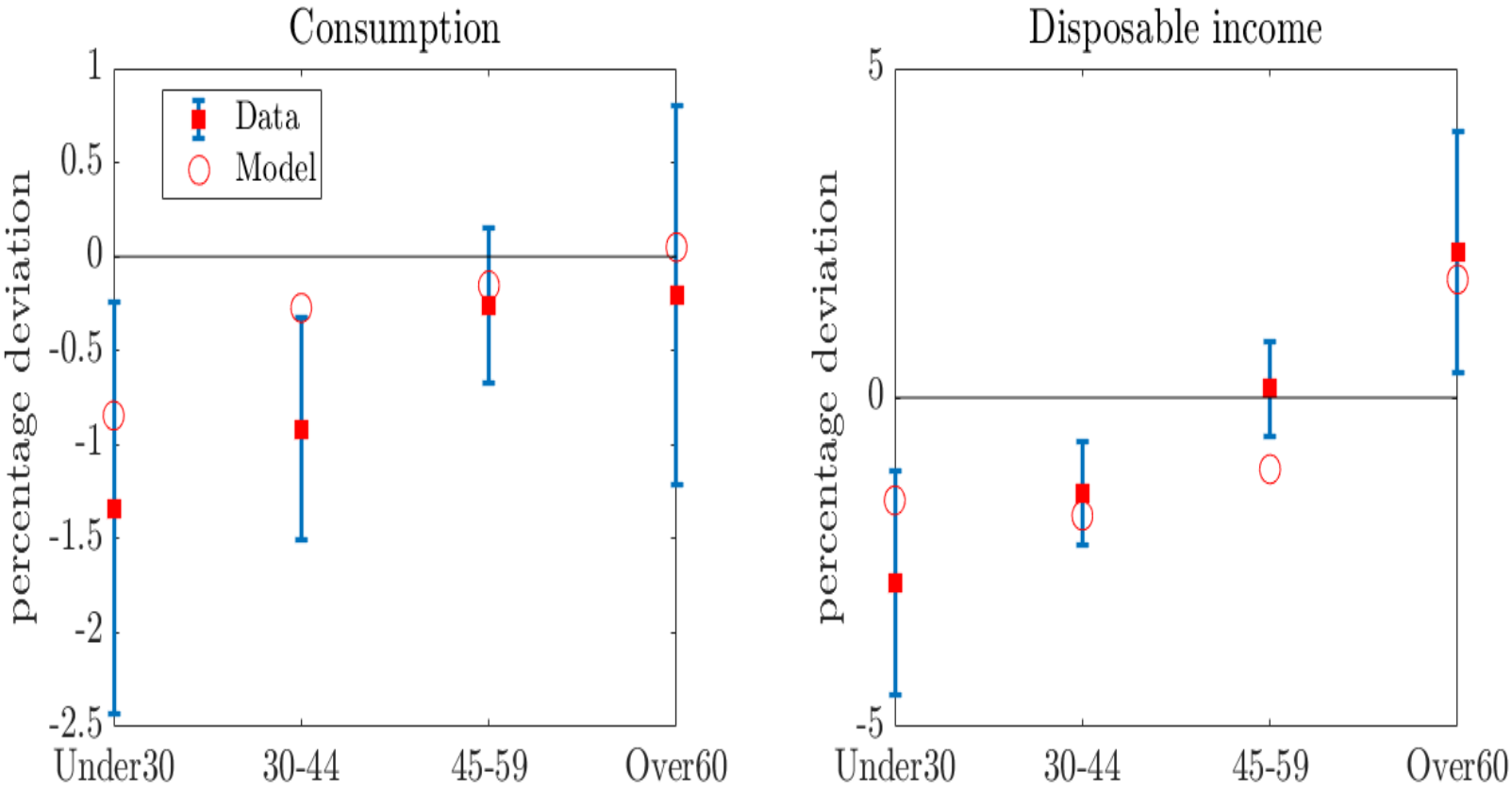


Summary: aggregate responses to a tighter MP

- Responses to a higher nominal policy rate
  - Inflation rate falls.
  - (Endogenous) interest rate spread narrows.
  - Price of equity falls persistently and overall real return on physical assets falls on impact.
  - Real wages fall.
  - Real stock of government debt increases.
  - Government transfers fall.

Summary of Braun and Ikeda (2022)

3. Model reproduces age-profile of consumption IRFs to MP shock.



Summary of Braun and Ikeda (2022)
4. Long and variable lags of monetary policy

Sign, size and persistence of consumption response of a household to monetary policy shock depends on its age.

- Peak (negative) consumption response of households aged 21 is in impact year -1.5.
- Peak (positive) consumption response of households aged 61 occurs 30 years after the shock arrives 0.14.

Aging shock: Initial conditions and conditioning assumptions for simulations

- 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 lumpsum tax
  - Central bank follows monetary policy rule

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

Aging induces an Asset Demand Glut

Partial equilibrium aggregate demand for liquid and illiquid assets

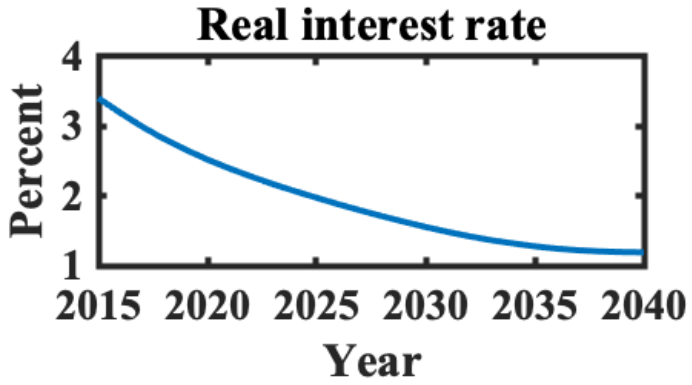
Changes in population distribution due to

