Monetary policy over the lifecycle.

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*These are the authors' personal views and not those of the Bank of Japan or Federal Reserve System.

How does a household's exposure to monetary policy vary with its age?

Conventional narrative 1. Wealth and income over the lifecycle

- Young working age households
  - Current earnings low relative to future earnings.
  - Current net worth low relative to future net worth.
  - Hold leveraged long positions in home, car, tv and other physical assets.
- Middle age households
  - Current earnings high relative to future pension income.
  - Net worth high.
    1. Large net holdings of liquid assets (Deposits and bonds net of debt).
    2. Large holdings of illiquid assets (physical assets and illiquid financial assets like equity and life insurance).
- Retirees
  - No labor income, rely on public pension and asset income.
  - Net worth gradually declines with age.
  - Retain physical assets like home until late in life.

Conventional narrative 2. Macro effects of tighter monetary policy

Empirical evidence using identified monetary policy (MP) shocks

- Nominal deposit rates and yields on government debt go up.
- Nominal borrowing costs increase.
- Inflation rate declines and real interest rates increase.

Impact in other markets:

- Stock prices fall.
- Real estate market weakens.
- Real wages fall.

What we do in "Monetary policy over the lifecycle"

- Measurement
  1. Use Japanese survey data (2014,NSFIE) to construct household holdings of liquid and illiquid assets by age.
  2. Use Japanese survey data (1995-2020, FIES) to estimate responses of household disposable income and consumption to MP shock.
- Theory Propose a computable OLG model that reflects both conventional narratives. Use it to ask how:
  1. a household's exposure to MP varies over the lifecycle?
  2. MP impacts wealth and consumption inequality?
  3. micro responses influence macro aggregates?

Summary of our results

- Novel economic mechanisms in our lifecycle model.
  - Asset substitution channel of MP/Tobin Effect (Hu, Ma, Qiao and Wallace, 2021; Tobin, 1969).
  - Monetary and fiscal policy jointly determine the price level. Not fiscal theory of the price level.
  - No Liquidity trap. ELB is not imposed. Consistent with Bernanke's views and our views that uncovential monetary policies (UMP) work.
- Monetary policy over the lifecycle
  1. Winners and losers. Households of different ages have *fundamentally* different exposures to MP.
  2. Tightening in MP increases wealth and consumption inequality.
  3. We resolve two aggregate puzzles: investment response, asset price response.

Why age?

Motivation: Household portfolios and income sources vary by age in Japanese data.

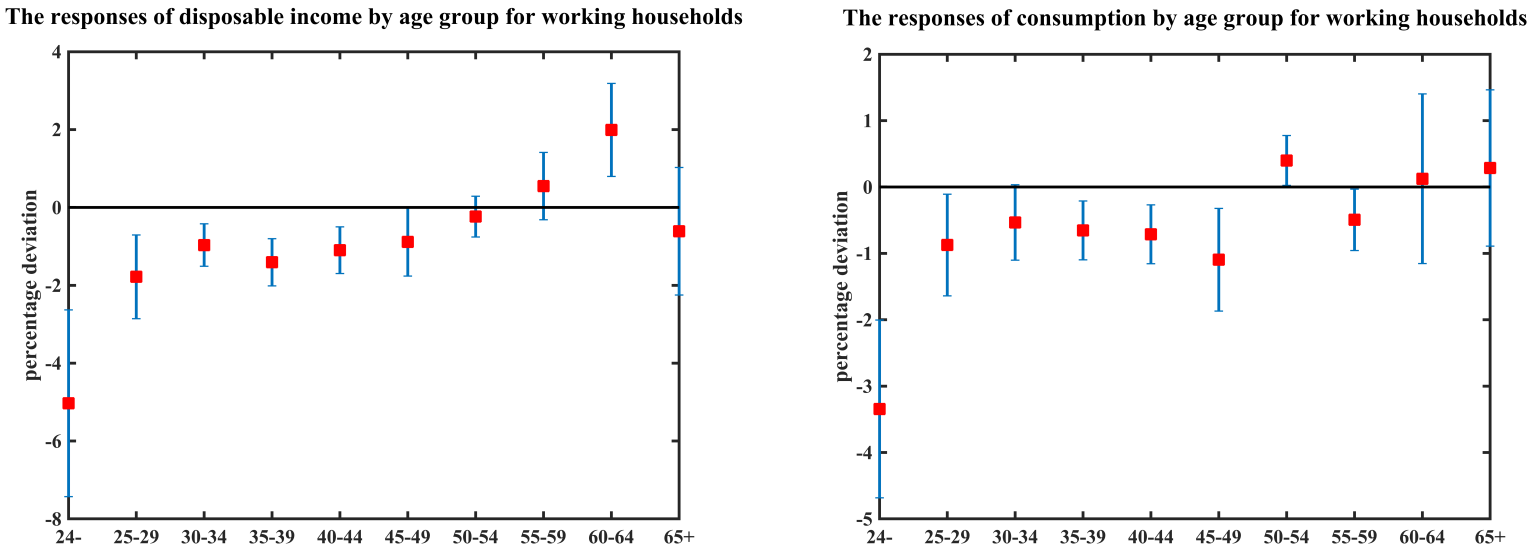
- Large variation in household net worth over lifecycle
- Large differences in portfolios of liquid and illiquid assets

