Monetary Policy According to HANK

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HANK: Heterogeneous Agent New Keynesian models

- HANK = equilibrium framework for quantitative analysis of macroeconomic fluctuations, fiscal and monetary policy
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• HANK = equilibrium framework for quantitative analysis of macroeconomic fluctuations, fiscal and monetary policy

• Two building blocks:

  (HA) Rich representation of hh portfolios and consumption behavior
      ▶ Bewley-Imrohoroglu-Huggett-Aiyagari-Krusell & Smith

  (NK) Nominal price rigidities
      ▶ Woodford’s “cashless limit”
HANK: Heterogeneous Agent New Keynesian models

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  (NK) Nominal price rigidities
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- Aim: Transmission mechanism for conventional monetary policy

- Main result: Stark difference between HANK and RANK Repr. Agent NK

Kaplan-Moll-Violante, “Monetary Policy According to HANK”
Monetary transmission in RANK and HANK

\[ \Delta C = \text{direct response to } r + \text{indirect GE response due to labor } Y \]
Monetary transmission in RANK and HANK

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RANK: >95%
HANK: <25%

RANK: <5%
HANK: >75%

Kaplan-Moll-Violante, “Monetary Policy According to HANK”
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- **RANK view:**
  - MPC out of \( r \) strong: intertemporal substitution
  - MPC out of \( Y \) weak: the RA is a PIH consumer

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• RANK view:
  - MPC out of \( r \) strong: intertemporal substitution
  - MPC out of \( Y \) weak: the RA is a PIH consumer

• HANK view:
  - MPC out of \( r \) weak: income effect of wealthy offsets int. subst.
  - MPC out of \( Y \) strong: sizable share of hand-to-mouth agents

Kaplan-Moll-Violante, "Monetary Policy According to HANK"
Why does this distinction matter?

- Suppose Fed wants to use \( i \) to stimulate \( C \) in the short run

- **RANK view:**
  - sufficient to influence the path for the real rate \( \{ r_t \} \)
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  ▶ must rely heavily on GE transmission to aggr. labor demand
  ▶ through fiscal policy reaction or an investment boom
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• Suppose Fed wants to use $i$ to stimulate $C$ in the short run

• RANK view:
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• HANK view:
  ▶ must rely heavily on GE transmission to aggr. labor demand
  ▶ through fiscal policy reaction or an investment boom
  ▶ Responsiveness of $C$ to $i$ may be largely out of Fed’s control

Kaplan-Moll-Violante, “Monetary Policy According to HANK”
Monetary transmission in RANK

- Preferences: CRRA with $I E S = \frac{1}{\gamma} > 0$ and discount rate $\rho > 0$

- Technology: $Y_t = N_t$

- Prices perfectly rigid: $p_t = 1$

- Monetary authority sets time path: $r_t = \rho + e^{-\eta t}(r_0 - \rho), \quad \eta > 0$

- Equilibrium: $C_t(\{r_s, Y_s\}_{s \geq t}) = Y_t$, and $\lim_{t \to \infty} C_t = \bar{C}$
Monetary transmission in RANK

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- Equilibrium: $C_t(\{r_s, Y_s\}_{s\geq t}) = Y_t$ and $\lim_{t\to\infty} C_t = \bar{C}$

- Overall effect of monetary policy:

\[
C_t = \bar{C} \exp \left( -\frac{1}{\gamma} \int_{t}^{\infty} (r_s - \rho) ds \right) \Rightarrow \frac{d \log C_0}{dr_0} = -\frac{1}{\gamma \eta}
\]
Monetary transmission in RANK

• Decompose $C$ response by totally differentiating $C_0(\{r_t, Y_t\}_{t\geq 0})$

\[
dC_0 = \int_0^\infty \frac{\partial C_0}{\partial r_t} dr_t dt + \int_0^\infty \frac{\partial C_0}{\partial Y_t} dY_t dt
\]

- direct response to $r$
- indirect effects due to $Y$

Kaplan-Moll-Violante, “Monetary Policy According to HANK”
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\]

direct response to $r$ \hspace{1cm} indirect effects due to $Y$

• In our special case:

\[
- \frac{d \log C_0}{dr_0} = \frac{1}{\gamma \eta} \left[ \frac{\eta}{\rho + \eta} + \frac{\rho}{\rho + \eta} \right]
\]

direct response to $r$ \hspace{1cm} indirect effects due to $Y$

• Plausible quarterly parameterization:

