Monetary Policy According to HANK

Greg Kaplan

Ben Moll

Gianluca Violante

Conference for Bob’s Phoenix Prize

Congratulations, Bob!!!

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And thank you for everything!

My job market paper in fall 2009...

TFP Losses from Financial Frictions: Can Self-Financing Undo Capital Misallocation?

Benjamin Moll

University of Chicago

September 21, 2009

1 Introduction

Underdeveloped countries often have underdeveloped financial markets. This leads to an inefficient allocation of capital, in turn translating into low aggregate total factor productivity (TFP) and per-capita income. While plausible, this simple argument ignores the effects of financial frictions on the *accumulation* of capital and wealth. For instance, while you may not be able to acquire capital in the market, in principle, you could just accumulate it yourself. Such issues are not well understood. This paper proposes a tractable dynamic theory featuring heterogeneous entrepreneurs and borrowing constraints to explore them. It also uses the theory to quantify TFP losses from financial frictions using plant-level panel data from two emerging market economies.

An entrepreneur has a business idea. In order to develop his idea, he requires some capital and labor. The quality of his idea translates into his productivity in using these resources. The

... and after Bob's "minor comments" (original in red)

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~~The extent~~ ~~The quantitative~~ The size of this ~~effe~~ effect

But available estimates of this effect ignore (often?)

1 Introduction

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Consider ~~An~~ an entrepreneur who begins with ~~has~~ a business idea. In order to develop his idea, he requires some capital and labor. The quality of his idea translates into his productivity in using these resources. ~~The~~ The

HANK: Heterogeneous Agent New Keynesian models

- Framework for quantitative analysis of the transmission mechanism of monetary policy

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- Framework for quantitative analysis of the transmission mechanism of monetary policy

- Three building blocks

  1. Uninsurable idiosyncratic income risk

  2. Nominal price rigidities

  3. Assets with different degrees of liquidity

How monetary policy works in RANK

- 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

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- However, 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

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- Once matched to micro data, HANK delivers realistic:
    - wealth distribution: small direct effect
    - MPC distribution: large indirect effect (depending on ΔY)

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- Overall effect depends crucially on fiscal response, unlike in RANK where Ricardian equivalence holds

HANK: a framework for monetary policy analysis

Households

- Face uninsured idiosyncratic labor income risk
- Consume and supply labor
- Hold two assets: liquid and illiquid

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- Budget constraints (simplified version)

$$\dot{b}_t = r^b b_t + w z_t \ell_t - c_t - d_t - \chi(d_t, a_t)$$
$$\dot{a}_t = r^a a_t + d_t$$

- b_t: liquid assets
- d_t: illiquid deposits ($\gtrless 0$)
- a_t: illiquid assets
- χ: transaction cost function

- In equilibrium: $r^a > r^b$

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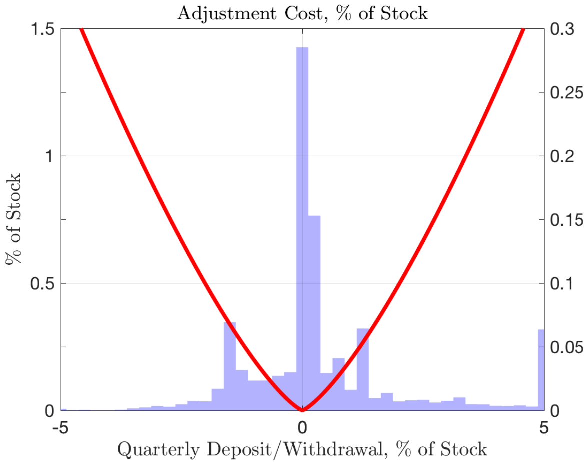
- In equilibrium: $r^a > r^b$
- Full model: borrowing/saving rate wedge, taxes/transfers

Kinked adjustment cost function $\chi(d, a)$



Remaining model ingredients

Illiquid assets: $a = k + qs$

- No arbitrage: $r^k - \delta = \frac{\Pi + \dot{q}}{q} := r^a$

Firms

- Monopolistic intermediate-good producers $\rightarrow$ final good
- Rent illiquid capital and labor services from hh
- Quadratic price adjustment costs à la Rotemberg (1982)