Net worth, *net* liquid and *gross* illiquid asset holdings by age relative to income of households aged 50–59 in Japan

Age	Net Worth	Liquid assets	Illiquid assets
Under 30	0.65	-0.08	0.73
30–39	1.60	-0.58	2.18
40–49	2.58	-0.31	2.90
50–59	4.52	0.76	3.76
60–69	6.29	1.70	4.60
70+	6.01	1.77	4.25

Main source: 2014 NSFIE survey.

Motivation: household responses to (tighter) monetary policy vary by age in Japanese data.



Notes: Japanese data FIES, high frequency identification (see Kubota and Shintani, 2021).

- Size and signs of disposable income and consumption responses to MP vary by age.
- Other results: Wong (2019) U.S. data by age; Cloyne, Ferreira and Surico (2020) by mortgage; Holm, Paul and Tischbirek (2020) by wealth.

Tobin/asset substitution effects in lifecycle models.

- In a flexible price 2-period OLG model: $\{k_{t+1}, P_t\}$ are determined by:
  1. Asset market clearing condition (aggregate savings function).

$$\frac{d_t^n}{P_t} + k_{t+1} = (1-\alpha)k_t^{\alpha} \equiv w_t \tag{1}$$

  where w_t is earnings of young, d_t^n is an exogenous sequence of per capita nominal government debt.

  2. Fisher equation

$$\alpha k_{t+1}^{\alpha-1} = R_t \frac{P_t}{P_{t+1}} \tag{2}$$

  where R_t is the nominal interest rate set by the central bank.

- Increase in R_t, lowers P_t, lowers k_{t+1} and increases the real return on capital and govt debt (see Hu et al., 2021).
- Monetary and fiscal policy influence the price level via asset Demand Theory of the Price Level (see Hagedorn, 2017). Under FTPL money policy is neutral (Braun and Ikeda, 2022).

Quantitative model: overview

- Environment: Overlapping generations, stationary population
- Hshlds: Finite lifetimes (individuals aged 21-120) with age dependent variation in:
  - family scale (one adult, age dependent fraction of children)
  - efficiency of labor
  - public pension income
  - survival risk.
  - Liquid and illiquid assets, natural borrowing constraint.
- Firms: Rotemberg (1983) NK structure, capital accumulation.

The model: government

- Fiscal authority
  - Taxes consumption, labor and assets.
  - Constant supply of *nominal* government debt.
  - Government purchases
  - Lumpsum transfers adjust to close the government budget constraint.
  - Pay-as-you-go public pension plan.
- Monetary authority
  - Sets the nominal interest rate on government debt and other liquid securities (private iou's).
  - Nominal interest rate targeting rule.
- General equilibrium closed economy.