▷ $\rho = 0.005$

▷ $\eta = 0.5$ (half-life $\approx 2$ quarters) $\rightarrow \frac{\eta}{\rho + \eta} = 0.99$

Kaplan-Moll-Violante, "Monetary Policy According to HANK"
In RANK it’s all about intertemporal substitution

True also in medium-scale monetary DSGE (e.g., Smets-Wouters)
In RANK it’s all about intertemporal substitution

True also in medium-scale monetary DSGE (e.g., Smets-Wouters)

What is wrong with this logic? Evidence

• Weak sensitivity of consumption to $r \leftrightarrow \text{“failure of aggregate EE”}$

• Strong sensitivity of consumption to $y \leftrightarrow \text{“excess sensitivity”}$

• MPCs vastly heterogeneous $\leftrightarrow \text{“hh balance sheet effects”}$
HANK

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Building blocks

Households
• Face uninsured idiosyncratic labor income risk
• Save in two assets (liquid and illiquid), consume and supply labor

Firms
• Monopolistic competition for intermediate-good producers
• Quadratic price-adjustment costs à la Rotemberg (1982)

Investment fund
• Intermediates illiquid assets/capital to producers

Government
• Issues liquid debt, spends, taxes, and transfers lump-sum

Monetary authority ("cashless limit")
• Sets nominal rate on liquid assets based on a Taylor rule
Households

\[
\max_{\{c_t, \ell_t,\} \geq 0} \mathbb{E}_0 \int_0^\infty e^{-(\rho+\lambda)t} u(c_t, \ell_t, ) dt \quad \text{s.t.}
\]

\[
\dot{b}_t = r_t b_t + w_t z_t \ell_t - T_t (w_t z_t \ell_t) - c_t
\]

\[z_t = \text{some Markov process}\]

\[b_t \geq -b\]

- \(c_t\): non-durable consumption
- \(b_t\): liquid assets
- \(z_t\): individual productivity
- \(\ell_t\): hours worked
- \(T_t\): labor income tax/transfer

Kaplan-Moll-Violante, "Monetary Policy According to HANK"
Households

\[
\max_{\{c_t, \ell_t, d_t\}_{t \geq 0}} \mathbb{E}_0 \int_0^{\infty} e^{-(\rho + \lambda) t} u(c_t, \ell_t) \, dt \quad \text{s.t.} \quad \\
\dot{b}_t = r^b_t(b_t)b_t + w_t z_t \ell_t - T_t(w_t z_t \ell_t) - d_t - \chi(d_t, a_t) - c_t \\
\dot{a}_t = r^a_t a_t + d_t
\]

\[z_t = \text{some Markov process}\]

\[b_t \geq -b, \quad a_t \geq 0\]

- \(c_t\): non-durable consumption
- \(b_t\): liquid assets
- \(z_t\): individual productivity
- \(\ell_t\): hours worked
- \(T_t\): labor income tax/transfer
- \(d_t\): illiquid deposits (\(\geq 0\))
- \(\chi\): transaction cost function
- \(a_t\): illiquid assets
- \(h_t\): housing services

Kaplan-Moll-Violante, "Monetary Policy According to HANK"
Households

\[ \max_{\{c_t, \ell_t, d_t\}, t \geq 0} \mathbb{E}_0 \int_0^\infty e^{-(\rho+\lambda)t} u(c_t, \ell_t) \, dt \quad \text{s.t.} \]

\[ \dot{b}_t = r_t^b(b_t)b_t + w_t z_t \ell_t - T_t(w_t z_t \ell_t) - d_t - \chi(d_t, a_t) - c_t \]

\[ \dot{a}_t = r_t^a \quad a_t + d_t \]

\[ z_t = \text{some Markov process} \]

\[ b_t \geq -b, \quad a_t \geq 0 \]

- **Adjustment cost function**

\[ \chi(d, a) = \chi_0 |d| + \chi_1 \left| \frac{d}{a} \right|^2 \chi_2 a \]

- Linear component: inaction region
- Convex component: finite deposit rates

Kaplan-Moll-Violante, "Monetary Policy According to HANK"
Households

\[
\max_{\{c_t, \ell_t, d_t\}_t \geq 0} \mathbb{E}_0 \int_0^\infty e^{-(\rho+\lambda)t} u(c_t, \ell_t, h_t) \, dt \quad \text{s.t.}
\]

\[
\dot{b}_t = r^b_t(b_t) b_t + w_t z_t \ell_t - \mathcal{T}_t (w_t z_t \ell_t) - d_t - \chi(d_t, a_t) - c_t
\]

\[
\dot{a}_t = r^a_t(1 - \omega) a_t + d_t
\]

\[
h_t = \omega a_t
\]

