Distributional consequences of conventional and unconventional monetary policy

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2. Model
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Motivation

- Monetary policy has redistributive effects:
  - via balance sheets (direct effects):
    e.g. surprise inflation redistributes away from owners of nominal assets (e.g. Doepke & Schneider 2006)
  - via its macroeconomic impact (indirect effects):
    e.g. higher unemployment after monetary tightening hurts relatively poor HHs (e.g. Heathcote et al. 2010; Kaplan et al. 2018)
- But:
  - Most studies focus on US
  - Unconventional monetary policy less explored (exception: Lenza & Slacalek 2018)
  - Life-cycle dimension of heterogeneity and housing underexploited (exception: Wong 2018)

This paper

- Construct a quantitative life-cycle model of the euro area with a rich asset structure
- Study the distributional consequences of monetary policy
  - Conventional (surprise interest rate shocks)
  - Unconventional (forward guidance)
- Why a life-cycle GE model?
  - Captures an important (and well documented) dimension of HH heterogeneity
  - Allows to consider both direct and indirect effects
  - Allows to document the crucial difference between initial balance sheet effects and remaining lifetime welfare

Preview of results

1. Monetary policy redstributes welfare between age-cohorts
    1. Monetary expansion benefits young households
    2. Both direct and indirect effects are important
2. Conventional policy and forward guidance differ
    1. Not dramatically
    2. Mainly for older cohorts
3. Welfare redistribution differs crucially from initial balance-sheet effects

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Model structure: overview

- New Keynesian model with life-cycle features:
  - 80 cohorts of overlapping generations of households (age 20-99)
  - Age-dependent mortality risk
  - Age-specific productivity
  - Age-specific asset structure
- Rigidities: sticky prices, sticky wages, investment adjustment costs, (collateral constraints)
- Monetary policy:
  - Taylor-like rule
  - Standard and forward guidance policy shocks
  - (ZLB constraint)

Households

- Maximize expected lifetime utility

$$U_{j,t} = \mathbb{E}_t \sum_{i=0}^{J-j} \beta^i \frac{N_{j+i}}{N_j} \left(\log c_{j+i,t+i} + \psi_{j+i} \log \chi_{j+i,t+i} - \phi_{j+i} \frac{h_{j+i,t+i}^{1+\varphi}}{1+\varphi} \right)$$

  subject to

$$c_{j,t} + p_{\chi,t}[\chi_{j+1,t+1} - (1-\delta_\chi)\chi_{j,t}] + a_{j+1,t+1} = w_t z_j h_{j,t} + \frac{R_{j,t}^a}{\pi_t} a_{j,t} + tr_t$$

- Retired households do not work ($z_j = 0$ for $j \geq 45$)
- Financial assets managed by investment funds offering age-specific financial products

$$R_{j,t}^a = s_{j,t} R_{t-1} + (1 - s_{j,t}) R_t^a$$

- Calvo-type wage stickiness

Investment funds

- Manage nominal and real financial assets
- Maximize expected return on total portfolio