Government

- Issues liquid debt (B), spends (G), taxes and transfers (T)

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: ▸ 50 shades of K
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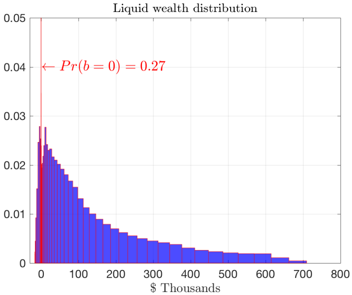
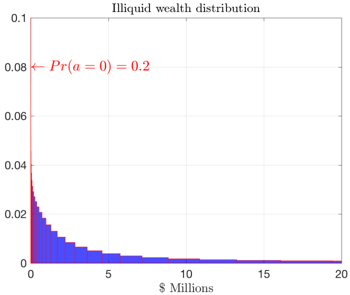
- Production side: standard calibration of NK models
- Standard separable preferences: $u(c, \ell) = \log c - \frac{1}{2}\ell^2$

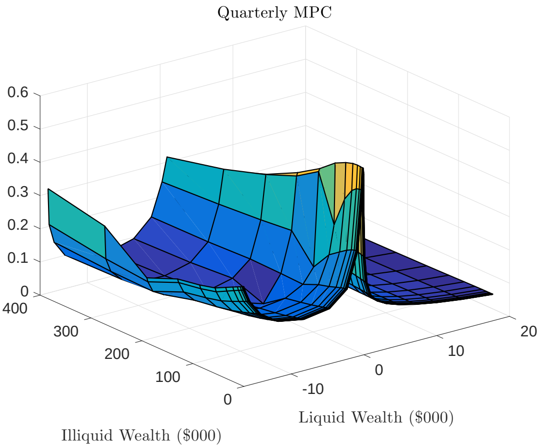
Model matches key feature of U.S. wealth distribution





	Data	Model
Mean illiquid assets (rel to GDP)	2.920	2.920
Mean liquid assets (rel to GDP)	0.260	0.263
Poor hand-to-mouth	10%	9%
Wealthy hand-to-mouth	20%	18%

Model generates high and heterogeneous MPCs



- Average quarterly MPC out of a $500 windfall: 16%

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

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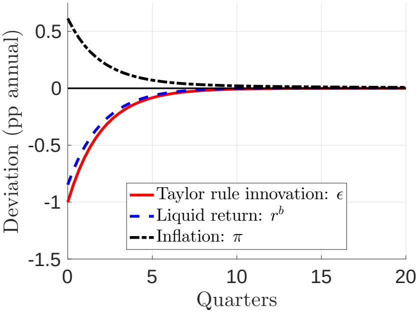

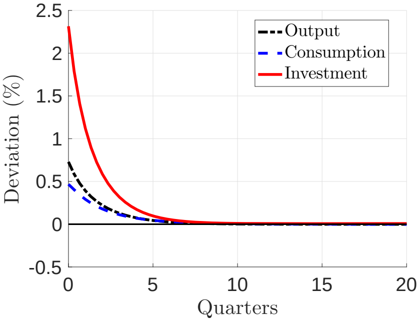

Transmission of monetary policy shock to C

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

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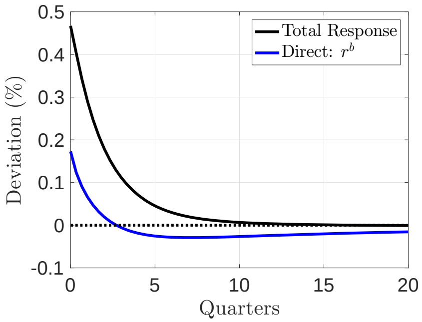
✓

