Redistribution, risk premia, and the macroeconomy

Rohan Kekre — Chicago Booth

Moritz Lenel — Princeton

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Risk premia, business cycles, and macroeconomic policy

- Risk premia are countercyclical (Fama-French (89))
- Expansionary monetary policy lowers risk premia
  - equity premium (Bernanke-Kuttner (05))
  - term premium (Hanson-Stein (15))
  - external finance premium (Gertler-Karadi (15))
- Workhorse RANK, HANK feature limited role for risk premia (Tallarini (00), Cochrane (17), Kaplan-Violante (18))

Why do risk premia vary over the cycle, in response to policy?
What does this reveal about driving forces, transmission?

Redistribution + heterogeneous propensities to bear risk

This paper: shocks which redistribute across het. propensities to bear risk in HANK drive fluctuations in risk premia and investment.

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- $Cov(\text{exposure}^i, \frac{\text{marginal propensity to save in capital}^i}{\text{marginal propensity to save}^i} - 1 \equiv mpr^i)$
    - *mpr* summarizes portfolio choice on the margin: preferences, constraints, rules-of-thumb, background risk
    - distinct from the *mpc* and undefined absent aggregate risk
- Expansionary monetary policy redistributes to high *mpr* HH
    - Rationalizes equity premium response to monetary policy shock
    - Important for transmission through investment (esp persistence)

Related work

- Monetary/fiscal policy in heterogeneous agent NK economies

  Auclert (18), Auclert et al (18), Hagedorn et al (19), Luetticke (18), McKay-Reis (17), Ottonello-Winberry (18), Werning (15), Wong (18), ...

  Here: focus on risk premia, investment, *mpr*s

- Heterogeneous-agent and intermediary-based asset pricing

  Endowment: Alvarez et al (09), Basak-Cuoco (98), Dumas (89), Drechsler et al (18), Longstaff-Wang (12), He-Krishnamurthy (13), ...

  Production: Gomes-Michaelides (08), Guvenen (09), ...

  Here: focus on interplay with production + nominal rigidities

- Financial accelerator and risk premia in NK economies

  Bernanke et al (99), Brunnermeier-Sannikov(12,14), Caballero-Farhi(18), Caballero-Simsek (18), DiTella (18), Gourio-Ngo (16), Silva (16), ...

  Here: focus on equity premium, conventional MP transmission

Outline

Environment (1/2)

- Continuum of agents with

$$v_0^i = \left((1-\beta^i)\left(c_0^i \Phi^i(\ell_0^i)\right)^{1-\frac{1}{\psi^i}} + \beta^i \left(\mathbb{E}_0 (c_1^i)^{1-\gamma^i}\right)^{\frac{1-\frac{1}{\psi^i}}{1-\gamma^i}} \right)^{\frac{1}{1-\frac{1}{\psi^i}}}$$

- $\mathbb{E}_0$ over z_1, aggregate productivity

- Resource constraints:

$$P_0 c_0^i + \frac{B_0^i}{1+i_0} + Q_0 k_0^i \leq W_0 \eta^i \ell_0^i + B_{-1}^i + (\Pi_0 + (1-\delta)Q_0) k_{-1}^i + P_0 \Delta_0^i t_0,$$

$$P_1(z_1) c_1^i(z_1) \leq W_1(z_1)\eta^i + B_0^i + \Pi_1(z_1) k_0^i$$

where $\int_0^1 \Delta_0^i di = 0$

Environment (2/2)

- Representative firm:

$$\Pi_0 k_{-1} = P_0 z_0 \ell_0^{1-\alpha} k_{-1}^{\alpha} - W_0 \ell_0 + Q_0 x_0 - P_0 \left(\frac{\bar{x}_0}{\delta k_{-1}}\right)^{\chi^x} x_0,$$

$$\Pi_1(z_1) k_0 = P_1(z_1) z_1 \ell_1^{1-\alpha} k_0^{\alpha} - W_1(z_1) \ell_1(z_1)$$

- Policy: $t_0, i_0, P_1(z_1)$, where $P_1(z_1) = \bar{P}_1$
- Market clearing:
  - Goods
  - Labor
  - Capital
  - Bonds

Approach

- Consider approximations around zero aggregate risk
  - Assume $\log z_1 \sim N\left(\log \bar{z}_1 - \frac{1}{2}\sigma^2, \sigma^2\right)$
  - Approximate around $\{\sigma = 0, t_0 = \bar{t}_0\}$
  - $\bar{\cdot}$: value at approximation point, $\hat{\cdot}$: log/level deviation (except σ)

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- Start with optimal portfolio choice + market clearing
- $\Rightarrow$ defining $1 + r_1^k(z_1) \equiv \frac{\pi_1(z_1)}{q_0}$, $1 + r_0 \equiv (1 + i_0)\frac{P_0}{P_1}$

$$\mathbb{E}_0 \hat{r}_1^k(z_1) - \hat{r}_1 + \frac{1}{2}\sigma^2 = \underbrace{\gamma\sigma^2}_{\text{“steady-state” risk premium}} + \underbrace{\zeta_{t_0}\hat{t}_0\sigma^2}_{\text{effect of “shock” on risk premium}} + o(||\cdot||^4)$$

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- Approach (and results) generalize to ∞-horizon Details

Redistribution and risk premia

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$$\zeta_{i_0} = \frac{\gamma}{\int_0^1 \bar{c}_1^i di}\left[\int_0^1 \bar{\xi}_{t_0}^i \left(1 - \frac{\gamma}{\gamma^i}\right) di\right], \text{ where } \bar{\xi}_{t_0}^i \equiv \overline{\frac{dc_1^i}{dt_0}}$$