Households: intuition for consumption-saving plans

Adjustment costs on illiquid assets allow model to reproduce the age profiles of illiquid and liquid assets in Japanese data.
FONC of age j household for illiquid assets a_j

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

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

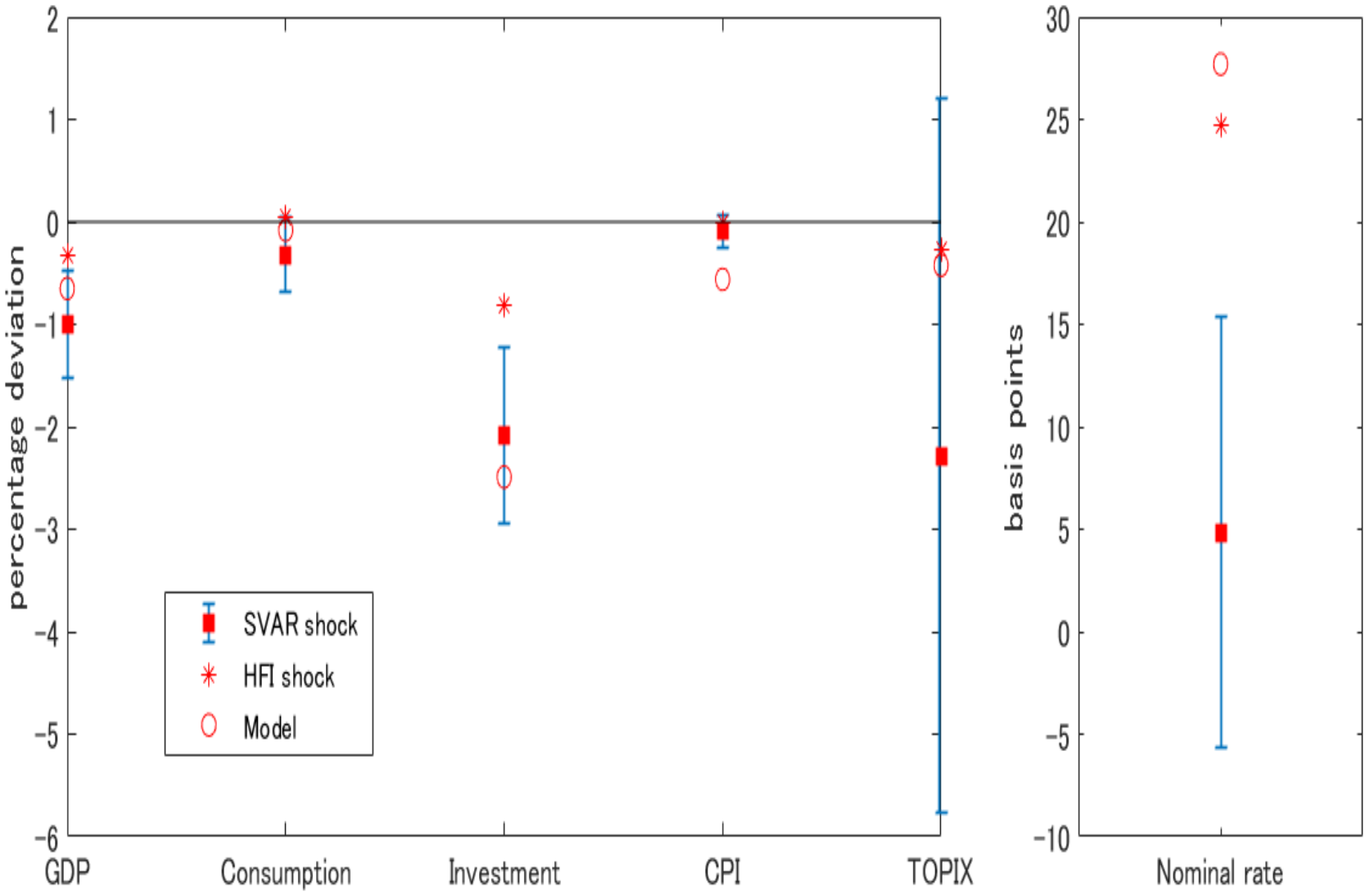
term 1 Want to accumulate illiquid assets because spread is positive.

