Monetary Policy According to HANK

Greg Kaplan
Ben Moll
Gianluca Violante

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How monetary policy works in RANK models

- Total consumption response to a drop in real rates

\[ C \text{ response} = \underbrace{\text{direct response to } r}_{>95\%} + \underbrace{\text{indirect effects due to } Y}_{<5\%} \]

- Direct response is everything, pure intertemporal substitution
How monetary policy works in RANK models

• Total consumption response to a drop in real rates

\[ C \text{ response} = \underbrace{\text{direct response to } r}_{>95\%} + \underbrace{\text{indirect effects due to } Y}_{<5\%} \]

• Direct response is everything, pure intertemporal substitution

• But both theory and data suggest

  1. **Low** sensitivity of \( C \) to \( r \)
  2. **Sizable** sensitivity of \( C \) to \( Y \)
  3. Micro sensitivity vastly **heterogeneous**, depends crucially on household **balance sheets**
How monetary policy works in HANK

- HANK delivers realistic distributions of household wealth and MPCs
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- HANK delivers realistic distributions of household wealth and MPCs

\[ C \text{ response} = \underbrace{\text{direct response to } r}_{\text{RANK: } >95\%} + \underbrace{\text{indirect effects due to } Y}_{\text{RANK: } <5\%} \]

\[ \underbrace{\text{HANK: } <15\%}_{\text{HANK: } >85\%} \]
How monetary policy works in HANK

• HANK delivers realistic distributions of household wealth and MPCs

\[ C \text{ response} = \text{direct response to } r + \text{indirect effects due to } Y \]

RANK: >95%
RANK: <5%
HANK: <15%
HANK: >85%

• Overall effect depends crucially on fiscal response, unlike in RANK
Households

• Face uninsured idiosyncratic labor income risk
• Consume and supply labor
• Hold two assets: liquid and illiquid
HANK: a framework for monetary policy analysis

Households

- Face uninsured idiosyncratic labor income risk
- Consume and supply labor
- Hold two assets: liquid and illiquid
- Budget constraints (simplified version)

\[
\frac{db_t}{dt} = r^b b_t + wz_t l_t - c_t - d_t - \chi(d_t, a_t)
\]

\[
\frac{da_t}{dt} = r^a a_t + d_t
\]

- \(b_t\): liquid assets
- \(d_t\): illiquid deposits \((\geq 0)\)
- \(a_t\): illiquid assets
- \(\chi\): transaction cost function

- In equilibrium: \(r^a > r^b\)
Households

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- \(a_t\): illiquid assets
- \(d_t\): illiquid deposits \((\geq 0)\)
- \(\chi\): transaction cost function

- In equilibrium: \(r^a > r^b\)
- Full model: borrowing/saving rate wedge, housing, taxes/transfers
Kinked adjustment cost function $\chi(d, a)$
Remaining model ingredients

**Firms**
- Monopolistically competitive intermediate-good producers
- Quadratic price adjustment costs à la Rotemberg (1982)

**Investment funds**
- Intermediate illiquid assets/capital to producers

**Government**
- Issues liquid debt, spends, taxes

**Monetary Authority**
- Sets nominal rate on liquid assets based on a Taylor rule
Three key aspects of parameterization

1. Measurement and partition of asset categories into:
   - **Liquid** (cash, bank accounts + government/corporate bonds)
   - **Illiquid productive** (equity) vs **non-productive** (housing)
Three key aspects of parameterization

1. Measurement and partition of asset categories into:
   - Liquid (cash, bank accounts + government/corporate bonds)
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2. Income process with leptokurtic income changes
   - Nature of earnings risk affects household portfolio
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   - Match mean liquid/illiquid wealth and fraction HtM
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3. Adjustment cost function and discount rate
   - Match mean liquid/illiquid wealth and fraction HtM
     - Preferences: GHH over consumption and labor supply
     - Production side: standard calibration of NK models
Model matches key feature of U.S. wealth distribution