$$\mathbb{E}_t \left[\; R^a_{t+1} k_{t+1} + R_t b_{t+1} \; \right]$$

where

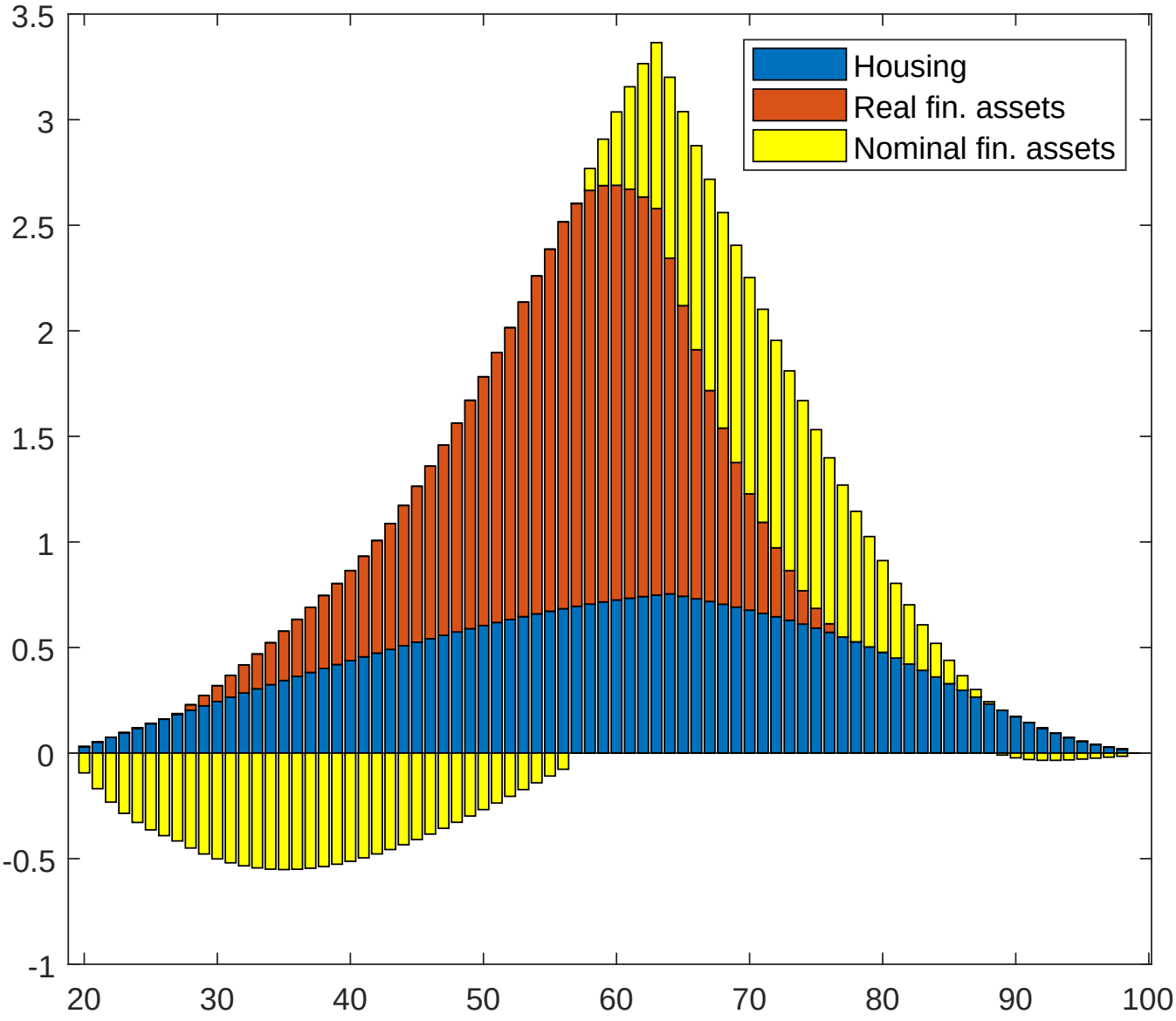
$$R^a_t = \frac{R^k_t + (1-\delta)\, Q_t}{Q_{t-1}}$$

- Distribute ex-post returns to HHs according to age-specific portfolio composition

HH balance sheet (incl. assets in investment funds)

Assets	Liabilities
Housing stock	Net worth
Real nonresidential assets	Nominal financial assets (if negative)
Nominal financial assets (if positive)	

Asset distribution



Producers

- Final goods aggregated from differentiated intermediate products

$$c_t + i_t + \delta_\chi p_{\chi,t} \chi = \left[\frac{1}{N_t} \int_0^{N_t} y_t(i)^{\frac{1}{\mu}} \mathrm{d}i \right]^{\mu}$$

- Intermediate goods firms produce differentiated products

$$y_t(i) = k_t(i)^{\alpha} h_t(i)^{1-\alpha} - \Phi$$

- Zero profits in the steady state, Calvo-type price stickiness
- Capital producers are subject to investment adjustment cost

$$k_{t+1} = (1-\delta) k_t + \left[1 - S\left(\frac{i_t}{i_{t-1}} \right) \right] i_t$$

Monetary policy

- Taylor rule with ZLB

$$R_t = \begin{cases} R_t^{cb} & \text{if } R_t^{cb} > 1 \\ 1 & \text{if } R_t^{cb} \leq 1 \end{cases}$$