Responses to marginal changes in income

- Agents' micro policies solve

$$\max \left((1-\beta^i)\left(c_0^i \Phi^i(\ell_0^i)\right)^{1-\frac{1}{\psi^i}} + \beta^i \left(\left(\mathbb{E}_0 (c_1^i)^{1-\gamma^i} \right) \right)^{\frac{1-\frac{1}{\psi^i}}{1-\gamma^i}} \right)^{\frac{1}{1-\frac{1}{\psi^i}}} \quad s.t.$$

$$c_0^i + \frac{1}{1+r_0} b_0^i + q_0 k_0^i = w_0 \eta^i \ell_0^i + y_0^i(P_0, \pi_0, q_0, \Delta_0^i t_0),$$

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- $\Rightarrow \{\frac{\partial b_0^i}{\partial y_0^i},\frac{\partial k_0^i}{\partial y_0^i},\frac{\partial a_0^i}{\partial y_0^i}\}$, where $\frac{1}{1+r_0}\frac{\partial b_0^i}{\partial y_0^i}+q_0\frac{\partial k_0^i}{\partial y_0^i}=\frac{\partial a_0^i}{\partial y_0^i}$

The *mpr*

- Building on Devereux-Sutherland (10,11), limiting $\{\frac{\partial b_0^i}{\partial y_0^i}, \frac{\partial k_0^i}{\partial y_0^i}\}$ determinate even though they are not "at" the limit

$$\frac{1}{1+\bar{r}_0}\overline{\frac{\partial b_0^i}{\partial y_0^i}} = \left(1 - \frac{\gamma}{\gamma^i}\right)\overline{\frac{\partial a_0^i}{\partial y_0^i}},$$

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- $\Rightarrow$ in this environment $\overline{mpr}_0^i = \frac{\gamma}{\gamma^i} - 1$

Redistribution and risk premia, revisited

$$\mathbb{E}_0 \hat{r}_1^k(z_1) - \hat{r}_0 + \frac{1}{2}\sigma^2 = \gamma\sigma^2 + \zeta_{t_0}\hat{t}_0\sigma^2 + o(||\cdot||^4)$$

- "Steady-state" risk premium:

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- Distinct from portfolio share $\frac{\bar{q}_0 \bar{k}_0^i}{\bar{a}_0^i} = \left(\frac{\bar{c}_1^i}{(1+\bar{r}_0)\bar{a}_0^i} \right) \left(\frac{\gamma}{\gamma^i} - \frac{\bar{w}_1 \eta^i}{\bar{c}_1^i} \right)$

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  - With rules-of-thumb (or binding constraint): $q_0 k_0^i = \omega_0^i a_0^i$

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  $$\overline{mpr}_0^i = \omega_0^i - 1$$
  - With idiosyncratic risk: endowment ϵ_1^i where $\mathbb{E}_0(\epsilon_1^i | z_1) = 0$
  $$\overline{mpr}_0^i = \gamma \left(\frac{\gamma^i + 1}{\gamma^i} \frac{\mathbb{E}_0(\bar{c}_1^i(\epsilon_1^i))^{-(\gamma^i+2)} \mathbb{E}_0(\bar{c}_1^i(\epsilon_1^i))^{-\gamma^i}}{\left(\mathbb{E}_0(\bar{c}_1^i(\epsilon_1^i))^{-(\gamma^i+1)}\right)^2} - 1 \right) - 1$$

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- "Steady-state" risk premium:

$$\gamma = \left(\int_{i \in A} \frac{1}{\int_{i \in A} \left[\bar{w}_1^i \eta^i + \bar{\pi}_1 \bar{k}_0^i \right] di} \frac{\mathbb{E}_0 \bar{c}_1^i (\epsilon_1^i)^{-\gamma^i}}{\mathbb{E}_0 (\bar{c}_1^i (\epsilon_1^i)^{-\gamma^i - 1}} \frac{1}{\gamma^i} di \right)^{-1}$$

- Effect of redistribution on risk premium:

$$\zeta_{t_0} = -\frac{\gamma}{\int_{i \in A} \left[\bar{w}_1^i \eta^i + \bar{\pi}_1 \bar{k}_0^i \right] di} \left[\int_0^1 \bar{\xi}_{t_0}^i \overline{mpr}_0^i di \right]$$

where $A = \{i | \text{actively trade}\}$ ($\rightarrow$ Chien-Cole-Lustig (12))

Risk premia and investment

- Since $1 + r_1^k(z_1) \equiv \frac{\alpha z_1 k_0^{\alpha-1}}{q_0}$, $\mathbb{E}_0 \hat{r}_1^k(z_1) \propto -\hat{k}_0$
- If redistribution implies $\mathbb{E}_0 \hat{r}_1^k(z_1) - \hat{r}_0 < 0$, is $\hat{k}_0 > 0$?
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  - Benchmark: r_0 does not respond to change in risk premium $\Rightarrow$

$$\hat{k}_0 \propto -\left[\mathbb{E}_0 \hat{r}_1^k(z_1) - \hat{r}_0\right] \propto \int_0^1 \bar{\xi}_{t_0}^i \overline{mpr}^i di$$

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- Many shocks involve redistribution!