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



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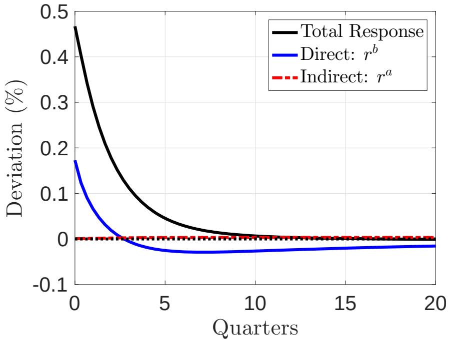
$\checkmark$

Portfolio reallocation effect from $r^a - r^b \uparrow$



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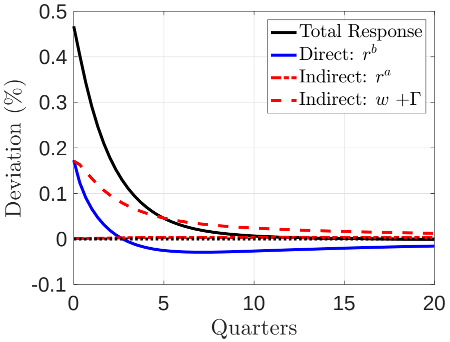
Labor demand channel from $w \uparrow$



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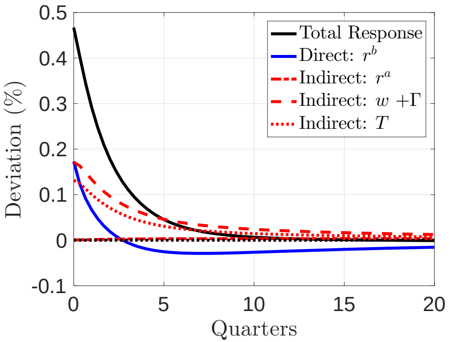
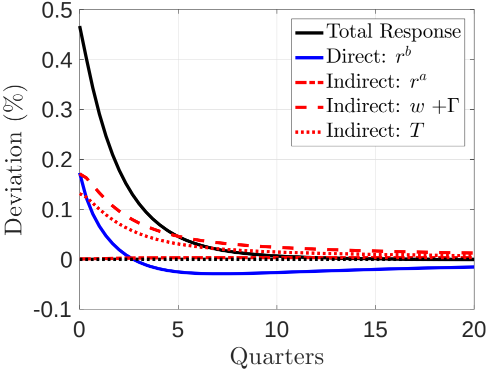
Fiscal adjustment: $T \uparrow$ in response to $\downarrow$ in interest payments on B

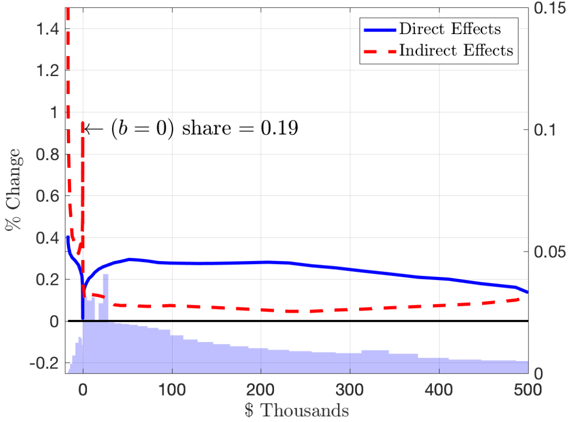


Transmission of monetary policy shock to C

$$dC_0 = \underbrace{\int_0^\infty \frac{\partial C_0}{\partial r_t^b} dr_t^b dt}_{19\%} + \underbrace{\int_0^\infty \left[\frac{\partial C_0}{\partial r_t^a} dr_t^a + \frac{\partial C_0}{\partial w_t} dw_t + \frac{\partial C_0}{\partial T_t} dT_t \right] dt}_{81\%}$$