where

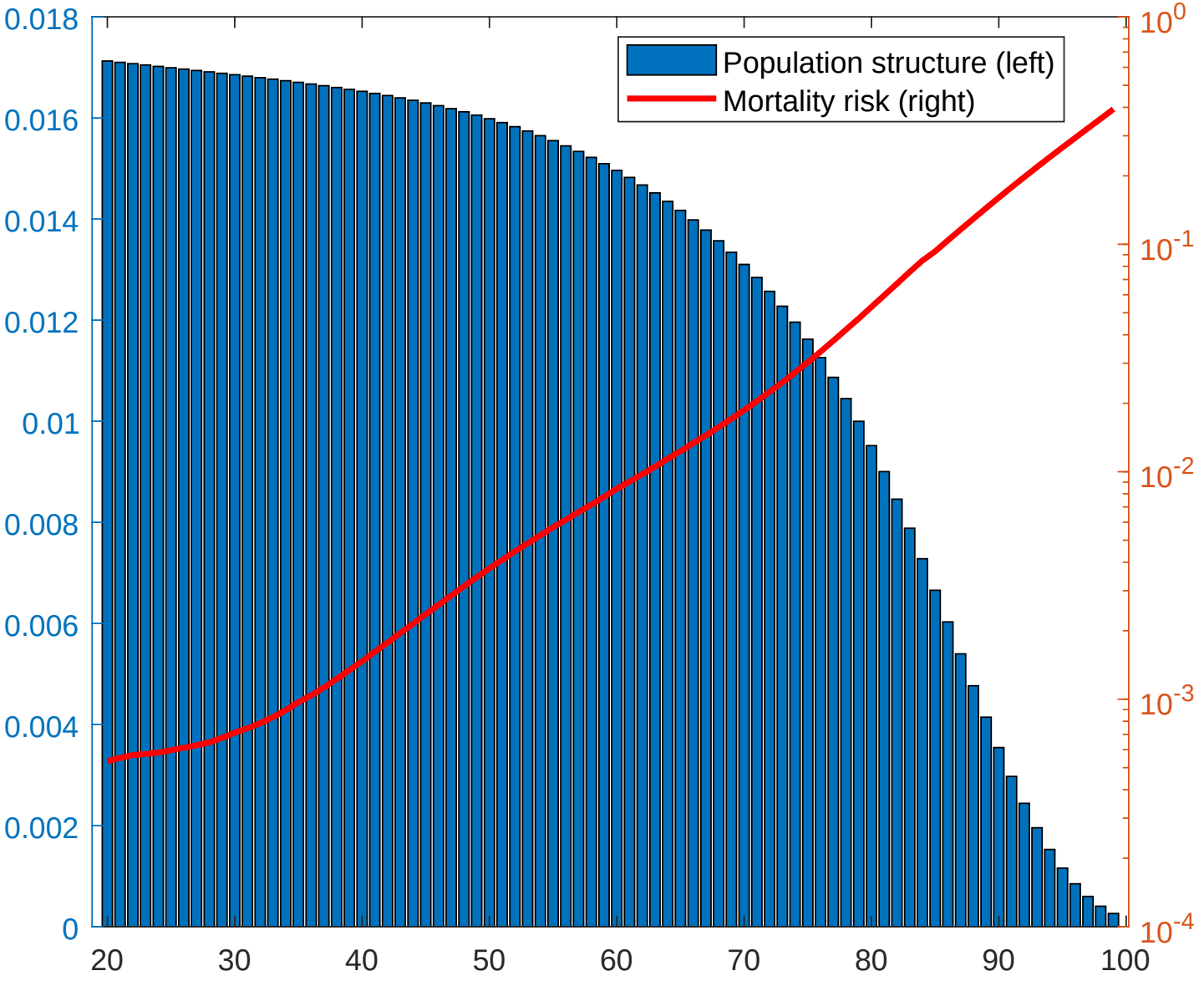
$$\frac{R_t^{cb}}{R} = \left(\frac{R_{t-1}}{R}\right)^{\gamma_R} \left[\left(\frac{\pi_t}{\pi}\right)^{\gamma_\pi} \left(\frac{y_t}{y_{t-1}}\right)^{\gamma_y}\right]^{1-\gamma_R} \exp(\varepsilon_t^R + \varepsilon_{t-H}^{FG})$$

- ε_t^R is a standard monetary policy shock, ε_t^{FG} is forward guidance (with horizon H)

Calibration

- Life-cycle features:
  - Demographic data: Eurostat and EUROPOP, period average: 1999-2018
  - Age-specific productivity and hours: HFCS (2014)
  - Age-specific asset structure: HFCS (2014)
- Taylor rule parameters estimated outside of the model
- Other structural parameters taken from the literature or matched to means observed in data