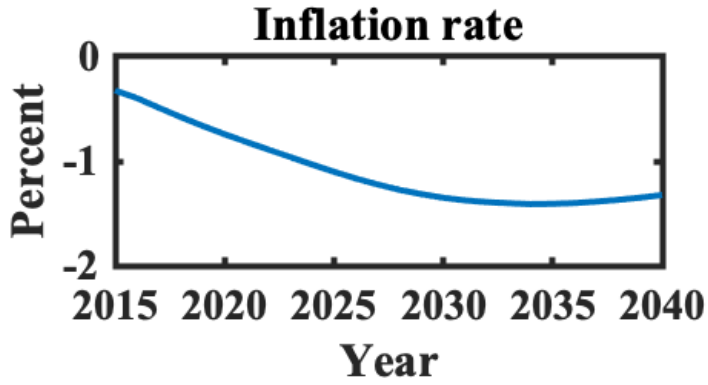
1. Aging of babyboomers: initial distribution
2. Longer life expectancy: higher survival rates
3. Lower fertility rates: birth rate of households aged 21

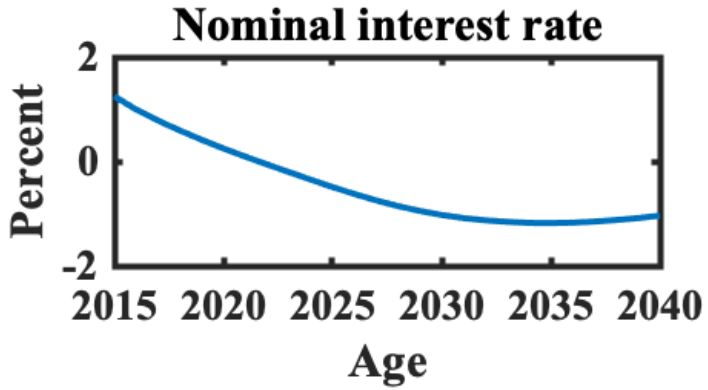
Year of maximum increase in assets (percentage change from 2014).

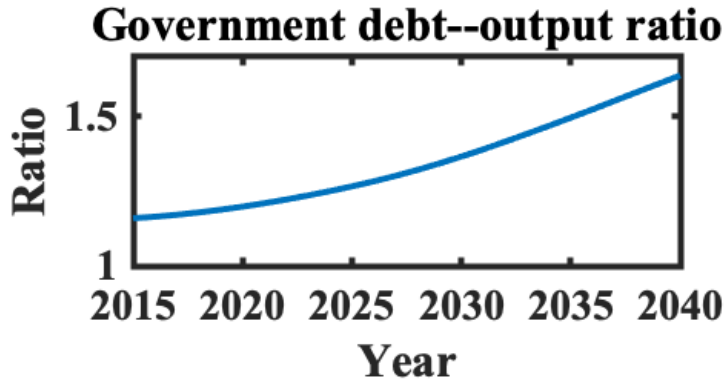
Demographic Scenario	Liquid assets	Year	Illiquid assets	Year
Aging of Babyboomers	19.83	2038	2.32	2029
Longer life expectancy	0.63	2045	0.07	2044
Lower fertility rates	24.12	2065	6.18	2067
Baseline	27.1	2043	5.24	2053

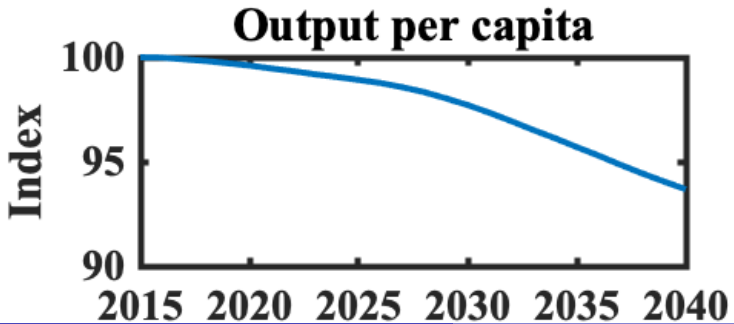
General Equilibrium: Aging accounts for all five secular stagnation observations



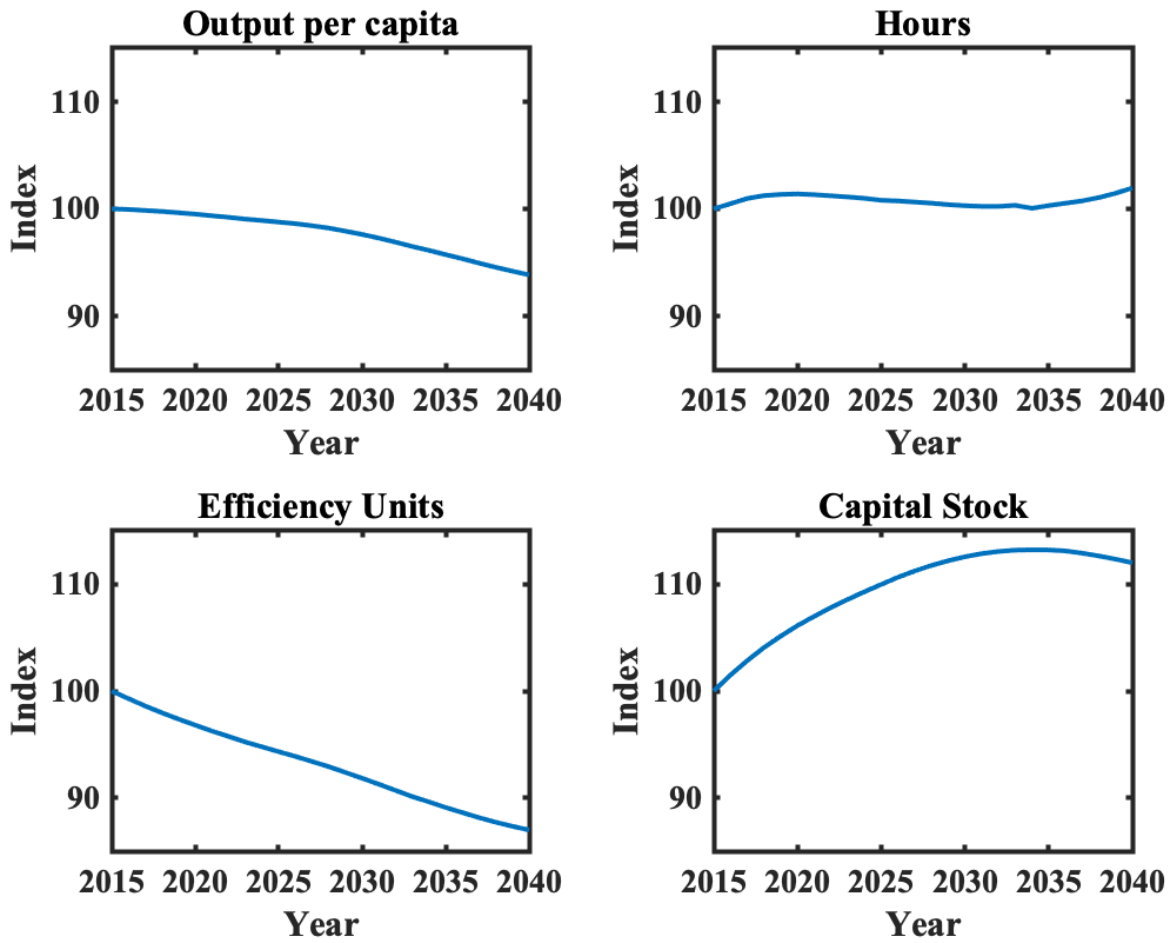








Why do output and real interest rates decline?