Effects of TFP or monetary shocks

- Risk premia respond to each shock:

$$\mathbb{E}_0 \hat{r}_1^k(z_1) - \hat{r}_0 + \frac{1}{2}\sigma^2 = \gamma\sigma^2 + \sum_{\theta_0 \in \{t_0, z_0, i_0\}} \zeta_{\theta_0} \hat{\theta}_0 \sigma^2 + o(||\cdot||^4)$$

  and effects on investment depend on monetary policy response

- Signs depend on redistribution across $\{mpr^i\}$:

$$\zeta_{\theta_0} = -\frac{\gamma}{\int_0^1 \bar{c}_1^i di} \left[\int_0^1 \bar{\xi}_{\theta_0}^i \overline{mpr}_0^i di\right], \text{ where } \bar{\xi}_{\theta_0}^i \equiv \overline{\frac{dc_1^i}{d\theta_0}}$$

- $\bar{\xi}_{\theta_0}^i$ depends on exposures, rigidity, and policy response

Redistributive effects of shocks

- Given $W_0 = \bar{W}$ and $\ell_0^i(\ell_0) := \{\int_0^1 \eta^i \ell_0^i di = \ell_0\}$:

$$\bar{\xi}^i_{\theta_0} = (1+\bar{r}_0)\overline{\frac{\partial a_0^i}{\partial y_0^i}}\Bigg[\qquad \Bigg]$$

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$$\left.\vphantom{\frac{1}{1}}\right]$$

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$$+\underbrace{k^i_{-1}\left(\overline{\frac{d\pi_0}{d\theta_0}} + (1-\delta)\frac{1}{1+\bar{r}_0}\overline{\frac{d\pi_1}{d\theta_0}}\right) + \eta^i\left(\overline{\frac{dw_0\ell_0^i}{d\theta_0}} + \frac{1}{1+\bar{r}_0}\overline{\frac{dw_1}{d\theta_0}}\right)}_{\text{claims on aggregate income}}\Bigg]$$

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- Given $W_0 = \bar{W}$ and $\ell_0^i(\ell_0) := \{\int_0^1 \eta^i \ell_0^i di = \ell_0\}$:

$$\bar{\xi}^i_{\theta_0} = (1+\bar{r}_0)\overline{\frac{\partial a_0^i}{\partial y_0^i}}\Bigg[\underbrace{-\frac{B^i_{-1}}{\bar{P}_0}\frac{1}{\bar{P}_0}\overline{\frac{dP_0}{d\theta_0}}}_{\text{unexpected inflation}} + \underbrace{\left(\frac{1}{1+\bar{r}_0}\bar{b}_0^i + \bar{q}_0(\bar{k}_0^i - (1-\delta)k^i_{-1})\right)\frac{1}{1+\bar{r}_0}\overline{\frac{d(1+r_0)}{d\theta_0}}}_{\text{terms of trade}}$$

$$+ \underbrace{k^i_{-1}\left(\overline{\frac{d\pi_0}{d\theta_0}} + (1-\delta)\frac{1}{1+\bar{r}_0}\overline{\frac{d\pi_1}{d\theta_0}}\right) + \eta^i\left(\overline{\frac{dw_0\ell_0^i}{d\theta_0}} + \frac{1}{1+\bar{r}_0}\overline{\frac{dw_1}{d\theta_0}}\right)}_{\text{claims on aggregate income}}$$

$$+ \underbrace{\psi^i c_0^i \frac{1}{1+\bar{r}_0}\overline{\frac{d(1+r_0)}{d\theta_0}} + \left(\psi^i - 1\right)\eta^i \bar{w}_0\left(1 - \bar{\tau}^{\ell_0^i}\right)\overline{\frac{d\ell_0^i}{d\theta_0}}}_{\text{substitution effects}}\Bigg]$$

where $\bar{\tau}^{\ell_0^i} \equiv 1 - \frac{-\bar{c}_0^i \Phi^{i'}(\bar{\ell}_0^i)/\Phi^i(\bar{\ell}_0^i)}{\eta^i z_1(\bar{\ell}_0)^{-\alpha} k_{-1}^{\alpha}}$

Redistributive effects of shocks

- Given $W_0 = \bar{W}$ and $\ell_0^i(\ell_0) := \{\int_0^1 \eta^i \ell_0^i di = \ell_0\}$:

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$$+ \underbrace{k^i_{-1}\left(\overline{\frac{d\pi_0}{d\theta_0}} + (1-\delta)\frac{1}{1+\bar{r}_0}\overline{\frac{d\pi_1}{d\theta_0}}\right) + \eta^i\left(\overline{\frac{dw_0\ell_0^i}{d\theta_0}} + \frac{1}{1+\bar{r}_0}\overline{\frac{dw_1}{d\theta_0}}\right)}_{\text{claims on aggregate income}}$$

$$+ \underbrace{\psi^i c_0^i \frac{1}{1+\bar{r}_0}\overline{\frac{d(1+r_0)}{d\theta_0}} + \left(\psi^i - 1\right)\eta^i \bar{w}_0\left(1-\bar{\tau}^{\ell_0^i}\right)\overline{\frac{d\ell_0^i}{d\theta_0}}}_{\text{substitution effects}}\Bigg]$$

where $\bar{\tau}^{\ell_0^i} \equiv 1 - \frac{-\bar{c}_0^i \Phi^{i\prime}(\bar{\ell}_0^i)/\Phi^i(\bar{\ell}_0^i)}{\eta^i z_1(\bar{\ell}_0)^{-\alpha} k^{\alpha}_{-1}}$

- Literature: $Cov(exposures^i, mpc^i) \Leftrightarrow$ risk-free rates, quantities,
  Here: $Cov(exposures^i, mpr^i) \Leftrightarrow$ risk premia, quantities

Outline

Monetary policy and risk premia in the data (1/3)

- Well-documented effects of unanticipated loosening
  - macro effects: price level rises & production expands
  - equity returns rise on impact
    $\Rightarrow$ primarily driven by news about future excess returns