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z_t = \text{some Markov process}
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- \(c_t\): non-durable consumption
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z_t = \text{some Markov process}
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b_t \geq -b, \quad a_t \geq 0
\]

- Households are price-takers wrt: \( \{\Psi_t\}_{t \geq 0} = \{w_t, r_t^a, r_t^b, T_t\}_{t \geq 0} \)

- The stationary recursive solution of hh problem:
  1. decision rules: \( c(a, b, z; \Psi), d(a, b, z; \Psi), \ell(a, b, z; \Psi) \)
  2. stationary distribution: \( \mu(da, db, dz; \Psi) \)
Firms

- Representative competitive final goods producer:

\[ Y = \left( \int_0^1 y_j \frac{\varepsilon - 1}{\varepsilon} dj \right)^{\frac{\varepsilon}{\varepsilon - 1}} \]
Firms

- Representative competitive final goods producer:

\[
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\]

- Monopolistically competitive intermediate goods producers:

  - Technology: \( y_j = Z k_j^\alpha n_j^{1-\alpha} \implies m = \frac{1}{Z} \left( \frac{r_k^j}{\alpha} \right)^\alpha \left( \frac{w}{1-\alpha} \right)^{1-\alpha} \)

  - Set prices subject to quadratic adjustment costs:

\[
\Theta \left( \frac{\dot{p}}{p} \right) = \frac{\theta}{2} \left( \frac{\dot{p}}{p} \right)^2 Y
\]
Firms

• Representative competitive final goods producer:

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  ▶ Set prices subject to quadratic adjustment costs:

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NK Phillips curve: \( \left( r^a - \frac{\dot{Y}}{Y} \right) \pi = \frac{\varepsilon}{\theta} \left( m - \bar{m} \right) + \dot{\pi}, \quad \bar{m} = \frac{\varepsilon - 1}{\varepsilon} \)
Competitive investment fund sector

- Own intermediate firms and issue one-period security w/ return $r^a$

- Hh productive assets $(1 - \omega) A$ are savings into this security

- Two sources of income into the fund:
  1. Rent illiquid asset as productive capital
     
     $$(r^k - \delta) K$$

  2. Receive dividends proportional to the $K$ owned
     
     $$\mathcal{D} = \left[ (1 - m)Y \right] / K$$

- Competition among funds implies illiquid asset return

  $$r^a = (r^k - \delta) + \mathcal{D}$$
Monetary authority and government

- **Taylor rule**

\[ i = \bar{r}^b + \phi \pi + \epsilon, \quad \phi > 1 \]

with \( \bar{r}^b \equiv i - \pi \)  (Fisher equation)
Monetary authority and government

- **Taylor rule**
  
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  with \( r^b \equiv i - \pi \) (Fisher equation)

- **Tax/transfer system**:
  
  \[ T(wz\ell) = \tau wz\ell - T \]

- **Government budget constraint** (in steady-state)
  
  \[ G + T + r^b B^g = \tau \int wz\ell(a, b, z) \, d\mu \]

Kaplan-Moll-Violante, “Monetary Policy According to HANK”
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• Ricardian equivalence fails \( \Rightarrow \) this matters!
PARAMETERIZATION
Some aspects of parameterization

- **Preferences**: GHH
Some aspects of parameterization

• Preferences: GHH

• Measurement and partition of asset categories into:
  - liquid (cash, bank accounts + government/corporate bonds)
  - illiquid productive (equity) + non-productive (housing)
Some aspects of parameterization

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• Continuous time **household earnings dynamics**
  ▶ Nature of earnings risk affects household portfolio

Kaplan-Moll-Violante, “Monetary Policy According to HANK”
### Earnings dynamics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Component $j = 1$</th>
<th>Component $j = 2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrival rate</td>
<td>$\lambda_j$</td>
<td>0.080</td>
</tr>
<tr>
<td>Mean reversion</td>
<td>$\beta_j$</td>
<td>0.761</td>
</tr>
<tr>
<td>St. Deviation of innovations</td>
<td>$\sigma_j$</td>
<td>1.74</td>
</tr>
</tbody>
</table>

- A career shock perturbed by periodic temporary shocks

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Some aspects of parameterization