- (Raw) hours per worker flat
- Aggregate labor efficiency units exhibit a steady decline due to aging
- Capital deepening (real interest rate declines)

Why does the price level decline?

- Savings glut for liquid assets
  - Demand for liquid assets is particularly strong and price level falls (DTPL).

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

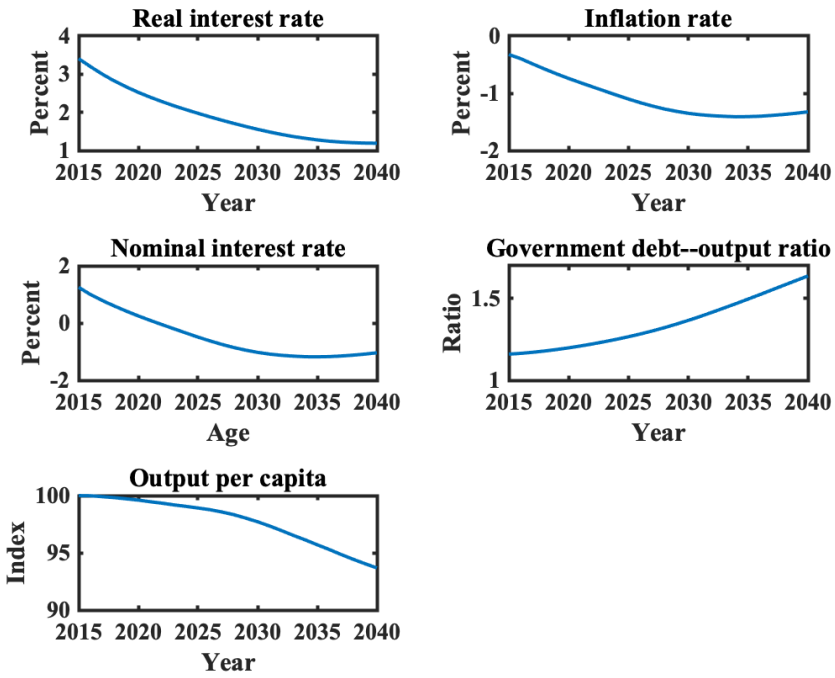
- Capital deepening
  - Capital deepening compounds the downward pressure on prices.
  - Return on illiquid assets falls and the interest rate spread widens.

Breakdown of monetary policy transmission channel

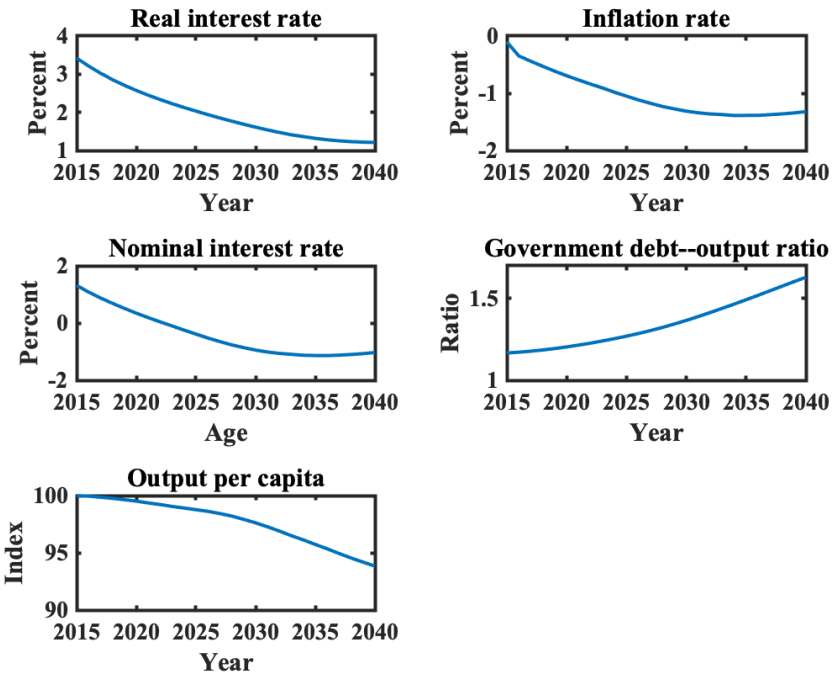
- Central bank responds to aging by lowering nominal interest rate.
- Why doesn't reaction of monetary policy
  - stimulate real economic activity?
  - or at least produce inflation?
- Two transmission channels of monetary policy in our model
  1. Nominal price rigidities (New Keynesian models)
  2. Asset substitution channel.