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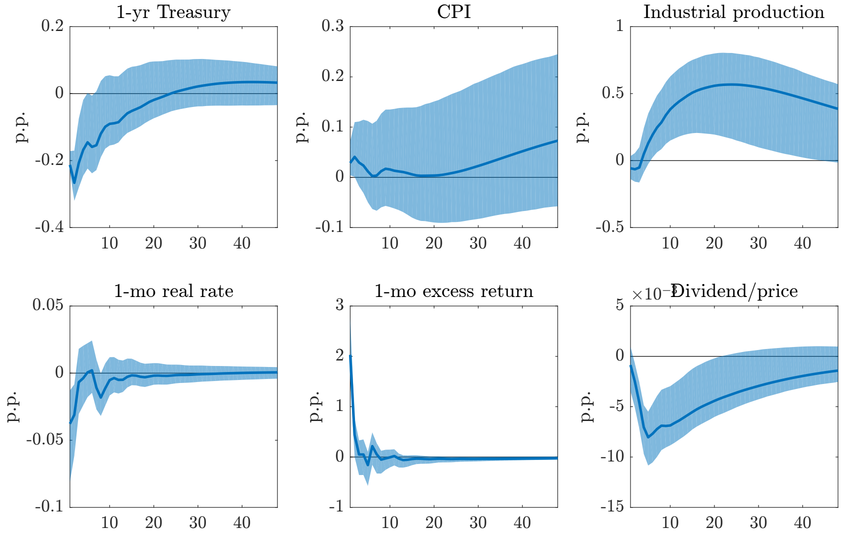
- Refresh: Gertler-Karadi (15) meets Bernanke-Kuttner (05) Details
  - monthly VAR (7/79-6/12) with six lags
    - 1-year Treasury yield, CPI, industrial production, S&P 500 excess return, risk-free return, dividend price ratio
    - external instrument: Fed Funds future surprises on FOMC days, aggregated to month (from Gertler-Karadi (15), 1/91-6/12)
  - Campbell-Shiller (88) decomposition of return innovations

Monetary policy and risk premia in the data (2/3)



Monetary policy and risk premia in the data (3/3)

- Following Campbell-Shiller (88):

$$
\begin{aligned}
(\text{excess return})_t - \mathbb{E}_{t-1}[(\text{excess return})_t] &= (\mathbb{E}_t - \mathbb{E}_{t-1}) \sum_{j=0} \rho^j \Delta(\text{dividends})_{t+j} \\
&- (\mathbb{E}_t - \mathbb{E}_{t-1}) \sum_{j=0} \rho^j (\text{real rate})_{t+j} - (\mathbb{E}_t - \mathbb{E}_{t-1}) \sum_{j=1} \rho^j (\text{excess return})_{t+j}
\end{aligned}
$$

Monetary policy and risk premia in the data (3/3)

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$$- (\mathbb{E}_t - \mathbb{E}_{t-1}) \sum_{j=0} \rho^j (\text{real rate})_{t+j} - (\mathbb{E}_t - \mathbb{E}_{t-1}) \sum_{j=1} \rho^j (\text{excess return})_{t+j}$$

- Using proxy SVAR approach to compute revisions:

		95% CI
Current excess return	2.03	[1.56,2.79]
Dividends	0.71	[0.37, 1.74]
Real rate	-0.21	[-0.52, 0.12]
Future excess return	-1.11	[-2.47, -0.17]

Outline of quantitative analysis

- Question: does micro-consistent heterogeneity in *mpr*s
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    - affect the investment response to monetary policy shocks?

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- Question: does micro-consistent heterogeneity in *mpr*s
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- Complementary approaches
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  2. numerical soln of calibrated model (global, limited het.) – today
- *mpr*s disciplined by income, trading behavior, portfolios in SCF
  - matching direct evidence, as for *mpc*s, would be valuable!
- Challenges: heterogeneity, quantity of risk, assets in calibration

Micro moments from the SCF (1/3)

1. Decompose a^i into $\{qk^i, \frac{1}{1+i}\frac{B^i}{P}\}$ s.t. $\frac{1}{1+i}\frac{B^i}{P} + qk^i = a^i$ Details

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- If household i holds 1 unit of equity in a firm with

$$\frac{\text{assets net of bonds}}{\text{equity}} = lev^f$$

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- If household i holds 1 unit of equity in an intermediary with

$$\frac{\text{assets net of bonds}}{\text{equity}} = lev^I$$

and assets net of bonds are above claims on firm equity,
$\Rightarrow$ assign $\{qk^i = lev^I lev^f, \frac{1}{1+i}\frac{B^i}{P} = 1 - lev^I lev^f\}$

Micro moments from the SCF (2/3)

2. Identify households which actively trade in capital

Details

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Micro moments from the SCF (2/3)

2 Identify households which actively trade in capital ▸ Details

$$A \equiv \{\text{have traded at least once in last year using broker } \| \text{ have active or nonactively managed business(es)}\}$$

	$i \notin A$	$i \in A$
Frac of total households	66%	34%
Frac of total net worth	28%	72%
Frac of total net worth, excl res + vehicles	22%	78%
$\sum_i qk^i / \sum_i a^i$	1.19	1.28
$\sum_i qk^i / \sum_i a^i$, excl res + vehicles	0.95	1.26
Mean wage and salary income to total income	61%	51%
N	20,613	10,627

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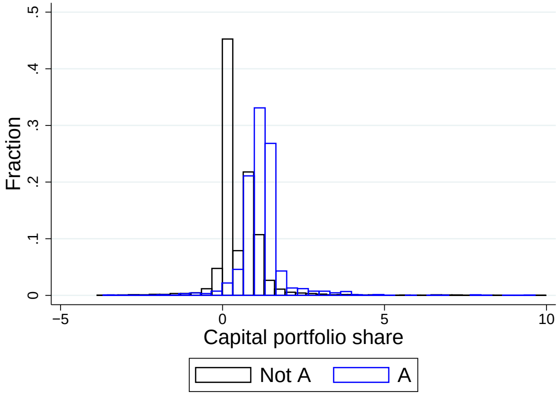

Micro moments from the SCF (3/3)