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

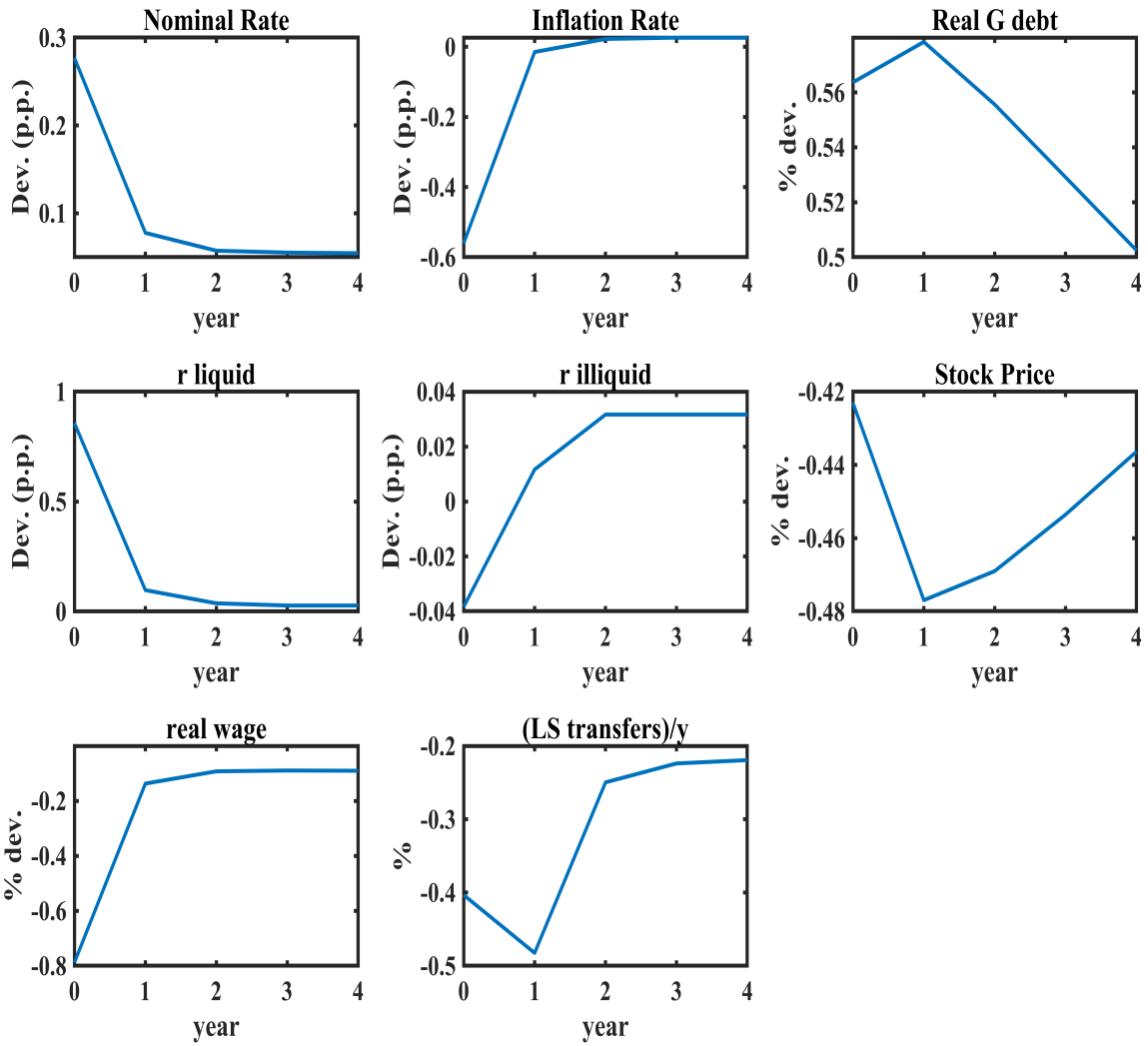
term 3 Investing today reduces welfare if you die tomorrow.

- 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.
- Very old households have leveraged long position in illiquid assets.