Contribution of nominal rigidities

Costly price adjustment



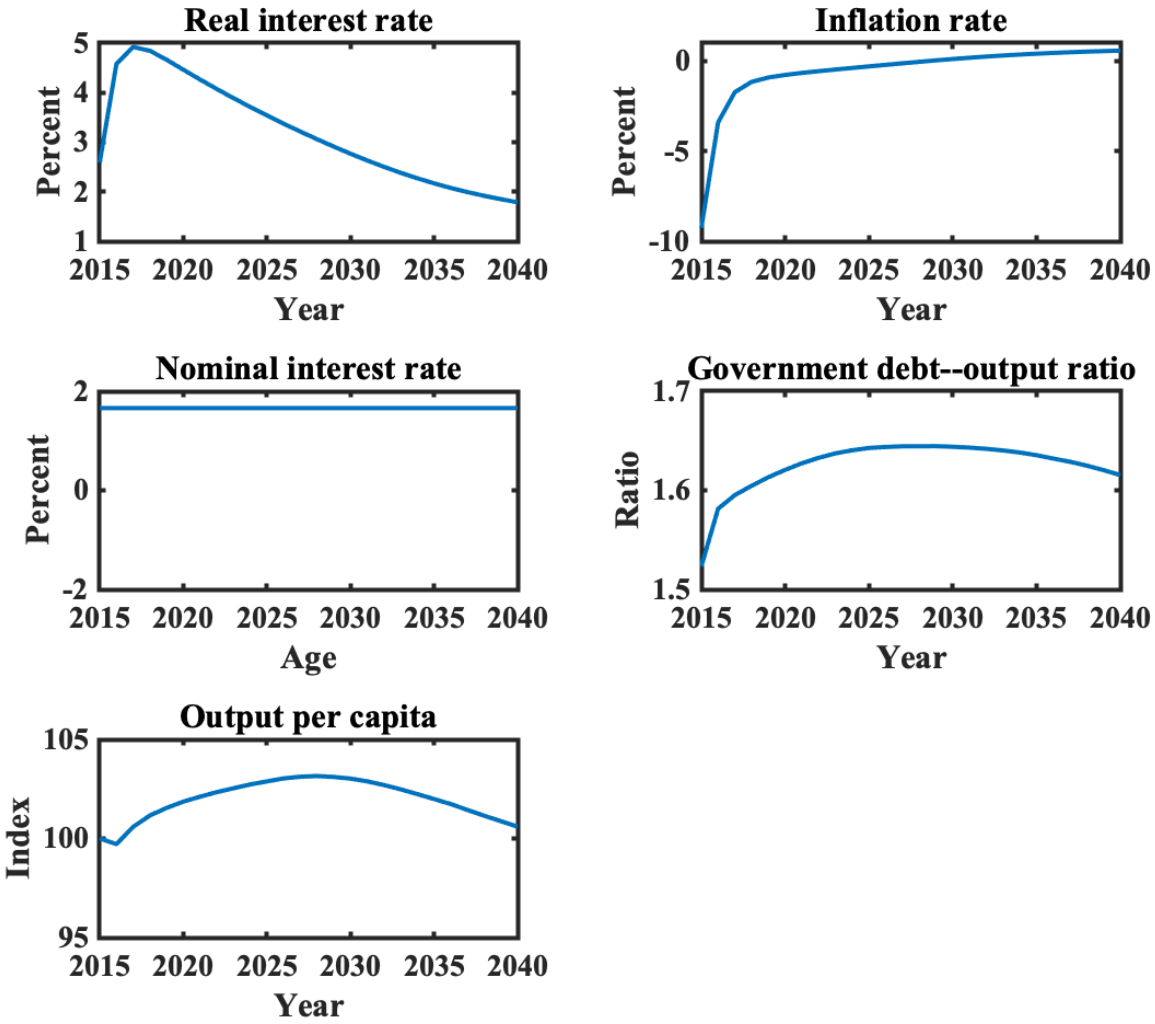
Flexible prices



- Nominal rigidities are not important for deflation and secular stagnation.

Contribution of asset substitution. Does reaction of MP matter?

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



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

Intuition for "apparent" breakdown of MP in Baseline

- By lowering its policy rate, the central bank:
  1. attenuates the negative impact response of prices to the aging shock.
  2. propagates the downward pressure on prices over time.
  3. persistently lowers real returns on liquid and illiquid assets.
- Negative wealth effects for the large mass of households aged 45–76 in 2014.
- They reduce their consumption persistently because returns on their preferred portfolio asset allocation scheme are persistently lower.

Intuition for "higher output" when MP doesn't respond

- Winners from the shock are retirees. Their consumption goes up persistently.
- Losers from the shock are workers. Their consumption goes down persistently.
- Real return on liquid assets is large and positive (real government debt has gone up and returns have to increase to induce savers to hold it).
- Real return on illiquid assets is initially low but catches up.
- Wealth effects are large in positive for retirees
- Wealth effects are large and negative for workers.
- Investment and wages both fall persistently.
- Labor supply of workers increases.
- Output increases because increase in labor supply is stronger than the decline in capital stock.

Imperfect substitutability: model asset market clearing conditions

liquid asset market clearing

$$\frac{d_t^n}{P_t} = \frac{\sum_{j=1}^{J} \bar{d}_{j,t} N_{j,t}}{N_t}. \tag{3}$$

Illiquid asset demand for a household of age j in period t

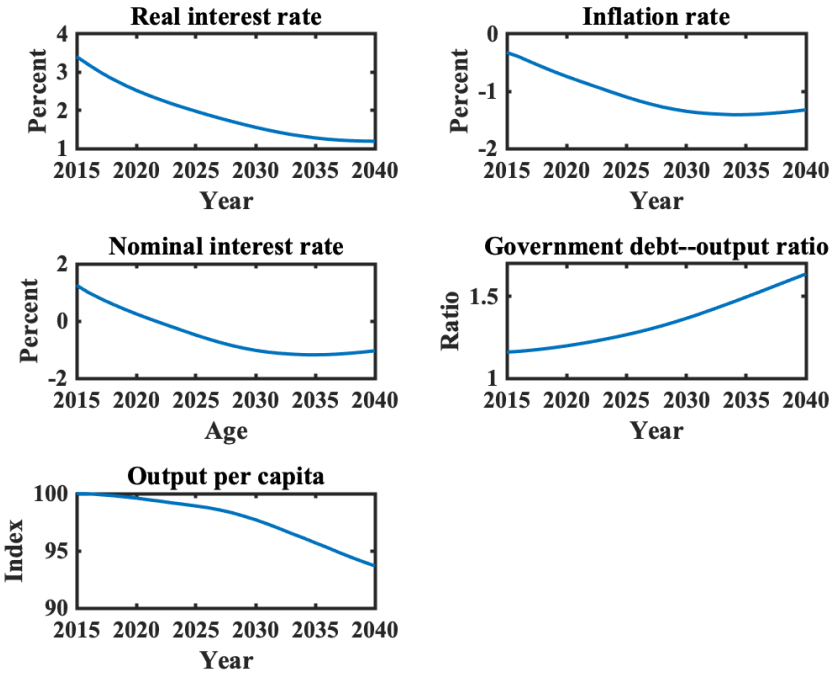
$$\frac{\tilde{R}_t}{\pi_{t+1}} = \frac{\tilde{R}^a_{t+1} + \gamma_a \Delta a_{j+1,t+1}}{1 + \gamma_a \Delta a_{j,t}} \tag{4}$$

- No financial frictions when $\gamma_a = 0$. Equation (4) is Fisher equation.
- With financial frictions: liquidity premium is positive in Steady State and time varying during transition.
- Household asset demand depends on age (survival probabilities).
- Monetary policy reaction induces persistent movements in liquidity premium.