<table>
<thead>
<tr>
<th></th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean illiquid assets (rel to GDP)</td>
<td>2.920</td>
<td>2.920</td>
</tr>
<tr>
<td>Mean liquid assets (rel to GDP)</td>
<td>0.260</td>
<td>0.263</td>
</tr>
<tr>
<td>Poor hand-to-mouth</td>
<td>10%</td>
<td>12%</td>
</tr>
<tr>
<td>Wealthy hand-to-mouth</td>
<td>20%</td>
<td>17%</td>
</tr>
</tbody>
</table>
Model generates high and heterogeneous MPCs

**Fraction of lump sum transfer consumed**

Quarterly MPC out of $500 = 17%

**Quarterly MPC $500**

Illiquid Wealth ($000)

Liquid Wealth ($000)
Transmission of monetary policy shock to $C$

Innovation $\epsilon < 0$ to the Taylor rule: $i = \bar{r}^b + \phi \pi + \epsilon$

- All experiments: $\epsilon_0 = -0.0025$, i.e. $-1\%$ annualized
Transmission of monetary policy shock to $C$

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Transmission of monetary policy shock to $C$

\[ dC_0 = \int_0^\infty \frac{\partial C_0}{\partial r^b_t} dr^b_t dt + \int_0^\infty \left( \frac{\partial C_0}{\partial r^a_t} dr^a_t + \frac{\partial C_0}{\partial w_t} dw_t + \frac{\partial C_0}{\partial T_t} dT_t \right) dt \]
Transmission of monetary policy shock to $C$

$$dC_0 = \int_0^\infty \frac{\partial C_0}{\partial r_t^b} dr_t^b dt + \int_0^\infty \left( \frac{\partial C_0}{\partial r_t^a} dr_t^a + \frac{\partial C_0}{\partial w_t} dw_t + \frac{\partial C_0}{\partial T_t} dT_t \right) dt$$

Intertemporal substitution channel: direct effects from $r^b \downarrow$
Transmission of monetary policy shock to $C$

\[
dC_0 = \int_0^\infty \frac{\partial C_0}{\partial r^b_t} dr^b_t dt + \int_0^\infty \left( \frac{\partial C_0}{\partial r^a_t} dr^a_t + \frac{\partial C_0}{\partial w_t} dw_t + \frac{\partial C_0}{\partial T_t} dT_t \right) dt
\]

Portfolio reallocation channel: indirect effects from $r^a \uparrow$
Transmission of monetary policy shock to $C$

$$ dC_0 = \int_0^\infty \frac{\partial C_0}{\partial r^b_t} dr^b_t \, dt + \int_0^\infty \left( \frac{\partial C_0}{\partial r^a_t} dr^a_t + \frac{\partial C_0}{\partial w_t} dw_t + \frac{\partial C_0}{\partial T_t} dT_t \right) \, dt $$

Labor demand channel: indirect effects from $w \uparrow$

![Graph showing deviation over quarters for different variables.](image)
Transmission of monetary policy shock to $C$

\[ dC_0 = \int_0^\infty \frac{\partial C_0}{\partial r^b_t} dr^b_t dt + \int_0^\infty \left( \frac{\partial C_0}{\partial r^a_t} dr^a_t + \frac{\partial C_0}{\partial w_t} dw_t + \frac{\partial C_0}{\partial T_t} dT_t \right) dt \]

Fiscal policy channel: indirect effects from $T \uparrow$ due to $r^b \times \text{debt} \downarrow$

![Graph showing deviation (%) over quarters for Liquid return, Iliquid return, Real wage, and Lump sum transfer.](image)
Transmission of monetary policy shock to $C$

\[ dC = \int_0^\infty \frac{\partial C_0}{\partial r^b_t} dr^b_t dt + \int_0^\infty \left( \frac{\partial C_0}{\partial r^a_t} dr^a_t + \frac{\partial C_0}{\partial w_t} dw_t + \frac{\partial C_0}{\partial T_t} dT_t \right) dt \]

\[12\%\] \hspace{1cm} \[88\%\]
Transmission across the liquid wealth distribution

- Agg. elasticity = $c$-weighted average of elasticity for given $b$
Why small direct effects?