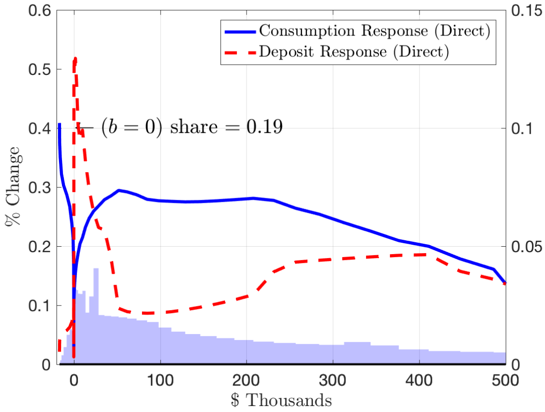


Monetary transmission across liquid wealth distribution



- Total change = c-weighted sum of (direct + indirect) at each 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

Role of fiscal response in determining total effect

	T adjusts	G adjusts	B^g adjusts
	(1)	(2)	(3)
Elasticity of C_0 to r^b	-2.21	-2.07	-1.48
Share of Direct effects:	19%	22%	46%

- Fiscal response to lower interest payments on debt:
  - T adjusts: stimulates AD through MPC of HtM households
  - G adjusts: translates 1-1 into AD
  - B^g adjusts: no initial stimulus to AD from fiscal side

Monetary transmission in RANK and HANK

ΔC	$=$	direct response to r	$+$	indirect GE response
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  - High sensitivity to Y: sizable share of hand-to-mouth agents

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- Work in progress: perturbation methods $\Rightarrow$ estimation, inference

Congratulations, Bob!!!

And thank you for everything!

Illiquid return and monopoly profits

- Illiquid assets = part capital, part equity

$$a = k + qs$$

  - k: capital, pays return $r - \delta$
  - s: shares, price q, pay dividends $\omega\Pi = \omega(1-m)Y$

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- Arbitrage:

$$\frac{\omega\Pi + \dot{q}}{q} = r - \delta := r^a$$

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- Remaining $(1-\omega)\Pi$? Scaled lump-sum transfer to hh's:

$$\Gamma = (1-\omega)\frac{z}{\bar{z}}\Pi$$

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- Set $\omega = \alpha \Rightarrow$ neutralize asset redistribution from markups

$$\text{total illiquid flow} = rK + \omega\Pi = \alpha mY + \omega(1-m)Y = \alpha Y$$

$$\text{total liquid flow} = wL + (1-\omega)\Pi = (1-\alpha)Y$$

Monetary Policy in Benchmark NK Models

Goal:

- Introduce decomposition of C response to r change

Setup:

- Prices and wages perfectly rigid $= 1$, GDP=labor $= Y_t$
- Households: CRRA(γ), income Y_t, interest rate r_t

$$\Rightarrow \quad C_t(\{r_s, Y_s\}_{s\geq 0})$$

- Monetary policy: sets time path $\{r_t\}_{t\geq 0}$, special case

$$r_t = \rho + e^{-\eta t}(r_0 - \rho), \quad \eta > 0 \tag{$*$}$$

- Equilibrium: $C_t(\{r_s, Y_s\}_{s\geq 0}) = Y_t$
- Overall effect of monetary policy

$$-\frac{d \log C_0}{d r_0} = \frac{1}{\gamma \eta}$$

Monetary Policy in RANK

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

$$dC_0 = \underbrace{\int_0^\infty \frac{\partial C_0}{\partial r_t} dr_t dt}_{\text{direct response to } r} + \underbrace{\int_0^\infty \frac{\partial C_0}{\partial Y_t} dY_t dt}_{\text{indirect effects due to } Y} .$$

- In special case $(*)$

$$-\frac{d \log C_0}{dr_0} = \frac{1}{\gamma\eta} \left[\underbrace{\frac{\eta}{\rho+\eta}}_{\text{direct response to } r} + \underbrace{\frac{\rho}{\rho+\eta}}_{\text{indirect effects due to } Y} \right].$$

- Reasonable parameterizations $\Rightarrow$ very small indirect effects, e.g.
  - $\rho = 0.5\%$ quarterly
  - $\eta = 0.5$, i.e. quarterly autocorr $e^{-\eta} = 0.61$

$$\Rightarrow \quad \frac{\eta}{\rho+\eta} = 99\%, \qquad \frac{\rho}{\rho+\eta} = 1\%$$

What if some households are hand-to-mouth?