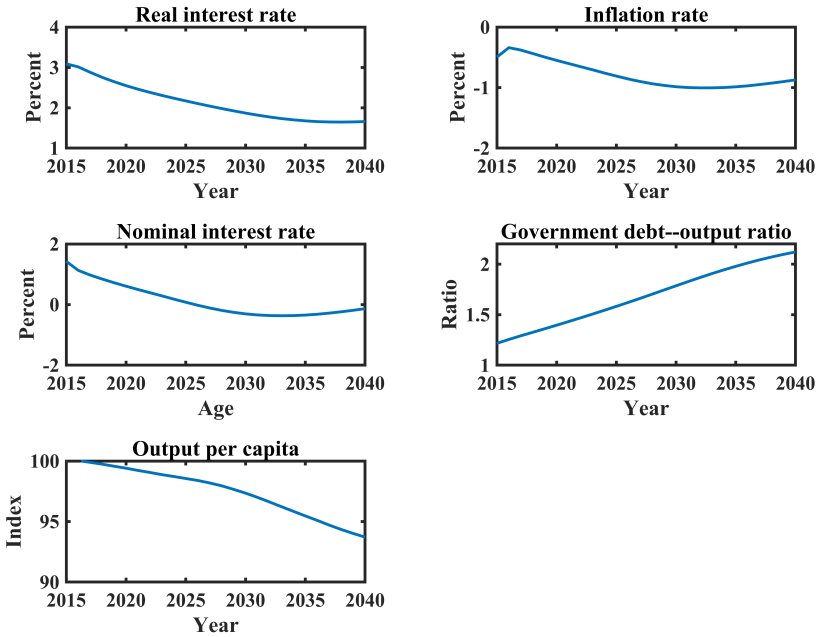
Breakdown of fiscal policy: Let's increase nominal govt debt

- Suppose liquid asset demand glut is accommodated by fiscal authority.
- Model continues to reproduce 5 secular stagnation observations!

Baseline

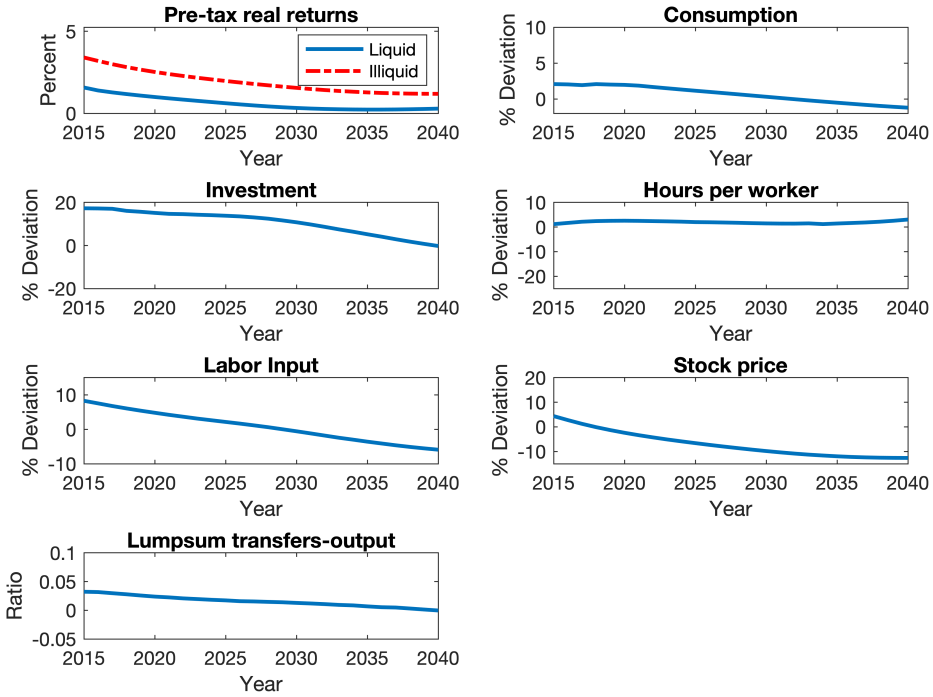


Higher Govt Debt

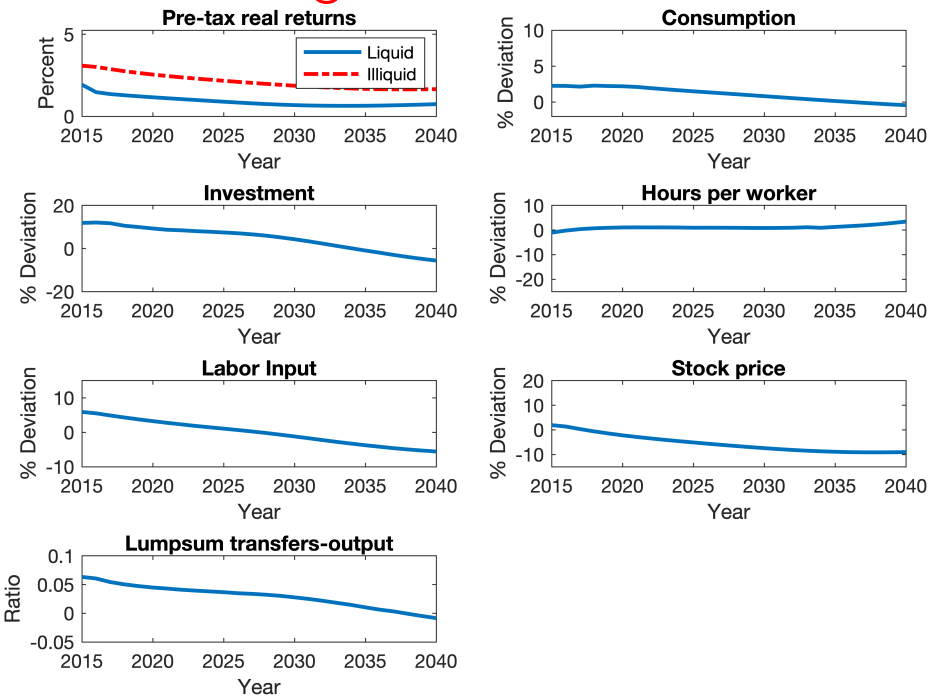


Higher nominal govt debt: more macro responses

Baseline



Higher Govt Debt



Macro responses to aging and higher nominal government debt issue

- Responses of aggregate output, hours and consumption about the same as the baseline.
- Debt–output ratio in year 2040 increases from 1.6 (baseline) to 2.1.
- At this horizon
  - 40% of increase in debt-GDP ratio is due to higher nominal supply.
  - lower price level contributes 60%.
- Higher nominal supply of government debt increases real supply too and puts upward pressure on return on liquid assets in medium term.
- Less deflation.
- Less monetary easing (contributes to higher real interest rates in medium term).
- Higher real return on liquid asset crowds out private investment.