3. Characterize $\{\frac{qk^i}{a^i}\}$ across households

Details

	$i \notin A$	$i \in A$
p1	-2.3	-1.7
p5	-0.2	0.0
p50	0.0	1.0
p95	1.4	2.1
p99	4.3	4.9
p99.75	9.9	10.8
N	20,209	10,611

Extending t and simplifying i

- Extend the model to the infinite horizon
  - Rotemberg wages (χ^w) and a Taylor Rule: $1 + i_t = \left(\frac{P_t}{P_{t-1}}\right)^{\phi^\pi} m_t$
  - $\{\log z_t, \log m_t\}$ follow independent AR(1) processes
  - State variables: $(\{B^i_{t-1}, k^i_{t-1}\}, W_{t-1}, z_{t-1}, m_{t-1})$

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- Assume capitalists die with prob ς, fraction λ reborn type a

Calibration: externally set parameters

	Description	Value	Notes
$\psi^{a,b,c}$	IES	0.75	
ξ	Frisch elast	0.75	Chetty et al (11)
λ	fraction reborn *a*	0.005	
α	1 - labor share	0.33	
δ	depreciation rate	0.025	
ϵ	elast of subs across workers	10	
φ	Rotemberg wage adj costs	400	$\approx \mathbb{P}(\text{adjust}) = 7$ qtrs
ϕ^{π}	Taylor coeff on inflation	1.5	
ρ_z	persistence TFP shock	0.95	
σ_m	stdev MP shock	0.0006	
ρ_m	persistence MP shock	0	
τ_w	undoes wage markup	-0.11	

Calibration: targets and parameters

	Description	Value	Moment	Target	Model
$\bar{\xi}$	ℓ disutility	21	ℓ	0.25	0.25
σ_z	std dev TFP	0.005	$\sigma(\Delta \log c)$	0.6%	0.7%
χ	elast q^k to $\frac{x}{k_{-1}}$	8	$\sigma(\Delta \log x)$	2.4%	2.4%
$\beta^{a,b,c}$	discount factor	0.99	$\mathbb{E}r_{+1}$	1.4%	1.4%
γ^b	RRA b	800	$\mathbb{E}\left[r^e_{+1} - r_{+1}\right]$	7.1%	7.6%
γ^a	RRA a	5	$\frac{qk^a}{a^a} - \frac{qk^b}{a^b}$	10	8
γ^c	RRA c	250	$\sum_{i \notin A} a^i / \sum_i a^i$	22%	14%
ω^c	portfolio c	0.95	$\sum_{i \notin A} qk^i / \sum_{i \notin A} a^i$	0.95	0.95
ς	death prob	0.07	$a^a / \sum_{i \in A} a^i$	1.6%	1.4%

To assess role of *mpr* heterogeneity, contrast with $\gamma^a = \gamma^b = 420$.

Business cycle and asset pricing moments

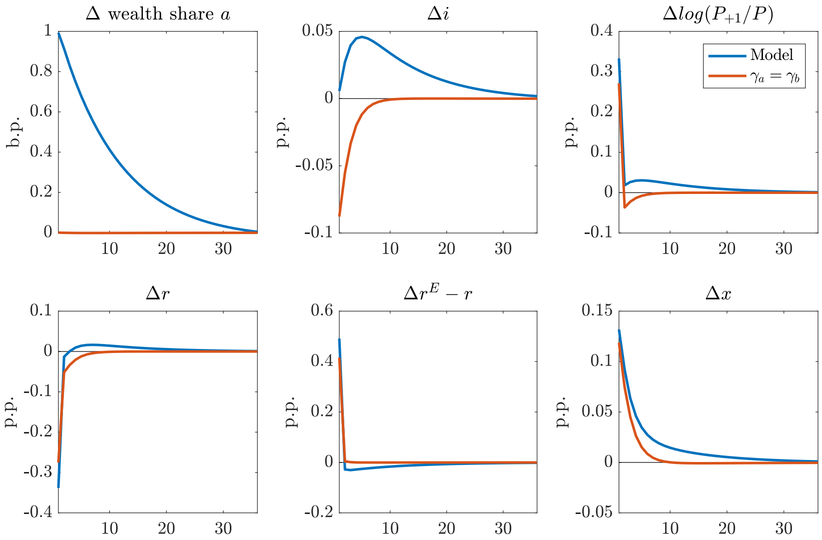
Addl micro moments

Moment (ann.)	Data	Model
$\sigma(\Delta \log c)$	0.6%	0.7%
$\sigma(\Delta \log x)$	2.4%	2.4%
$\mathbb{E}r_{+1}$	1.4%	1.4%
$\mathbb{E}\left[r^e_{+1} - r_{+1}\right]$	7.1%	7.6%
$\sigma(\Delta \log y)$	0.9%	1.2%
$\sigma(\Delta \log \ell)$	0.9%	1.1%
$\sigma\left(\mathbb{E}r_{+1}\right)$	0.8%	0.7%
$\sigma\left(\mathbb{E}\left[r^e_{+1} - r_{+1}\right]\right)$	5.4%	1.2%

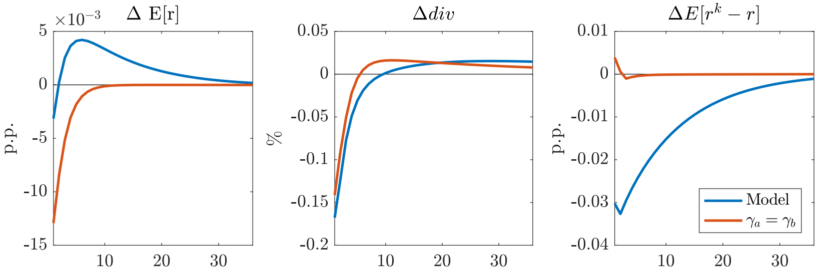
Business cycle moments from NIPA (Q1/47-Q1/18).
Asset pricing moments using VAR (7/79-6/12, assume D/E=2).