- "Spender-saver" or Two-Agent New Keynesian (TANK) model
- Fraction Λ are HtM "spenders": $C_t^{sp} = Y_t$
- Decomposition in special case $(*)$

$$-\frac{d\log C_0}{dr_0} = \frac{1}{\gamma\eta}\left[\underbrace{(1-\Lambda)\frac{\eta}{\rho+\eta}}_{\text{direct response to } r} + \underbrace{(1-\Lambda)\frac{\rho}{\rho+\eta}+\Lambda}_{\text{indirect effects due to } Y}\right].$$

- $\Rightarrow$ indirect effects $\approx \Lambda = 20\text{-}30\%$

What if there are assets in positive supply?

- Govt issues debt B to households sector
- Fall in r_t implies a fall in interest payments of $(r_t - \rho)\, B$
- Fraction λ^T of income gains transferred to spenders
- Initial consumption restponse in special case $(*)$

$$-\frac{d \log C_0}{d r_0} = \frac{1}{\gamma\eta} \quad + \quad \underbrace{\frac{\lambda^T}{1-\lambda}\frac{B}{\bar{Y}}}_{\text{fiscal redistribution channel}} \quad .$$

- Interaction between non-Ricardian households and debt in positive net supply matters for overall effect of monetary policy

Fifty shades of K

	Liquid	Illiquid	Total
Non-productive	Household deposits net of revolving debt Corp & Govt bonds $B^h = 0.26$	$0.6\times$ net housing $0.6\times$ net durables $\omega A = 0.79$	1.05
Productive		Indirectly held equity Directly held equity Noncorp bus equity $0.4\times$ housing, durables $(1-\omega)A = 2.13$	2.13 K
Total	$-B^g = 0.26$	$A = 2.92$	3.18

- Quantities are multiples of annual GDP
- Sources: Flow of Funds and SCF 2004

back

Leptokurtic earnings changes (Guvenen et al.)

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

Moment	Data	Model	Moment	Data	Model
Variance: annual log earns	0.70	0.70	Frac 1yr change $< 10\%$	0.54	0.56
Variance: 1yr change	0.23	0.23	Frac 1yr change $< 20\%$	0.71	0.67
Variance: 5yr change	0.46	0.46	Frac 1yr change $< 50\%$	0.86	0.85
Kurtosis: 1yr change	17.8	16.5			
Kurtosis: 5yr change	11.6	12.1			

back

Description		Value	Target / Source
Preferences			
λ	Death rate	1/180	Av. lifespan 45 years
γ	Risk aversion	1	
φ	Frisch elasticity (GHH)	1	
ρ	Discount rate (pa)	4.8%	Internally calibrated
Production			
ε	Demand elasticity	10	Profit share 10 %
α	Capital share	0.33	
δ	Depreciation rate (p.a.)	7%	
θ	Price adjustment cost	100	Slope of Phillips curve, $\varepsilon/\theta = 0.1$
Government			
τ	Proportional labor tax	0.25	
T	Lump sum transfer (rel GDP)	\$6,900	6% of GDP
$\bar{g}$	Govt debt to annual GDP	0.233	government budget constraint
Monetary Policy			
ϕ	Taylor rule coefficient	1.25	
r^b	Steady state real liquid return (pa)	2%	
Illiquid Assets			
r^a	Illiquid asset return (pa)	5.7%	Equilibrium outcome
Borrowing			
r^{borr}	Borrowing rate (pa)	7.9%	Internally calibrated
$\underline{b}$	Borrowing limit	\$16,500	$\approx 1\times$ quarterly labor inc
Adjustment Cost Function			
χ_0	Linear term	0.04383	Internally calibrated
χ_1	Coef on convex term	0.95617	Internally calibrated
χ_2	Power on convex term	1.40176	Internally calibrated
$\bar{a}$	Min a in denominator	\$360	Internally calibrated