- Intertemporal substitution: (+) for non-HtM
- Income effect: (-) for rich households
- Portfolio reallocation: (-) for those with low but > 0 liquid wealth
Why large indirect effects?

- $c$ response to $(w, T)$ income: (+) and strong for HtM
- GHH $\Rightarrow (c, \ell)$ complementarity: (+) for non-HtM
Shutting down \((c, \ell)\) complementarity

(a) Baseline

(b) No complementarity
## Importance of fiscal response

<table>
<thead>
<tr>
<th>Component</th>
<th>$T$ adjusts (1)</th>
<th>$G$ adjusts (2)</th>
<th>$B^g$ adjusts (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in $r^b$ (pp)</td>
<td>-0.23%</td>
<td>-0.21%</td>
<td>-0.25%</td>
</tr>
<tr>
<td>Change in $Y_0$ (%)</td>
<td>0.41%</td>
<td>0.81%</td>
<td>0.13%</td>
</tr>
<tr>
<td>Implied elasticity $Y_0$</td>
<td>-1.77</td>
<td>-3.86</td>
<td>-0.52</td>
</tr>
<tr>
<td>Change in $C_0$ (%)</td>
<td>0.50%</td>
<td>0.64%</td>
<td>0.19%</td>
</tr>
<tr>
<td>Implied elasticity $C_0$</td>
<td>-2.20</td>
<td>-3.05</td>
<td>-0.77</td>
</tr>
</tbody>
</table>

Component of Change in $C$ due to:

<table>
<thead>
<tr>
<th>Direct effect: $r^b$</th>
<th>12%</th>
<th>9%</th>
<th>37%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indirect effect: $w$</td>
<td>59%</td>
<td>91%</td>
<td>48%</td>
</tr>
<tr>
<td>Indirect effect: $T$</td>
<td>32%</td>
<td>0%</td>
<td>15%</td>
</tr>
<tr>
<td>Indirect effect: $r^a$</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
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Monetary policy transmission in HANK ≠ RANK

Reason:

- Intertemporal substitution weak, indirect GE channels strong
- Both hand-to-mouth and wealthy households important
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Why care? Suppose Fed wants to stimulate $C$

RANK view:

- Sufficient to influence real rates $\{r_t\}$
- Household intertemporal substitution does the rest
Monetary policy transmission in HANK $\neq$ RANK

Reason:

• Intertemporal substitution weak, indirect GE channels strong
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Why care? Suppose Fed wants to stimulate $C$

RANK view:

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• Household intertemporal substitution does the rest

HANK view:

• Rely heavily on GE feedbacks to boost hh labor income
• Through fiscal policy reaction or an investment boom
• Responsiveness of $C$ to $i$ is partly (largely?) out of Fed's control
Direct effect when $\Delta r^a = \Delta r^b$
Forward Guidance: $\epsilon_t < 0$ at $t = 8$ (2 years)

(a) Interest rate response

(b) $C$: transfers adjusting

(c) $C$: $G$ adjusting

(d) $C$: $B^g$ adjusting
## Fifty shades of K

<table>
<thead>
<tr>
<th></th>
<th>Liquid</th>
<th>Illiquid</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-productive</strong></td>
<td>Household deposits net of revolving debt</td>
<td>0.6× net housing</td>
<td>1.05</td>
</tr>
<tr>
<td></td>
<td>Corp &amp; Govt bonds</td>
<td>0.6× net durables</td>
<td></td>
</tr>
<tr>
<td></td>
<td>$B^h = 0.26$</td>
<td>$\omega A = 0.79$</td>
<td></td>
</tr>
<tr>
<td><strong>Productive</strong></td>
<td></td>
<td>Indirectly held equity</td>
<td>2.13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Directly held equity</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Noncorp bus equity</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>0.4× housing, durables</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>$(1 - \omega) A = 2.13$</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$-B^g = 0.26$</td>
<td>$A = 2.92$</td>
<td>3.18</td>
</tr>
</tbody>
</table>

