Distributional consequences of conventional and unconventional monetary policy

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Outline

1. Motivation
2. Model
3. Calibration and fit
4. Results
5. Conclusions
6. Additional slides
Motivation

- Monetary policy has redistributive effects:
  - via balance sheets (direct effects):
    e.g. surprise inflation redistributes away from owners of nominal assets (Doepke & Schneider 2006)
  - via its macroeconomic impact (indirect effects):
    e.g. higher unemployment after monetary tightening hurts relatively poor HHs (Heathcote et al. 2010; Kaplan et al. 2018)

- But:
  - Unconventional monetary policy less explored (exception: Lenza & Slacalek 2018)
  - Life-cycle dimension of heterogeneity and housing underexploited (exception: Wong 2018)
  - Most studies focus on US
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 shock)
  - Unconventional (imperfectly communicated 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 redistributes welfare between age-cohorts
   1. Monetary expansion benefits young households and hurts old ones
   2. Both direct and indirect effects matter
   3. Nominal asset positions are most important

2. Conventional policy and forward guidance differ
   1. Not dramatically
   2. Depending on ELB

3. Welfare redistribution differs a lot 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 and labor disutility
  - Age-specific asset structure

- Rigidities: sticky prices, sticky wages, habits, investment adjustment costs

- Monetary policy:
  - Taylor-like rule with unexpected (conventional policy) and expected (forward guidance) deviations
  - Forward guidance imperfectly communicated (Campbell et al. 2019)
  - With or without ELB
Households

- Maximize expected lifetime utility

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

subject to

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

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

- Manage nominal and real financial assets owned by households
- Maximize expected return on total portfolio
- Distribute ex-post returns to HHs according to age-specific and exogenous portfolio composition

\[ R_{j,t}^{a} = s_{j,t} R_{t-1} + (1 - s_{j,t}) R_t^{a} \]
## HH balance sheet (incl. assets in investment funds)

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing stock</td>
<td>Net worth</td>
</tr>
<tr>
<td>Real financial assets</td>
<td>Nominal financial liabilities</td>
</tr>
<tr>
<td>Nominal financial assets</td>
<td></td>
</tr>
</tbody>
</table>
Model

Asset distribution

Note: Average total assets over the life cycle = 1.
Producers

- Final goods aggregated from differentiated intermediate products
  \[ c_t + i_t + \delta \chi p_{\chi, t} \chi = \left[ \frac{1}{N_t} \int_0^{N_t} y_t(i) \frac{1}{\mu} \, di \right]^\mu \]

- 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

\[
R_t = \begin{cases} 
R_{cb}^t & \text{if } R_{cb}^t > 1 \\
1 & \text{if } R_{cb}^t \leq 1 
\end{cases}
\]

\[
\frac{R_{cb}^t}{R} = \left( \frac{R_{t-1}}{R} \right)^{\gamma_R} \left[ \left( \frac{\pi_t}{\pi} \right)^{\gamma_\pi} \left( \frac{y_t}{y_{t-1}} \right)^{\gamma_y} \right]^{1-\gamma_R} \exp(\varepsilon_R^t)
\]

- Deviations \( \varepsilon_R^t \) can be unexpected or (imperfectly) communicated
Imperfect communication

- Noisy signal \( s_t \) about future policy deviations

\[
s_t = \varepsilon_t^R + v_t
\]

where \( \varepsilon_t^R = [\varepsilon_t^R \ldots \varepsilon_{t+H}^R]' \)

- Kalman updating

\[
E_t \varepsilon_t^R = E_{t-1} \varepsilon_t^R + \kappa (s_t - E_{t-1} \varepsilon_t^R)
\]

- Calibration of the Kalman gain matrix based on Campbell et al. (2019)

\[
\kappa = \begin{bmatrix}
0.2 & 0 & 0 \\
0 & 0.6 & 0 \\
0 & 0 & 1
\end{bmatrix}
\]
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Calibration

- Standard structural parameters: taken from literature or to match means (including aggregate asset composition)
- Taylor rule parameters: estimated
- Life-cycle features:
  - Demographic data: Eurostat and EUROPOP, period average: 1999-2018
  - Age-specific productivity, hours and asset structure: HFCS (2014)
Asset structure
Monetary shocks from high-frequency identification

Source: Altavilla et al. (2019)

Impulse responses: VAR for EA estimated over 2002-2018
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Overview of simulations

- Monetary shocks:
  - Conventional: unexpected deviation from policy rule (-25 bp)
  - Unconventional (with or without ELB): signal about -25 bp deviation from policy rule, issued 2 years ahead, repeated 1 year ahead, and implemented as announced

\[
s_1 = \begin{bmatrix} 0 \\ 0 \\ -0.0025 \end{bmatrix} \quad s_2 = \begin{bmatrix} 0 \\ -0.0025 \\ 0 \end{bmatrix} \quad s_3 = \begin{bmatrix} -0.0025 \\ 0 \\ 0 \end{bmatrix}
\]

- 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
Aggregate effects of monetary policy easing
Balance-sheet and income effects on impact

Note: % of per capita output.