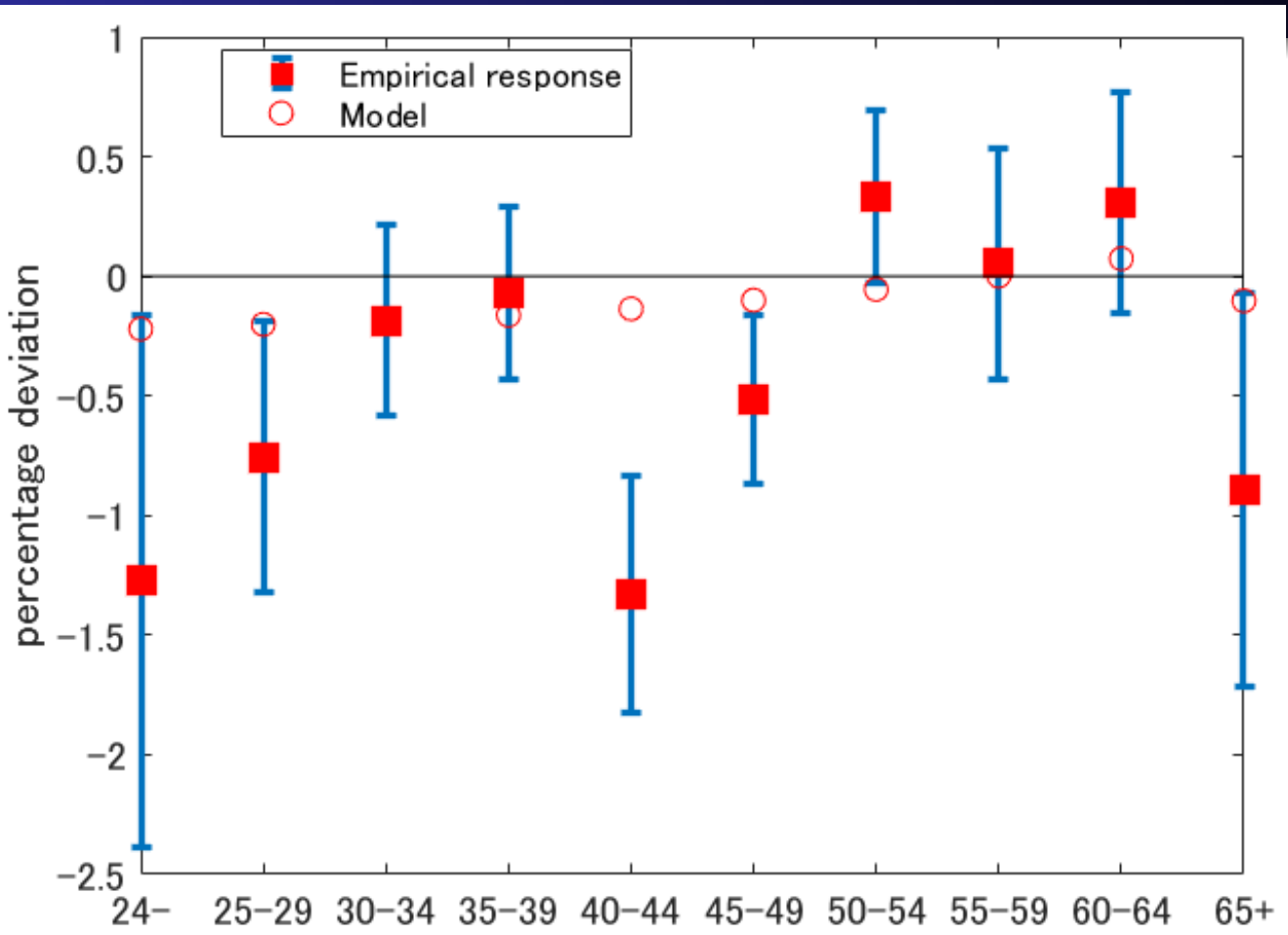
Validation: impact responses (year 0) to tighter MP (shock size is +0.01) model and data