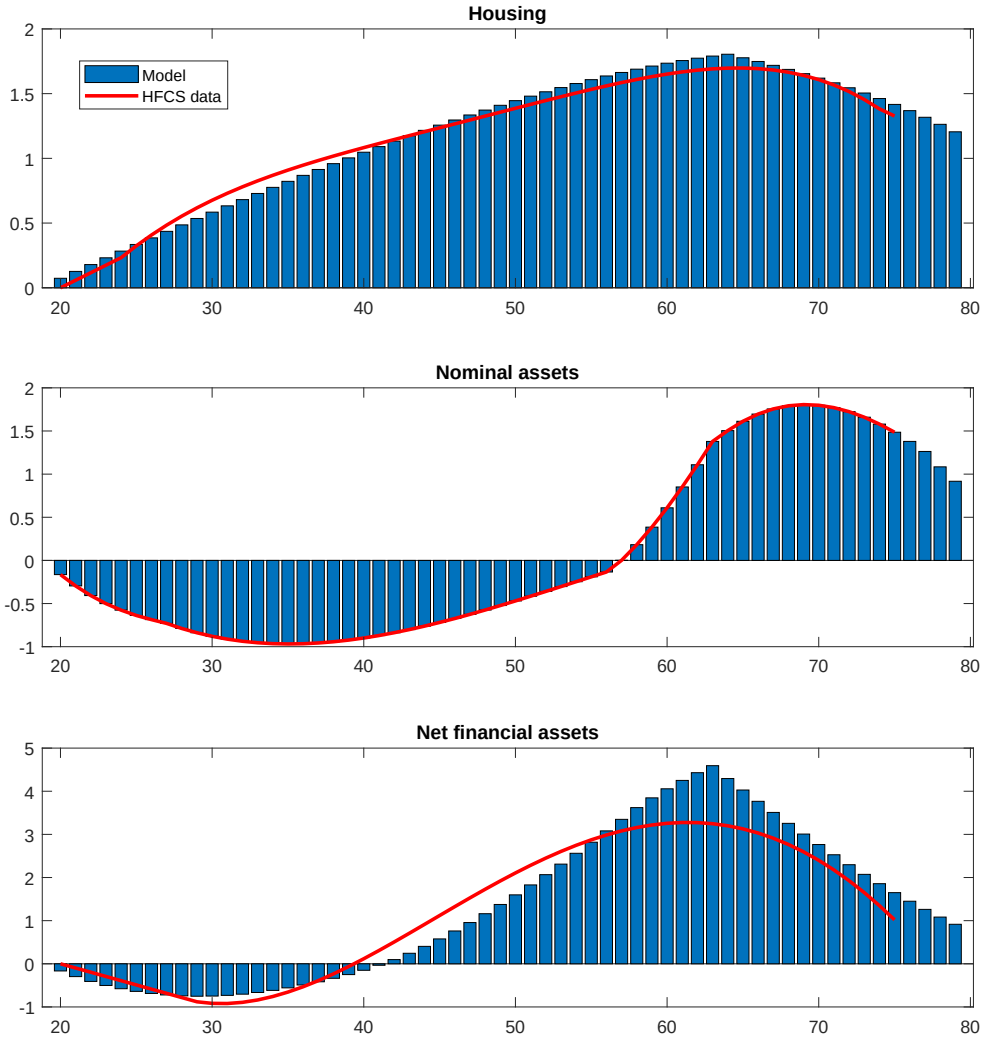
Population (stationary)



Asset structure

- Aggregate data from financial and non-financial balance sheets (Eurostat, % of GDP w/o government expenditures):
  - Housing stock (170% GDP)
  - Nonresidential fixed assets (230% GDP)
  - HH loans / deposits (84% GDP)
- Age profiles taken from HFCS:
  - Housing = HH main residence + other non-business real estate property
  - Fixed assets = HH business wealth + non self-employment private business + shares + bonds + mutual funds
  - Nominal assets = deposits – mortgage loans – non-mortgage loans. Positive part adjusted proportionally to so that net supply is zero