- Quantities are multiples of annual GDP
- Sources: Flow of Funds and SCF 2004
Leptokurtic earnings changes (Guvenen et al)

Key idea: normally distributed jumps = kurtosis at discrete time intervals
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Key idea: normally distributed jumps = kurtosis at discrete time intervals

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<tr>
<td>Variance: annual log earns</td>
<td>0.70</td>
<td>0.70</td>
<td>Frac 1yr change &lt; 10%</td>
<td>0.54</td>
<td>0.56</td>
</tr>
<tr>
<td>Variance: 1yr change</td>
<td>0.23</td>
<td>0.23</td>
<td>Frac 1yr change &lt; 20%</td>
<td>0.71</td>
<td>0.67</td>
</tr>
<tr>
<td>Variance: 5yr change</td>
<td>0.46</td>
<td>0.46</td>
<td>Frac 1yr change &lt; 50%</td>
<td>0.86</td>
<td>0.85</td>
</tr>
<tr>
<td>Kurtosis: 1yr change</td>
<td>17.8</td>
<td>16.5</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Kurtosis: 5yr change</td>
<td>11.6</td>
<td>12.1</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Description</td>
<td>Value</td>
<td>Target / Source</td>
<td></td>
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<td>------------------------</td>
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<tr>
<td><strong>Preferences</strong></td>
<td></td>
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<tr>
<td>$\lambda$ Death rate</td>
<td>1/180</td>
<td>Av. lifespan 45 years</td>
<td></td>
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<tr>
<td>$\gamma$ Risk aversion</td>
<td>1</td>
<td></td>
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<tr>
<td>$\varphi$ Frisch elasticity (GHH)</td>
<td>0.5</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>$\psi$ Disutility of labor</td>
<td>27</td>
<td>Av. hours worked equal to 1/3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\zeta$ Weight on housing</td>
<td>0.15</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>$\rho$ Discount rate (pa)</td>
<td>4.7%</td>
<td>Internally calibrated</td>
<td></td>
<td></td>
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<tr>
<td><strong>Production</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\varepsilon$ Demand elasticity</td>
<td>10</td>
<td>Profit share 10 %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\alpha$ Capital share</td>
<td>0.33</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\delta$ Depreciation rate (p.a.)</td>
<td>10%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\theta$ Price adjustment cost</td>
<td>100</td>
<td>Slope of Phillips curve, $\epsilon/\theta = 0.1$</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Government</strong></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>$\tau$ Proportional labor tax</td>
<td>0.25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$T$ Lump sum transfer (rel GDP)</td>
<td>0.075</td>
<td>40% hh with net govt transfer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\bar{g}$ Govt debt to annual GDP</td>
<td>0.26</td>
<td>government budget constraint</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Monetary Policy</strong></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>$\phi$ Taylor rule coefficient</td>
<td>1.25</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$r^b$ Steady state real liquid return (pa)</td>
<td>2%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Housing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\omega$ Fraction of illiquid assets in housing</td>
<td>0.25</td>
<td>Flow of Funds 2004</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$r^h$ Net housing return (pa)</td>
<td>1.5%</td>
<td>Kaplan and Violante (2014)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Illiquid Assets</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$r^a$ Illiquid asset return (pa)</td>
<td>6.5%</td>
<td>Equilibrium outcome</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Borrowing</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$r^{borr}$ Borrowing rate (pa)</td>
<td>8.4%</td>
<td>Internally calibrated</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$b$ Borrowing limit</td>
<td>-0.42</td>
<td>$1 \times$ quarterly labor inc</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>