Intergenerational Redistribution

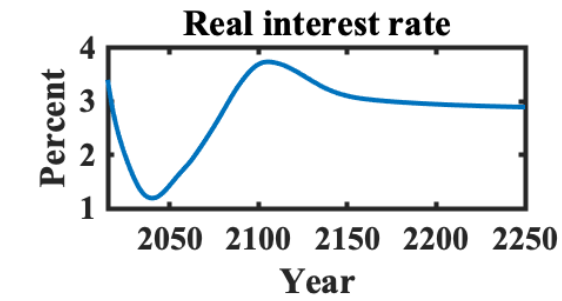
Consumption responses by age group and year

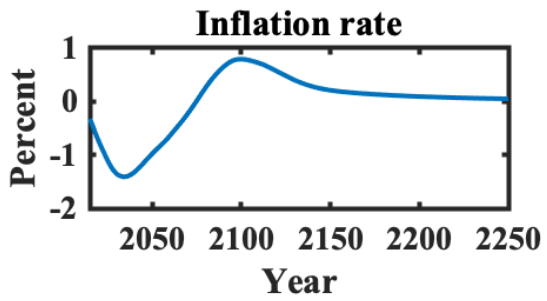
Specification	Age	Population Share	Consumption 2015	Consumption 2025	Consumption 2035
Baseline					
	21-45	0.37	2.51	4.70	4.68
	46-67	0.32	-4.15	-2.10	-1.31
	68-120	0.31	1.32	-8.34	-11.23
	Total (21-120)	1.00	0.03	-1.51	-2.16
Less responsive monetary policy ($\phi_\pi = 1.5$)					
	21-45	0.37	1.31	3.36	2.17
	46-67	0.32	-4.65	-1.11	-0.46
	68-120	0.31	-2.90	-9.73	-10.63
	Total (21-120)	1.00	-1.89	-2.13	-2.64
Higher government debt					
	21-45	0.37	1.65	3.32	2.62
	46-67	0.32	-3.21	-1.06	-0.56
	68-120	0.31	0.06	-7.76	-9.19
	Total (21-120)	1.00	-0.39	-1.51	-2.06

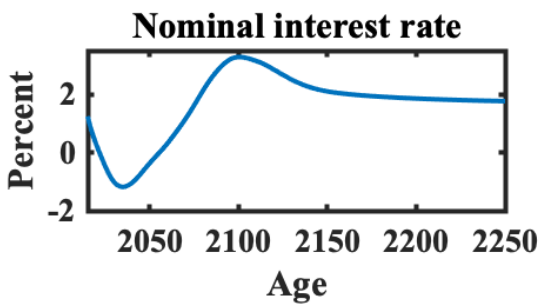
- Winners from aging shock are young households.
- Less responsive MP and higher government debt redistribute resources away from younger households.
- Differences in the incidence of monetary and fiscal policy. Higher government debt provides better insurance to age groups most negatively impacted by aging shock.

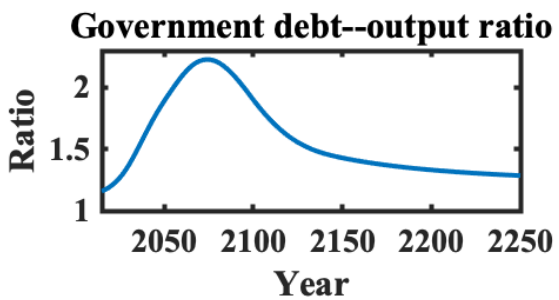
How persistent are these responses: Unpleasant monetarist arithmetic

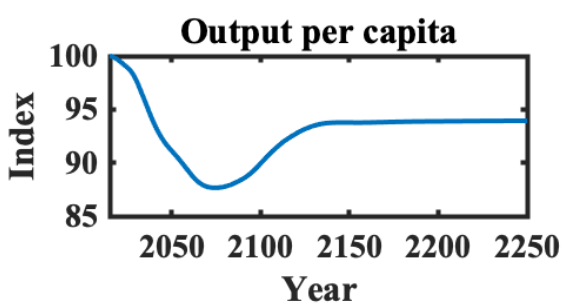
- Deflation is followed by gradual increase in inflation rate from about 2030.