Asset structure



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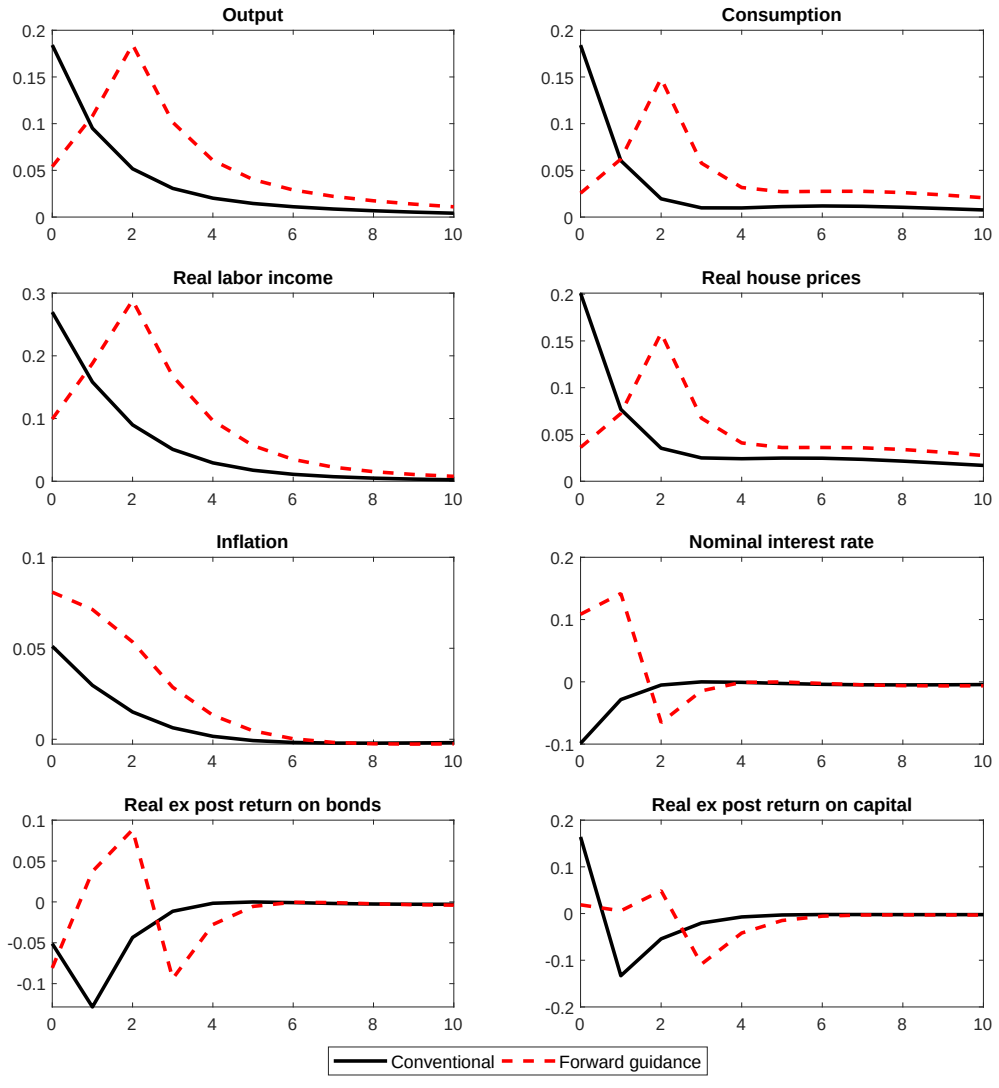
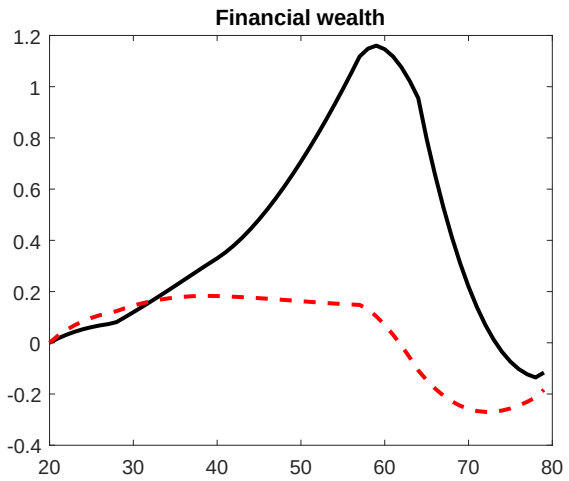
Overview of simulations

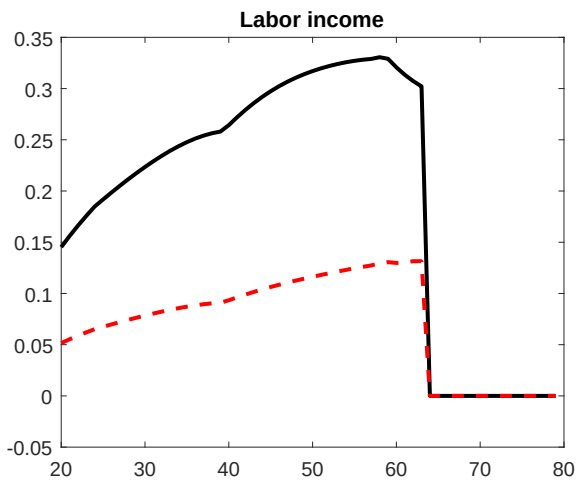
- Effects of conventional and unconventional monetary policy:
  - Aggregate effects
  - Balance sheet effects by cohort
  - Impact on remaining lifetime wealth by cohort
  - Impact on welfare by cohort
- Additional simulations (see the paper):
  - Collateral constraints
  - ZLB
  - Forward guidance puzzle