Monetary policy shock

TFP shock



Applying the Campbell-Shiller decomposition



% Excess return	Data	Model	$a = b$
Δ Dividends	35%	27%	67%
$-$Real rates	10%	12%	33%
$-$Excess returns	55%	61%	0%

Conclusion and next steps

This paper: shocks which redistribute across het. propensities to bear risk in HANK drive fluctuations in risk premia and investment.

Conclusion and next steps

This paper: shocks which redistribute across het. propensities to bear risk in HANK drive fluctuations in risk premia and investment.

- $Cov(\text{exposure}^i, \frac{\text{marginal propensity to save in capital}^i}{\text{marginal propensity to save}^i} - 1 \equiv mpr^i)$
- Expansionary monetary policy redistributes to high *mpr* HH, rationalizing equity premium response + amplifying investment

Ongoing: heterogeneity, quantity of risk, assets in calibration.

APPENDIX

Main analytical result in infinite horizon

Back

- Consider ∞-horizon with $\beta^i = \beta$, $\psi^i = \psi$ and union-set wages
- Then:

$$\mathbb{E}_0 \hat{r}_1^k(\varepsilon_1) - \mathbb{E}_1 \hat{r}_1(\varepsilon_1) = \Gamma \sigma^2 + \sum_{\theta \in \{t,m,z\}} \zeta_{\epsilon_0^\theta} \hat{\epsilon}_0^\theta \sigma^2 + o(||\cdot||^3)$$

where

$$\zeta_{\epsilon_0^\theta} = \tilde{\zeta}_{\epsilon_0^\theta} - \frac{\gamma}{\bar{z}\bar{\ell}^{1-\alpha}\bar{k}^\alpha - \delta \bar{k}} \left[\int_0^1 \xi^i_{\epsilon_0^\theta} \overline{mpr}^i di + \tilde{\xi}_{\epsilon_0^z} \int_0^1 \left(\overline{mpr}^i - \overline{mpr} \right) di \right] \left(\tilde{\delta}^{r_1^k - r_1}_{\epsilon_1^z} \right)^2$$

and $\tilde{\zeta}_{\epsilon_0^\theta}$, $\tilde{\xi}_{\epsilon_0^\theta}$ and $\tilde{\delta}^{r_1^k - r_1}_{\epsilon_1^z}$ are those obtained in a RANK with β, ψ, appropriately defined ξ, and the same tech parameters

Limiting MPC

Back

- For unconstrained agent facing no idiosyncratic risk,

$$\overline{\frac{\partial c_0^i}{\partial y_0^i}} = \frac{\bar{c}_0^i(1+\bar{r}_0)}{\bar{c}_0^i(1+\bar{r}_0)+\bar{c}_1^i}\left(1+\bar{w}_0\eta^i\overline{\frac{\partial \ell_0^i}{\partial y_0^i}}\right) + \frac{\bar{c}_1^i}{\bar{c}_0^i(1+\bar{r}_0)+\bar{c}_1^i}(1-\psi^i)\left(1-\bar{\tau}^{\ell_0^i}\right)\bar{w}_0\eta^i\overline{\frac{\partial \ell_0^i}{\partial y_0^i}}$$

where $\bar{\tau}^{\ell_0^i} \equiv 1 - \frac{-\bar{c}_0^i\Phi^{i\prime}(\bar{\ell}_0^i)/\Phi^i(\bar{\ell}_0^i)}{\bar{w}_0\eta^i}$

VAR

Back

- 6-lag VAR over 7/1979-6/2012 with, in each month t:
  - mp_t: average 1-year Treasury yield during t, the *MP indicator*
  - xr_t: S&P 500 return over t less 1-mo. Tbill yield at end $t-1$
  - r_t: 1-mo. Tbill yield at end $t-1$ less realized infl. during t
  - y_{1t}: 3-mo. moving average of dividend price ratio at t
  - y_{2t}: industrial production during month t
  - y_{3t}: inflation during month t
- Identification assumptions:
  - Exogenous variation in mp_t due to structural policy shock ϵ_t^{mp}
  - Observe z_t satisfying $\mathbb{E}z_t\epsilon_t^{mp} \neq 0$, $\mathbb{E}z_t\epsilon_t^{xr} = \mathbb{E}z_t\epsilon_t^{r} = \mathbb{E}z_t\epsilon_t^{y_i} = 0$
- z_t: monetary policy shock in month t

Monetary policy shock measures (z_t)

Back

1. *mp1_tc*: surprise in current month Fed Funds
2. *ff4_tc*: surprise in expected Fed Funds 3 mos ahead
3. *ed2_tc*: surprise in expected 3-mo ED rate, 2 qtrs ahead
4. *ed3_tc*: surprise in expected 3-mo ED rate, 3 qtrs ahead
5. *ed4_tc*: surprise in expected 3-mo ED rate, 4 qtrs ahead

	mp1_tc	*ff4_tc*	*ed2_tc*	*ed3_tc*	*ed2_tc*
Mean	-0.01	-0.01	-0.01	-0.01	-0.01
Median	0	0	0	0	0
Std dev	0.06	0.05	0.05	0.05	0.05
Min	-0.42	-0.29	-0.26	-0.28	-0.25
Max	0.15	0.09	0.13	0.16	0.21
Observations	258	258	258	258	258