Aggregate responses to a tighter MP (shock size is +0.01) model



Age profile of consumption responses: model and data

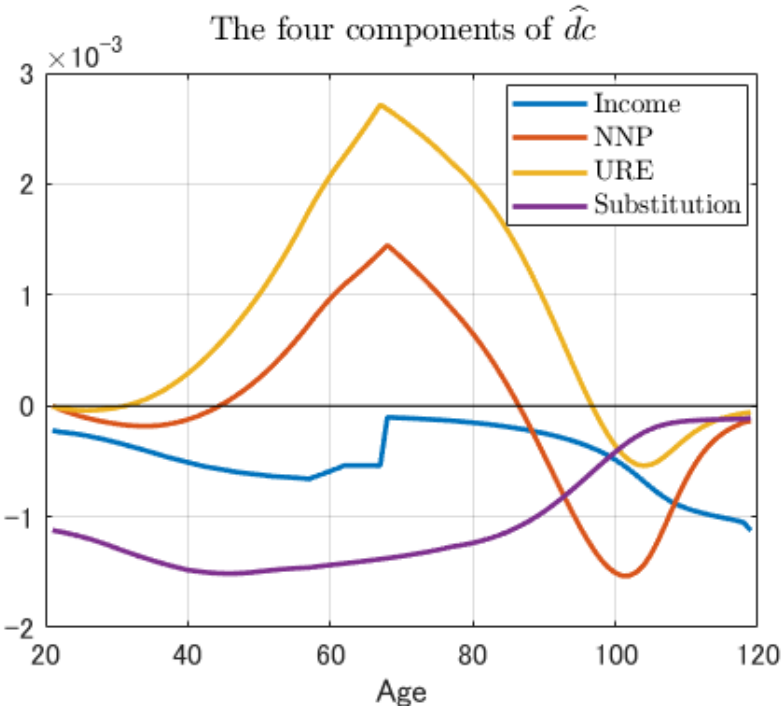


Notes: Cumulative consumption responses in the impact year, monthly Japanese data (FIES), high frequency identification based on Kubota and Shintani (2021). Vertical lines are 90% confidence intervals.

Model: tightening of monetary policy on households of different ages on impact.

- Young workers of age 40 or less
  - Consumption falls between 0.1. and 0.15 %.
- Retirement aged households between 60–87
  - Consumption increases by about 0.05%.
- Older retirees: 88+
  - Consumption falls by 0.4% or more.

Model: Auclert decomposition of consumption responses by age, (Impact period)



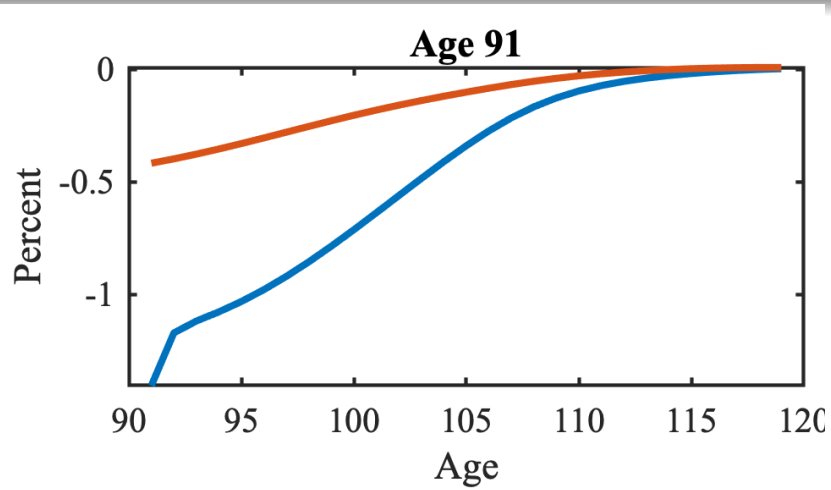
Income, labor+govt.; NNP, net nominal position, unexpected inflation, URE, unhedged real interest rate; Intertemporal Substitution.

- Households < 40
  - Labor income and intertemporal substitution are very negative.
- Households circa 68
  - URE and NNP are large and positive.
- Households 87+
  - NNP and (govt) income are very negative.

Persistence: monetary has long and variable lags in our model

- ". . . there is much evidence that monetary changes have their effect only after a considerable lag and over a long period and that the lag is rather variable." (Friedman, 1959).
- The persistence and date of the peak consumption response to a tighter monetary policy depends on the household's age when the shock arrives.

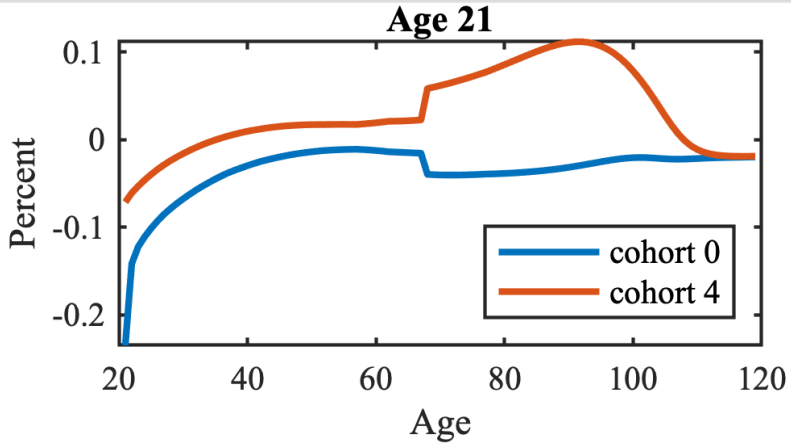
Consumption-age profiles for 91 year old cohorts, year 0, year 4



Note: Consumption deviation from steady state as a percentage of steady-state disposable income.