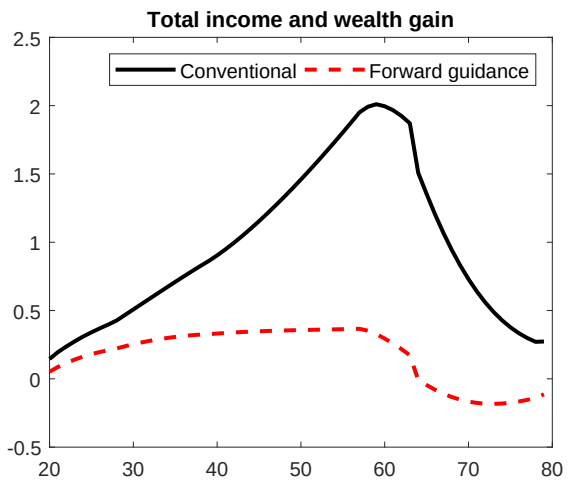
Aggregate effects of monetary policy easing



Balance-sheet and income effects on impact







Note: % of per capita output.

Balance sheet effects vs remaining life-time welfare

- What matters for redistribution are price changes of maturing assets (Auclert 2017)
- Asset holdings are mainly driven by life-cycle aspects, less so by price changes
  - Example: even if housing becomes expensive, young households continue accumulating it
- Higher asset prices may not necessarily benefit those who hold them
  - Example: higher house prices are bad for a 40-year old HH despite positive balance sheet effects
- To calculate redistributive effects we keep allocations at their steady state values

Definitions of remaining life-time effects

- House price effect

$$\Gamma^{\chi}_{j,t} = \mathbb{E}_t \sum_{i=0}^{J-j} \beta^i \frac{N_{j+i}}{N_j} \left(p_{\chi,t+i} - p_{\chi}\right) \left[(1-\delta_{\chi})\chi_{j+i} - \chi_{j+i+1}\right]$$

- Financial returns effect

$$\Gamma^{a}_{j,t} = \mathbb{E}_t \sum_{i=0}^{J-j} \beta^i \frac{N_{j+i}}{N_j} \left(\frac{R^a_{j+i,t+i}}{\pi_{t+i}} - \frac{R^a_{j+i}}{\pi} \right) a_{j+i}$$

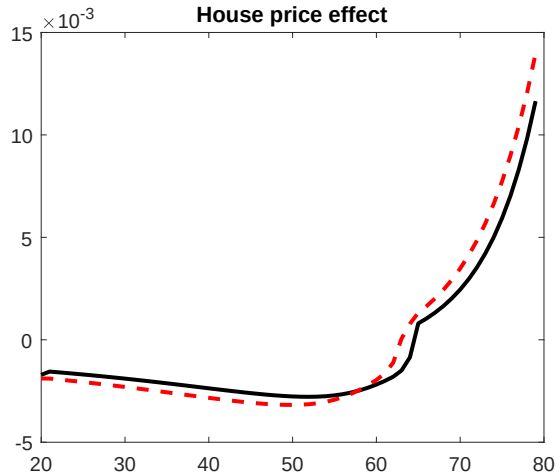
- Labor income effect

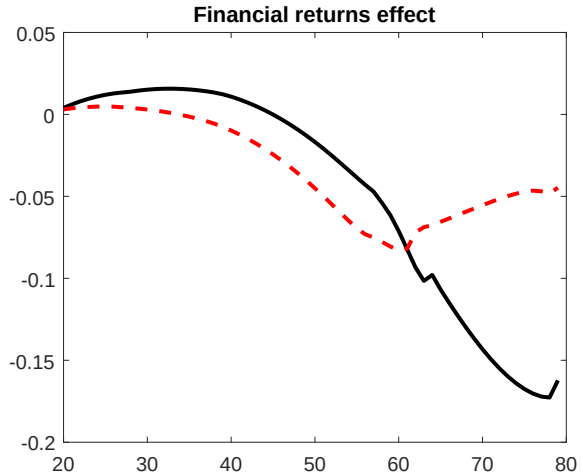
$$\Gamma^{w}_{j,t} = \mathbb{E}_t \sum_{i=0}^{JR-1-j} \beta^i \frac{N_{j+i}}{N_j} \left(w_{t+i} z_{j+i} h_{j+i,t+i} - w z_{j+i} h_{j+i}\right)$$