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  - liquid (cash, bank accounts + government/corporate bonds)
  - illiquid productive (equity) + non-productive (housing)

- Continuous time household earnings dynamics
  - Match variance and kurtosis of 1- and 5-yr earnings changes

- Adjustment cost function $\chi(d, a)$ and discount factor $\rho$
  - Match mean/median liquid/illiquid wealth and fraction $HtM$

Kaplan-Moll-Violante, "Monetary Policy According to HANK"
Kinked adjustment cost function $\chi(d, a)$

Total transaction costs (financial services to households): 2% of GDP

Kaplan-Moll-Violante, “Monetary Policy According to HANK”
### Wealth distribution statistics

<table>
<thead>
<tr>
<th></th>
<th>Data</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean illiquid assets (rel. to GDP)</td>
<td>2.92</td>
<td>2.92</td>
</tr>
<tr>
<td>Mean liquid assets (rel. to GDP)</td>
<td>0.26</td>
<td>0.26</td>
</tr>
<tr>
<td>Gini coefficient for liquid wealth</td>
<td>0.98</td>
<td>0.85</td>
</tr>
<tr>
<td>Gini coefficient for illiquid wealth</td>
<td>0.80</td>
<td>0.81</td>
</tr>
<tr>
<td>Poor hand-to-mouth ($a = b = 0$)</td>
<td>10%</td>
<td>12%</td>
</tr>
<tr>
<td>Wealthy hand-to-mouth ($a &gt; 0, b = 0$)</td>
<td>20%</td>
<td>17%</td>
</tr>
</tbody>
</table>

Kaplan-Moll-Violante, "Monetary Policy According to HANK"
Some aspects of parameterization

• **Preferences**: GHH

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• Continuous time **household earnings dynamics**
  - Nature of earnings risk affects household portfolio

• Adjustment cost function \( \chi(d, a) \) and discount factor \( \rho \)
  - Match mean/median liquid/illiquid wealth and **fraction HtM**

• **Production** side: **standard calibration** of NK models

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MPC heterogeneity

- Quarterly (annual) MPC out of a $500 windfall: 17% (50%)
- MPC declining with the size of the transitory income change

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RESULTS
Expansionary monetary policy shock

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

- All experiments: $\epsilon_0 = -0.0025$, i.e. $-1\%$ annualized
Expansionary monetary policy shock

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• All experiments: $\epsilon_0 = -0.0025$, i.e. $-1\%$ annualized

Kaplan-Moll-Violante, "Monetary Policy According to HANK"
Transmission of monetary policy shock to $C$

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

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Transmission of monetary policy shock to $C$

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

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Intertemporal substitution and income effects from $r^b \downarrow$

Kaplan-Moll-Violante, "Monetary Policy According to HANK"
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 effect from $r^a - r^b \uparrow$

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Transmission of monetary policy shock to $C$

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

Labor demand channel from $w \uparrow$

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Transmission of monetary policy shock to $C$

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Fiscal policy channel from $T \uparrow$ due to $r^b \times B \downarrow$

Kaplan-Moll-Violante, "Monetary Policy According to HANK"
Transmission of monetary policy shock to $C$

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

12% + 88%

Kaplan-Moll-Violante, “Monetary Policy According to HANK”
The distribution of the monetary transmission

- Aggregate elasticity = \( c \)-weighted average of elasticity for given \( b \)
Transmission across the distribution: direct effects

- **Intertemporal substitution**: (+) for non-HtM
- **Income effect**: (-) for rich savers and (+) for borrowers
- **Portfolio reallocation**: (-) for those with $b$ low but positive

Kaplan-Moll-Violante, "Monetary Policy According to HANK"
Transmission across the distribution: indirect effects

- $c$ response to $(w, T)$ income: (+) and strong for HtM
- $c − ℓ$ complementarity: (+) for non-HtM
Role of fiscal response in monetary transmission

Kaplan-Moll-Violante, “Monetary Policy According to HANK”
Role of fiscal response in monetary transmission

<table>
<thead>
<tr>
<th></th>
<th>$T$ adjusts</th>
<th>$G$ adjusts</th>
<th>$B^g$ adjusts</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td></td>
</tr>
<tr>
<td>Change in $C_0$ (%)</td>
<td>0.47%</td>
<td>0.63%</td>
<td>0.09%</td>
</tr>
<tr>
<td>Elasticity of $C_0$ to $r^b$</td>
<td>-2.10</td>
<td>-3.01</td>
<td>-0.36</td>
</tr>
<tr>
<td>Direct effect: $r^b$</td>
<td>12%</td>
<td>9%</td>
<td>37%</td>
</tr>
</tbody>
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- **$G$ adjusts**: $G$ translates 1-1 into aggregate demand
- **$B^g$ adjusts**: no direct stimulus to aggr. demand from fiscal side