- Consumption response is large and persistent.
- Capital loss on portfolio, low returns on preferred portfolio moving forward. Short planning horizon.

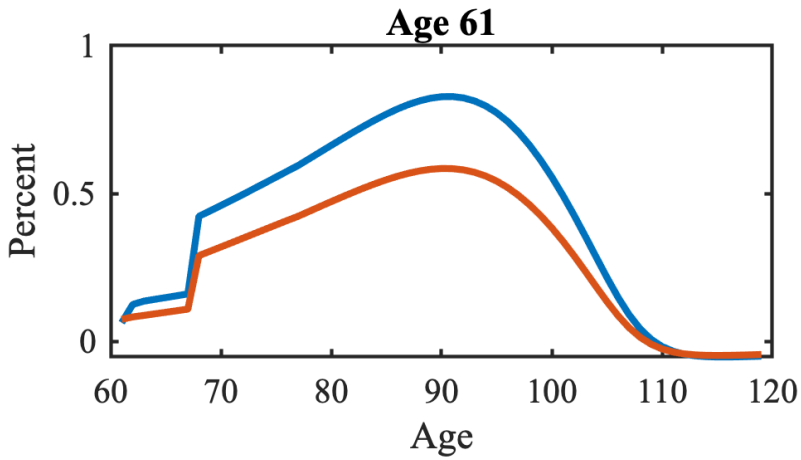
Consumption-age profiles for 21 year old cohorts, year 0, year 4



Note: Consumption deviation from steady state as a percentage of steady-state disposable income.

- 21 year old. Impact consumption response is largest but magnitude is small.
- Better to be born 5 years later!

Consumption-age profiles for 61 year old cohorts, year 0, year 4



Note: Consumption deviation from steady state as a percentage of steady-state disposable income.

- Impact consumption response is positive but small.
- largest positive consumption response occurs at about age 90 (conditional on survival)!
- Tighter monetary policy enhances its asset allocation opportunities for many years. (Cash flows from holdings of liquid assets increase persistently.)

Asset substitution: investment and stock price responses

- All households reduce their allocation to illiquid assets in impact year. (Downward sloping asset demand, imperfect substitutability of liquid and illiquid assets, heterogenous MPCs).
- Aggregate investment falls.
- Stock price falls.
  1. Dividends increase (profits of intermediate goods producers increase)
  2. Discount factor falls by more.
- Our model is consistent with Campbell-Shiller (1988) observations.

Responses of wealth and consumption inequality

(percentage deviations from steady state)

Year	0	1	2	3	4
Wealth Gini	0.20	0.20	0.19	0.19	0.17
Consumption Gini	0.082	0.084	0.085	0.086	0.086

Note: Inequality is measured as the percentage change in the Gini coefficient associated with a shock of size 0.01 to monetary policy. For instance, a value of 0.2 increases the wealth Gini coefficient from 0.41 to 0.412.

- Wealth inequality increases
  - Households aged 57–79 have high initial wealth and see their wealth increase.
  - Younger working–aged households and older retirees have lower wealth and see their wealth decline.
- Consumption inequality increases persistently.
  - Households aged 57–79 increase their consumption but have low MPCs.
  - Younger working–aged households and older retirees reduce their consumption and have relatively high MPCs.

Concluding remarks: Why demographic change produces deflation and secular stagnation.

- In period prior to 2020 many industrialized economies experienced: steady and persistent declines in: natural interest rate, inflation rate and output growth.
- Will aging continue to put downward pressure on these variables moving forward?
- In Braun and Ikeda (2022) we show that the model developed here reproduces the secular stagnation observations as well as the government policy responses to aging.