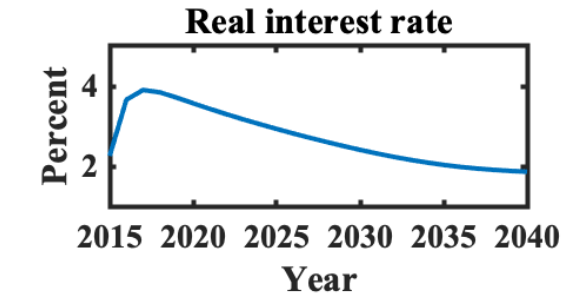


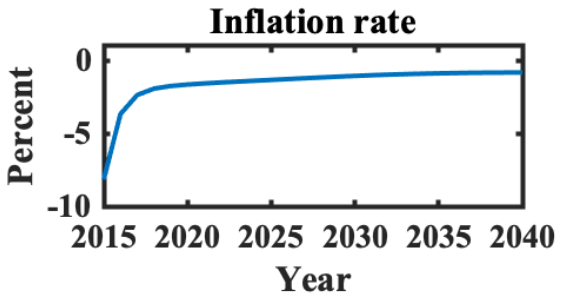


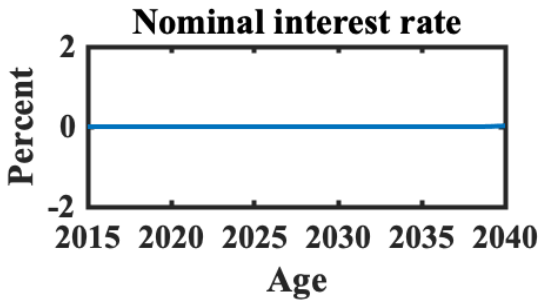
Concluding remarks

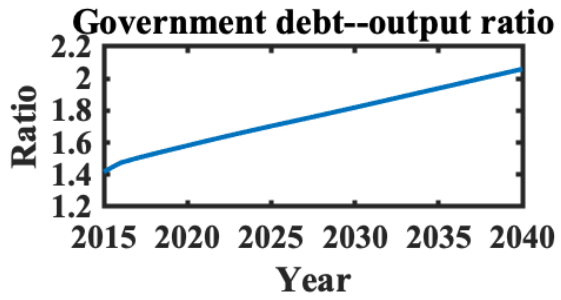
- Aging shock induces a sustained period of "secular stagnation" and downward pressure on prices.
- Response of MP is important for this result.
- Transmission channel of MP is asset-substitution, and DTPL.
- Narrative according to our model:
  - Monetary policy accommodated deflationary pressure induced by aging.
  - UMP was reasonably successful in undoing ELB in Japan.
  - Japanese fiscal policy by accommodating liquid asset demand glut partially hedged cohort risk.
- The overlapping generations model is a good quantitative model of monetary in the shortun (Braun and Ikeda, 2025, RED) and a good quantitative model of monetar policy in the medium term. I can see my children in this model and I know how to generalize it so that I can see my grandchildren too.

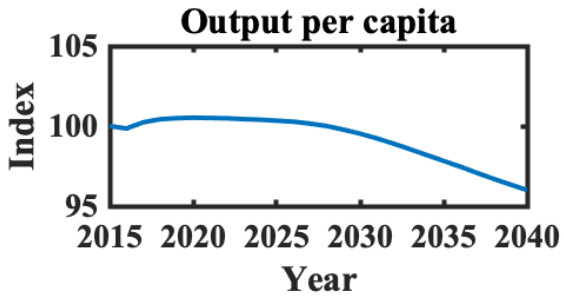
Robustness: impose the effective lower bound







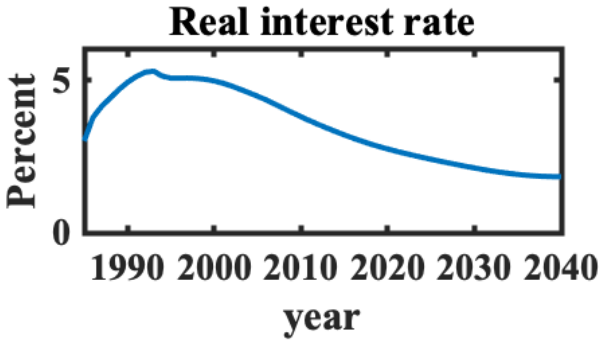


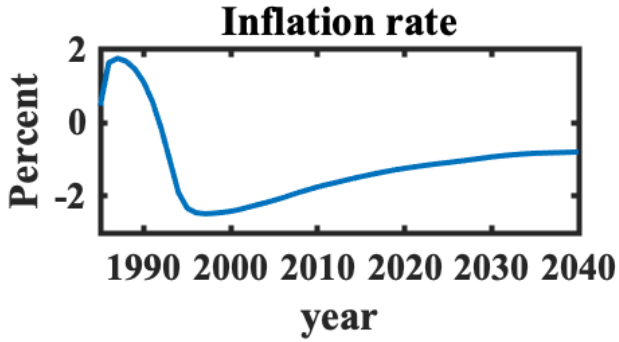


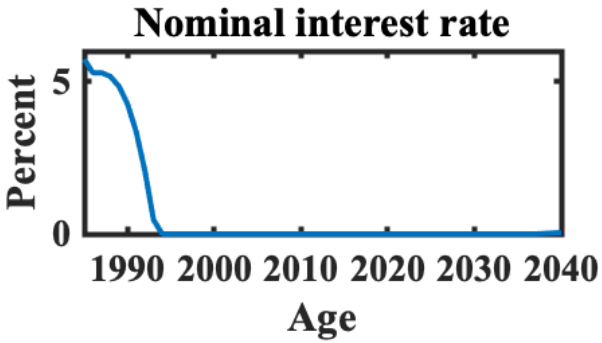
- Severe deflation; output puzzle; higher debt-output ratio;
- Unconventional monetary policy (UMP) works (see e.g. Ikeda et al., 2020; Swanson, 2021).

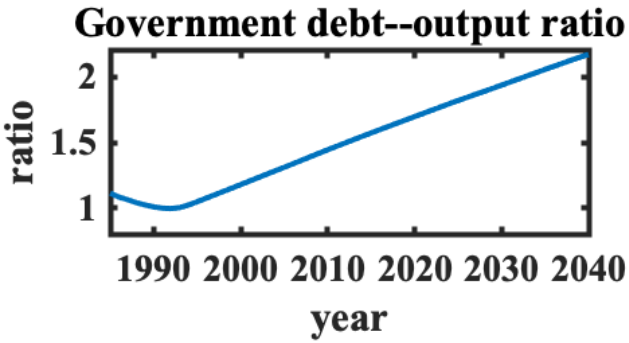
Robustness: starting year

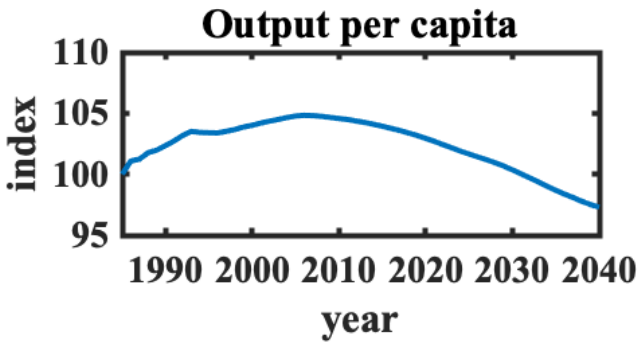
- Suppose demographic transition shock arrives in 1983 and ELB is imposed.