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Balance sheet vs remaining life-time effects

- 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, because it is in the process of accumulating housing
Definitions of remaining life-time effects

- **House price effect**
  \[
  \Gamma_{j,t}^{\chi} = \mathbb{E}_t \sum_{i=0}^{J-j} \beta^i \frac{N_{j+i}}{N_j} (p_{\chi,t+i} - p_{\chi}) [(1 - \delta_{\chi})\chi_{j+i} - \chi_{j+i+1}]
  \]

- **Financial returns effect**
  \[
  \Gamma_{j,t}^{a} = \mathbb{E}_t \sum_{i=0}^{J-j} \beta^i \frac{N_{j+i}}{N_j} \left( \frac{R_{a,j+i,t+i}}{\pi_{t+i}} - \frac{R_{a,j+i}}{\pi} \right) a_{j+i}
  \]

- **Labor income effect**
  \[
  \Gamma_{j,t}^{w} = \mathbb{E}_t \sum_{i=0}^{JR-1-j} \beta^i \frac{N_{j+i}}{N_j} (w_{t+i}z_{j+i} + h_{j+i,t+i} - wz_{j+i}h_{j+i})
  \]

- **Consumption streams (for normalization)**
  \[
  \Gamma_{j}^{c} = \sum_{i=0}^{J-j} \beta^i \frac{N_{j+i}}{N_j} c_{j+i}
  \]
Redistributive effects

- **House price effect**
- **Nominal financial asset returns effect**
- **Real financial asset returns effect**
- **Labor income**
- **Total financial asset returns effect**
- **Total income and asset price return effect**

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

**Welfare effects**

- **Most comprehensive measure**
- **Captures i.a. negative effect of higher labor supply on utility**

![Graph showing welfare effects](image-url)
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Conclusions

1. Monetary policy redistributes welfare between age-cohorts: Monetary expansion benefits young HHs (at the expense of old HHs)

2. Welfare redistribution differs crucially from initial balance-sheet effects

3. Conventional policy and forward guidance differ, but not dramatically

4. Forward guidance at ELB can have larger redistributive effects than conventional policy
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## Calibration

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>0.988</td>
<td>Discount factor</td>
</tr>
<tr>
<td>$\varphi^{-1}$</td>
<td>0.5</td>
<td>Frisch elasticity of labor supply</td>
</tr>
<tr>
<td>$\varrho$</td>
<td>0.8</td>
<td>Habit persistence</td>
</tr>
<tr>
<td>$\delta_\chi$</td>
<td>0.015</td>
<td>Housing depreciation rate</td>
</tr>
<tr>
<td>$\delta$</td>
<td>0.12</td>
<td>Capital depreciation rate</td>
</tr>
<tr>
<td>$\alpha$</td>
<td>0.3</td>
<td>Capital share in output</td>
</tr>
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<td>$S_1$</td>
<td>4</td>
<td>Investment adjustment cost curvature</td>
</tr>
<tr>
<td>$\mu$</td>
<td>1.2</td>
<td>Product markup</td>
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<tr>
<td>$\theta$</td>
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<td>Calvo probability (prices)</td>
</tr>
<tr>
<td>$\mu_w$</td>
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<td>Wage markup</td>
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<tr>
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<td>Calvo probability (wages)</td>
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<td>$\pi$</td>
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<td>Inflation target</td>
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<tr>
<td>$\gamma_R$</td>
<td>0.41</td>
<td>Interest rate smoothing</td>
</tr>
<tr>
<td>$\gamma_\pi$</td>
<td>1.97</td>
<td>Reaction to inflation</td>
</tr>
<tr>
<td>$\gamma_y$</td>
<td>0.42</td>
<td>Reaction to GDP growth</td>
</tr>
</tbody>
</table>
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 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 so that net supply is zero
Impact on allocations: consumption

- Conventional
- Forward guidance with ELB
- Forward guidance without ELB
Impact on allocations: housing

![Graphs showing impact on allocations: Conventional, Forward guidance with ELB, Forward guidance without ELB]