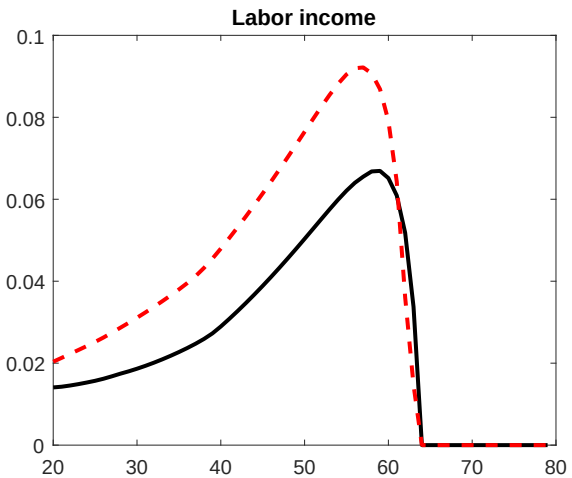
- Consumption streams (for normalization)

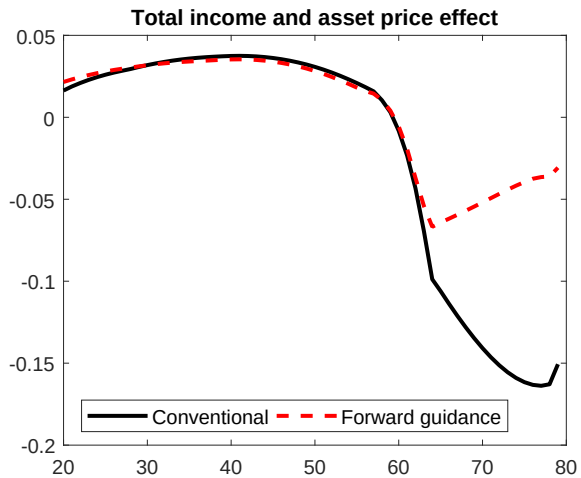
$$\Gamma^{c}_{j} = \sum_{i=0}^{J-j} \beta^i \frac{N_{j+i}}{N_j} c_{j+i}$$

Redistributive effects





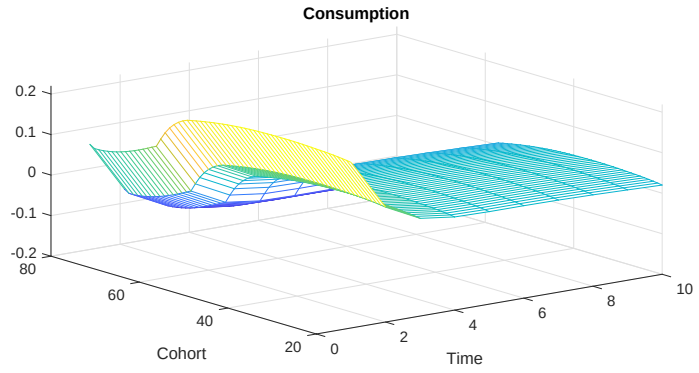


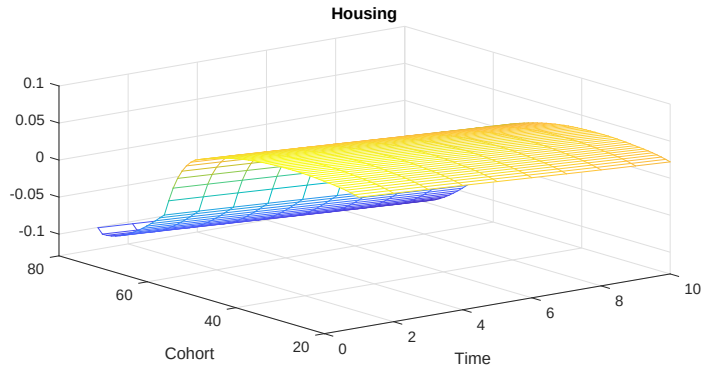


Note: Loss / gain in % of expected lifetime steady state consumption.

Impact on allocations: consumption and housing

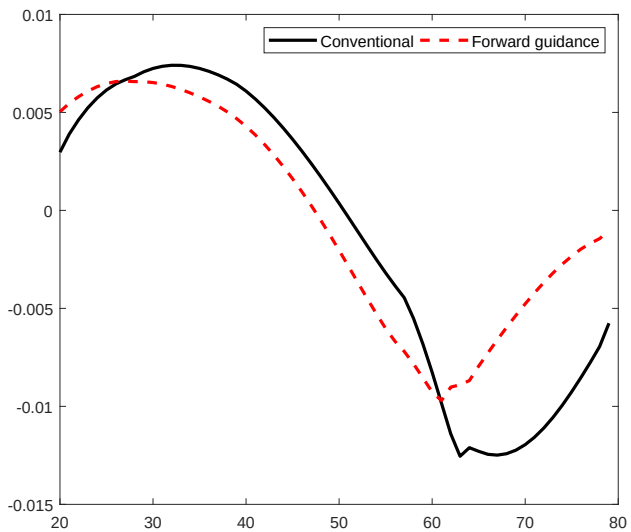
- After monetary policy easing everybody consumes more on impact
  - Young cohorts - because they become richer
  - Old cohorts - because they accelerate decumulation of (relatively expensive) housing
- Stronger reaction of young HHs