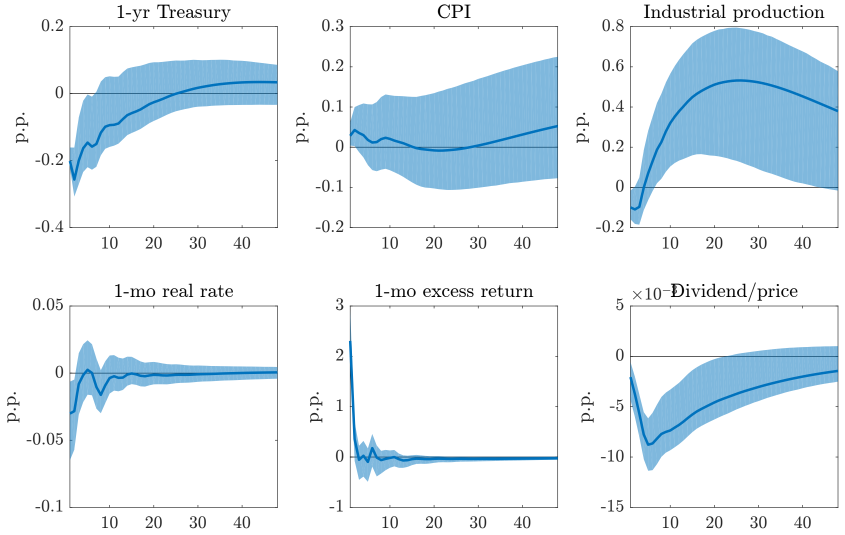
Effect of monetary policy shocks on VAR residuals

▸ Back

	mp	*mp*	*mp*	*mp*	*mp*	*mp*
*mp*1_*tc*	0.85					0.25
	(0.22)					(0.43)
*ff*4_*tc*		1.15				1.26
		(0.28)				(0.46)
*ed*2_*tc*			0.84			1.72
			(0.31)			(1.38)
*ed*3_*tc*				0.68		-4.90
				(0.30)		(1.82)
*ed*4_*tc*					0.70	3.04
					(0.31)	(1.05)
Observations	258	258	258	258	258	258
Adj R^2	0.05	0.06	0.03	0.02	0.02	0.07
F-statistic	14.46	16.27	7.59	5.24	5.00	6.39

Using 3-mo ahead FF as monetary policy shock

Back



Variance decomposition of excess returns

Back

	Total	Share (%)
Var(excess return)	17.8	
Var(dividends)	6.2	34.9
		(11.2)
Var(real rate)	0.6	3.5
		(1.7)
Var(future returns)	10.0	56.1
		(33.0)
-2Cov(dividends, real rate)	-0.4	-2
		(6.7)
-2Cov(dividends, future returns)	4.0	22.4
		(26.1)
2Cov (future returns, real rate)	-2.7	-15.0
		(12.5)
R^2 from excess return equation	0.121	
adj R^2 from excess return equation	0.031	
Observations	390	

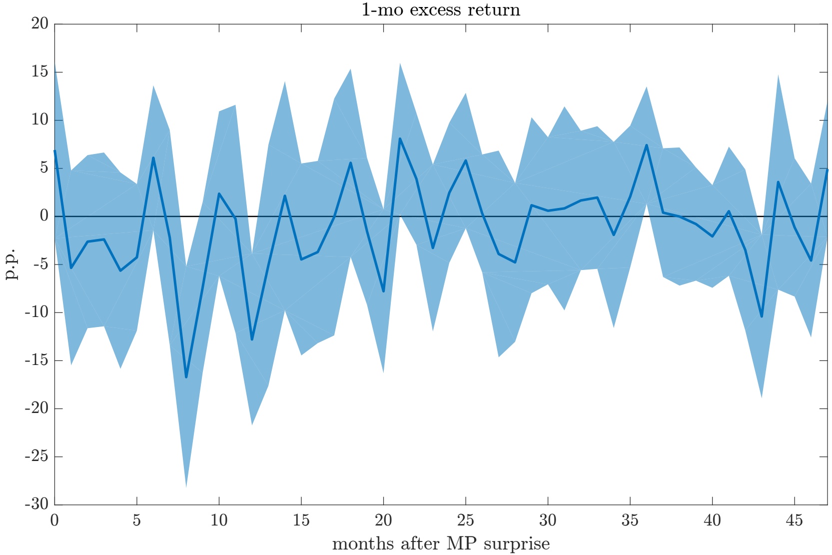
Campbell-Shiller decompositions

Back

	Baseline	Using 3-mo ahead FF
Current excess return	2.03	2.31
	[1.56,2.79]	[1.89,2.92]
Dividends	0.71	0.71
	[0.37, 1.74]	[-0.37,1.74]
Real rate	-0.21	-0.17
	[-0.52, 0.12]	[-0.47,0.16]
Future excess return	-1.11	-1.43
	[-2.47, -0.17]	[-2.73,-0.44]

Local projection

Back



Key assumptions in wealth classification

Back

Moment	Value	Source
Firm net leverage (except private business)	1.5	FFA, Nonfinancial corporate business, 2016
Active managed private business net leverage	1.5	FFA, Nonfinancial noncorporate business, 2016
Non-active managed private business net leverage	4	Axelson et al (2013)
Other mutual fund leverage	1.36	Ang et al (2011)
Quasi-liquid retirement account equity share	0.57	FFA, Private and public pension fund holdings, 2016
Combination mutual fund equity share	0.67	FFA, Mutual fund holdings, 2016
Other mutual fund equity share	0.67	assumed same as above
Other managed assets equity share	0.67	assumed same as above

Aggregate household wealth

Back

	$2016bn		
	$\sum_i \frac{1}{1+i}\frac{B^i}{P}$	$\sum_i qk^i$	$\sum_i a^i$
1 Transaction accounts	4,940	0	4,940
2 CDs	620	0	620
3 Stock mutual funds	-3,123	9,062	5,939
4 Tax-free bond mutual funds	1,329	0	1,329
5 Govt bond mutual funds	276	0	276
6 Other bond mutual funds	404	0	404
7 Combination mutual funds	-12	769	757
8 Other mutual funds	-386	1,397	1,011
9 Savings bonds	104	0	104
10 Directly held stocks	-3,019	8,761	5,742
11 Directly held bonds	1,179	0	1,179