Related literature

- Asset Demand Theory of the Price Level (DTPL) $\neq$ FTPL
  - Sargent and Wallace (1981); Hagedorn (2017); Hu et al. (2021)
- Asset substitution transmission channel of monetary policy
  - Tobin (1969); Hu et al. (2021)
  - Distinct transmission channel from New Keynesian (NK).
- Monetary Policy Feedback rule Taylor (1993), Ikeda et al. (2020), Swanson (2021)

▸ Literature: stagnation ▸ Literature: demographics

What has caused "secular stagnation"?

Summers (2014) points out four potential culprits

- Financial crisis – deleveraging; hysteresis
  - Eggertsson and Krugman (2012); Ikeda and Kurozumi (2019)
- Inequality
  - Mian et al. (2021); Fernández-Villarverde et al. (2022)
- Relative price of investment
  - Sajedi and Thwaites (2016)
- Demographics
  - Braun et al. (2009); Ikeda and Saito (2014); Muto et al. (2016); Carvalho et al. (2016); Eggertsson et al. (2019); Sudo and Takizuka (2020); Gagnon et al. (2021); Auclert et al. (2021); Jones (2021)

▸ Back

Scope of the literature on demographics

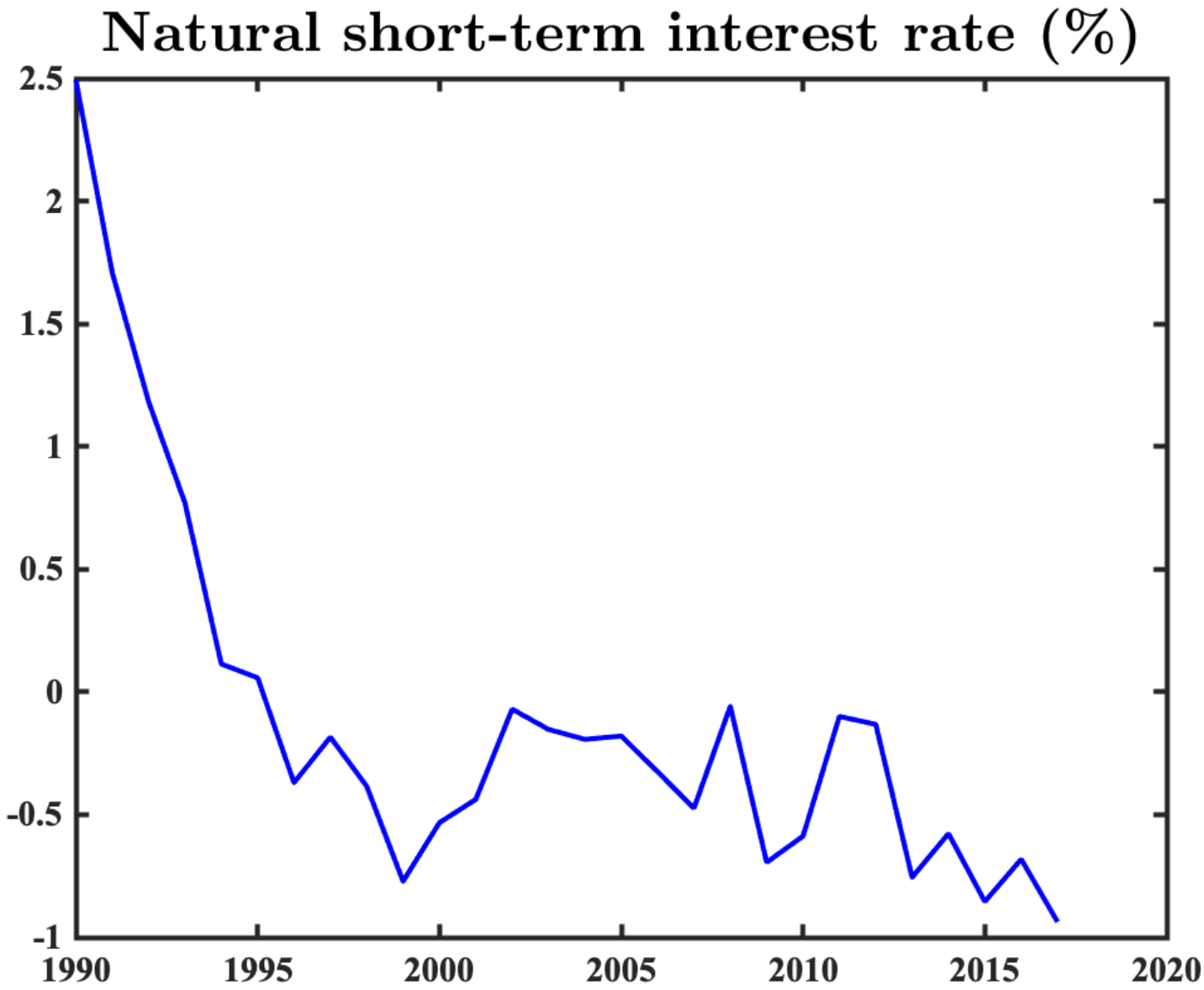
- Real interest rate
  - Braun et al. (2009); Ikeda and Saito (2014); Carvalho et al. (2016); Eggertsson et al. (2019); Sudo and Takizuka (2020); Gagnon et al. (2021); Auclert et al. (2021)
- + Output
  - Muto et al. (2016)
- + Inflation and nominal interest rate
  - Jones (2021)

"Conventional" view (e.g. ECB strategic review)

1. Low real interest rate environment; negative shocks
2. Low nominal rate; hitting the effective lower bound
3. Low inflation and low output

Back

Alternative (Laubach-Williams, 2001) natural rate estimate



Similarities and differences between us and Angeletos et al (2024)

- Model: Ricardian equivalence fails.
  1. Us: OLG
  2. Angeletos et al: Blanchard-Yaari
- Government debt is nominal and exogenous in both papers. Its real value jumps when price level changes.
- taxes
  1. Us: lumpsum taxes are exogenous under (FTPL) but endogenous under (DTPL).
  2. Angeletos et al (2024): tax revenue rule with exog. lumpsum component and end. lumpsum component that responds to real debt-output ratio.
- Monetary Policy
  1. Us: Taylor rule MP policy rate responds to deviations of inflation rate from target.
  2. Angeletos et al (2024) MP follows a real interest rate targeting rule that (may) react to departures of output.
- Nominal price rigidities in our Quant model and in their model.