Kaplan-Moll-Violante, "Monetary Policy According to HANK"
Main findings

- Intertemporal subst. weak, indirect GE channels strong
- Both HtM and wealthy households are important
- Fiscal response to monetary policy shock is key
Monetary policy transmission in HANK ≠ RANK

• Main findings
  ▶ Intertemporal subst. weak, indirect GE channels strong
  ▶ Both HtM and wealthy households are important
  ▶ Fiscal response to monetary policy shock is key

• Implications for conduct of monetary policy
  ▶ Fed must rely heavily on GE feedbacks that boost labor $Y$
Monetary policy transmission in HANK ≠ RANK

• Main findings
  ▶ Intertemporal subst. weak, indirect GE channels strong
  ▶ Both HtM and wealthy households are important
  ▶ Fiscal response to monetary policy shock is key

• Implications for conduct of monetary policy
  ▶ Fed must rely heavily on GE feedbacks that boost labor $Y$

• Road ahead
  ▶ Forward guidance and unconventional monetary policy

Kaplan-Moll-Violante, "Monetary Policy According to HANK"
THANKS!
Summary of market clearing conditions

• Liquid asset market

\[ B^h = B^g \]

• Illiquid asset/capital market \( \rightarrow r^a \)

\[ K = (1 - \omega)A \]

• Labor market \( \rightarrow w \)

\[ N = \int z\ell(a, b, z) d\mu \]

• Goods market \( \rightarrow \pi \)

\[ Y = C + H + I + G + \chi + \text{borrowing costs} + \Theta \]

Kaplan-Moll-Violante, "Monetary Policy According to HANK"
## Fifty shades of K

### Table: Liquid, Illiquid, Total

<table>
<thead>
<tr>
<th>Category</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 Corp &amp; Govt bonds $B^h = 0.26$</td>
<td>$0.6 \times \text{net housing}$ $0.6 \times \text{net durables}$ $\omega A = 0.79$</td>
<td>1.05</td>
</tr>
<tr>
<td><strong>Productive</strong></td>
<td></td>
<td>Indirectly held equity</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Directly held equity</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Noncorp bus equity</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$0.4 \times \text{housing, durables}$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$(1 - \omega) A = 2.13$</td>
<td>2.13</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

Kaplan-Moll-Violante, “Monetary Policy According to HANK”
<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>Target / Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preferences</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \lambda ) Death rate</td>
<td>1/180</td>
<td>Av. lifespan 45 years</td>
</tr>
<tr>
<td>( \gamma ) Risk aversion</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>( \varphi ) Frisch elasticity (GHH)</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>( \psi ) Disutility of labor</td>
<td>27</td>
<td>Av. hours worked equal to 1/3</td>
</tr>
<tr>
<td>( \zeta ) Weight on housing</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>( \rho ) Discount rate (pa)</td>
<td>4.7%</td>
<td>Internally calibrated</td>
</tr>
<tr>
<td>Production</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \varepsilon ) Demand elasticity</td>
<td>10</td>
<td>Profit share 10 %</td>
</tr>
<tr>
<td>( \alpha ) Capital share</td>
<td>0.33</td>
<td></td>
</tr>
<tr>
<td>( \delta ) Depreciation rate (p.a.)</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>( \theta ) Price adjustment cost</td>
<td>100</td>
<td>Slope of Phillips curve, ( \varepsilon / \theta = 0.1 )</td>
</tr>
<tr>
<td>Government</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \tau ) Proportional labor tax</td>
<td>0.25</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>
</tr>
<tr>
<td>( \bar{g} ) Govt debt to annual GDP</td>
<td>0.26</td>
<td>government budget constraint</td>
</tr>
<tr>
<td>Monetary Policy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>( \phi ) Taylor rule coefficient</td>
<td>1.25</td>
<td></td>
</tr>
<tr>
<td>( \gamma ) Steady state real liquid return (pa)</td>
<td>2%</td>
<td></td>
</tr>
<tr>
<td>Housing</td>
<td></td>
<td></td>
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</tbody>
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