Aggregate household wealth

▸ Back

	$2016bn		
	$\sum_i \frac{1}{1+i}\frac{B^i}{P}$	$\sum_i qk^i$	$\sum_i a^i$
12 Cash value life insurance	914	0	914
13 Other managed assets	-53	3,284	3,231
14 Quasi-liquid ret assets	1,934	13,067	15,001
15 Other misc financial assets	0	659	659
16 Vehicles	0	2,717	2,717
17 Primary residence	0	24,176	24,176
18 Res RE excl primary res	0	6,301	6,301
19 Non-res RE	0	3,694	3,694
20 Actively-managed businesses	-8,538	25,552	17,015
21 Non-active-managed businesses	-6,997	9,329	2,332

Aggregate household wealth

Back

	$2016bn		
	$\sum_i \frac{1}{1+i}\frac{B^i}{P}$	$\sum_i qk^i$	$\sum_i a^i$
22 Other misc non-fin assets	0	559	559
23 Mortgage on primary res	-8,310	0	-8,310
24 Mortgage excl primary res	-1,128	0	-1,128
25 Other lines of credit	-127	0	-127
26 Credit card balance	-316	0	-316
27 Installment loans	-1,976	0	-1,976
Vehic installment	-733	0	-733
28 Other debt	-176	0	-176
29 Total	-22,462	109,327	86,865
30 Total_exvh	-13,419	82,434	69,015

Components of active trader definition

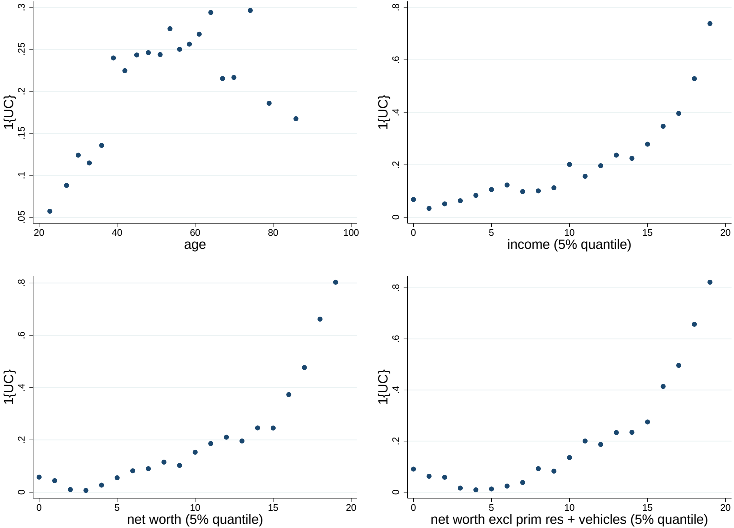
Back

	$\{htrad^i = 0\}$	$\{htrad^i = 1\}$
Frac of total households	83%	17%
Frac of $\sum_i a^i$	55%	45%
Frac of $\sum_i a^i$, excl prim res + vehicles	51%	49%
Mean wage+salary inc to total inc	60%	53%
N	25,792	5,448

	$\{hbus^i = 0\}$	$\{hbus^i = 1\}$
Frac of total households	74%	26%
Frac of $\sum_i a^i$	47%	53%
Frac of $\sum_i a^i$, excl prim res + vehicles	42%	58%
Mean wage+salary inc to total inc	61%	49%
N	23,215	8,025

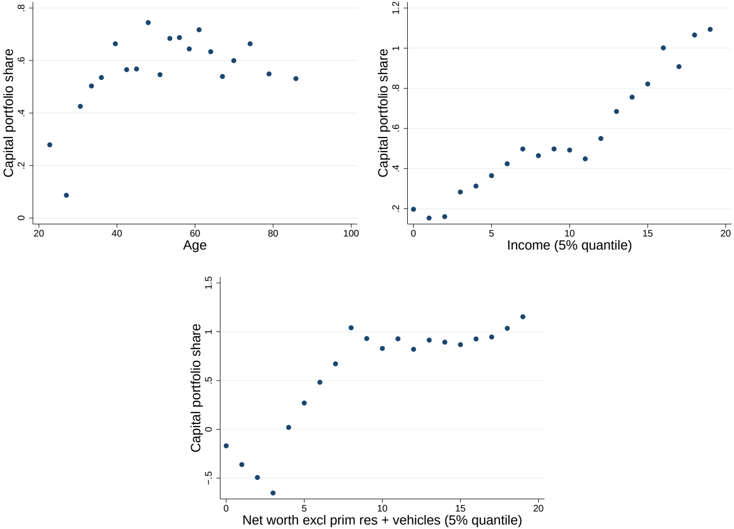
Projecting active trading status on observables

Back



Projecting $\frac{qk^i}{a^i}$ on observables

Back



Exposures and *mprs*

Back

Moment	Model	$a = b$
$a^a / \sum_i a^i$	1.2%	0.5%
$a^b / \sum_i a^i$	84.9%	93.3%
$qk^a / \sum_i a^i$	10.5%	0.5%
$qk^b / \sum_i a^i$	76.3%	93.6%
$\partial a^a / \partial y^a$	0.99	0.99
$\partial a^b / \partial y^b$	0.99	0.99
$\partial a^c / \partial y^c$	0.99	0.99
$\partial k^a / \partial y^a$	8.58	0.99
$\partial k^b / \partial y^b$	0.89	0.99
$\partial k^c / \partial y^c$	0.94	0.94
mpr^a	7.67	0.00
mpr^b	-0.10	0.00
mpr^c	-0.05	-0.05

TFP shocks and time-varying risk-premia

▸ Back