Welfare effects

- Welfare is the most comprehensive measure of impact
  - it captures i.a. the negative effect of higher labor supply
- Positive effects for young, negative for older HHs
- Picture similar to total income and asset price effect - quantity adjustements are not key



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Conclusions

1. Monetary policy redstributes welfare between age-cohorts: Monetary expansion benefits young HHs (at the expense of old HHs)
2. Conventional policy and forward guidance differ, but not dramatically
3. Welfare redistribution differs crucially from initial balance-sheet effects

Still to do

- Fit model responses to VAR evidence both for conventional and forward guidance shocks
  - Use recently published estimates of shocks obtained from high-frequency identification for the EA
  - Better combat forward guidance puzzle by modelling it as signal rather than news
- Explore ZLB and occasionally-binding collateral constraints

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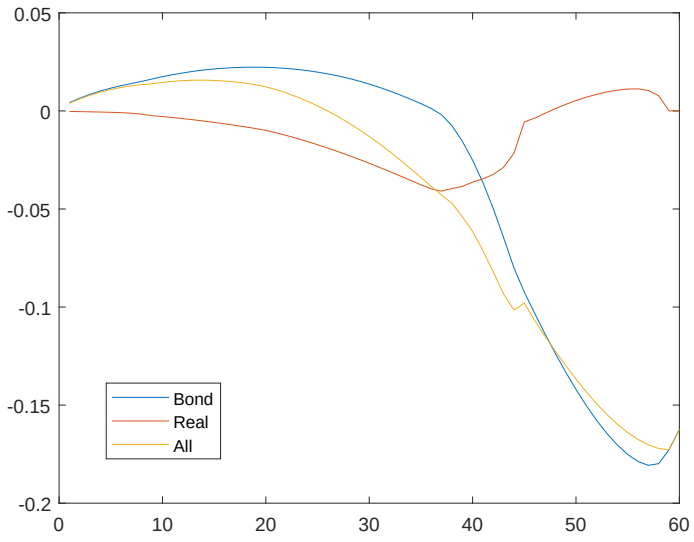
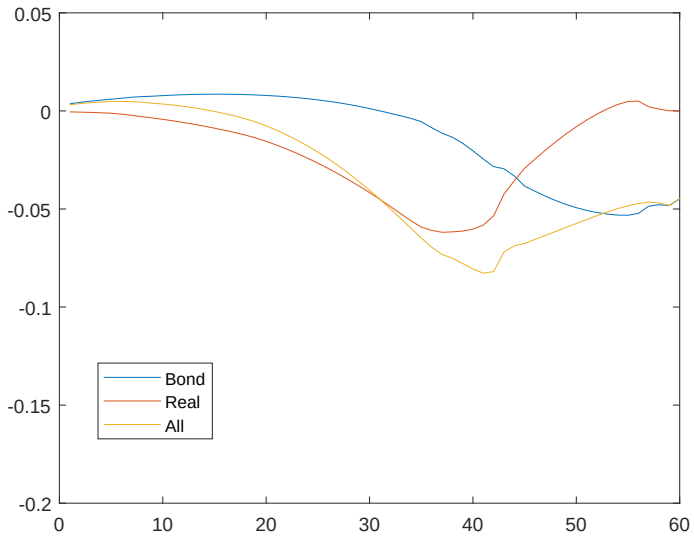
Calibration

Parameter	Value	Description
β	0.988	Discount factor
φ^{-1}	0.5	Frisch elasticity of labor supply
δ_χ	0.015	Housing depreciation rate
δ	0.12	Capital depreciation rate
α	0.3	Capital share in output
S_1	1	Investment adjustment cost curvature
μ	1.2	Product markup
θ	0.66	Calvo probability (prices)
Φ	0.04	Intermediate goods producers fixed cost
μ_w	1.2	Wage markup
θ_w	0.32	Calvo probability (wages)
π	1.02	Inflation target
γ_R	0.41	Interest rate smoothing
γ_π	1.97	Reaction to inflation
γ_y	0.42	Reaction to GDP growth

Decomposition of financial returns effect



Conventional policy



Forward guidance

Forward guidance puzzle

- Small compared to FGP in Del Negro et al. (2015): 50 b.p. shock