Inequality and Macroeconomic Fluctuations and Policies

THANK, The Tractable Way

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Harry Johnson Keynote Lecture, Money Macro and Finance Conference

Manchester, September 6th, 2024

Based on (20 years – TODAY!)

- Limited Asset Market Participation, Monetary Policy, and (Inverted) Aggregate Demand Logic, **2008** *Journal of Economic Theory* (Ch. 1, **2004** PhD Thesis)
- The New Keynesian Cross, 2020 *Journal of Monetary Economics*
- Monetary Policy and Heterogeneity: An Analytical Framework, 2024 *Review of Economic Studies*

- Joint work w/ **R. Straub** (2004 Mimeo, 2012 JEDC, 2013 REStat); **Meier and Mueller** (2008 JMCB); **Monacelli and Perotti** (2011 Mimeo; 2013 EJ; 2024 JME); **Ragot** (2020 RED); **Känzig Surico** (2023 JME)
- Ongoing with **Primiceri and Tambalotti; w/ Känzig; w/ Gürkaynak, Galaasen, Maehlum and Molnar; etc.**

Convergence and Synthesis, and Harry Johnson

The original "Keynesian Monetarist"

Convergence and Synthesis, and Harry Johnson

- "managed to synthesize divergent economic viewpoints." ...synthesized Keynesianism with monetarism ... hired by U of Chicago to be the university's token "Keynesian" (see Laidler's JPE)
- "the purpose of economics as a Social Science is to arrive at a set of principles for understanding and interpreting the economy that are **both scientifically 'robust' and sufficiently simple** to be communicable to successive generations of students and policy makers and the general public." (Harry Johnson, 1974, "Major Issues in Monetary Economics", OEP)

Convergence and Synthesis, 21st Century

- Modern Macro: Aggregate to Aggregate$\underline{D}$
- Tectonic shift, convergence e.g. "nominal rigidities"
- Distributional concerns, Inequality: feed back to aggregate

Dimensions of Convergence

- Policy, Empirical, Computational, Analytical
- **2008 Great Expansion**—*stabilization* policies (mon&fisc)
  - + inequality-redistribution, i.a. Bernanke, Yellen, Draghi
- Micro data & solving HA models Krusell Smith, Den Haan, Reiter (...)
- *Aggregate* Euler? Hall; Cambell Mankiw (...) zero net worth: Wolff (...)
- Consumption—Income: Johnson, Parker, Souleles; Surico et al; etc.
- *Liquidity* constr. & MPC: Kaplan Violante; Cloyne Ferreira Surico; Gorea Midrigan

HA

____ ____ ____

NK

HA

HA NK

2000s: TANK, Macro to Micro

2010s: Micro to Macro

HANK

— — — —

HANK

2000s: TANK, Macro to Micro

("let's aggregate properly")

2010s: Micro to Macro

HANK

HANK

2000s: TANK, Macro to Micro

("let's disaggregate a bit")

TANK

is to Campbell Mankiw, Flavin, Zeldes, Carroll, Kimball, Deaton etc

what

HANK

is to Bewley Aiyagari İmrohoroğlu Huggett Krusell Smith Rios-Rull etc.

	Quantitative	Tractable
TANK 2000s		Bilbiie **2008** *JET* (2004) LAMP, Mon. Pol. & (Inv.) Aggregate Demand Logic ↓
HANK 2010s	Ben Moll's lecture	↓ χ

Key channel?: $\chi \gtrless 1 \sim$ Cyclical Inequality

Elasticity of individual (-> distribution) to aggregate

Complementarity Quant–Tractable

(**not** substitutes in any way)

Literature

- **TANK 2000s** Bilbiie 04, 08; Galí Lopez-Salido Vallés 04, 07 (Mankiw 00); Bilbiie Straub; Bilbiie Meier Muller; Colciago; Di Bartolomeo Rossi; Areosa Areosa; Furlanetto; Natvik; Ascari, Colciago and Rossi; Eser, etc.; **different:** Iacoviello 05; Eggertsson Krugman; Curdia Woodford; Nistico; Bilbiie Monacelli Perotti
- **HANK 2010s** Oh Reis, Guerrieri Lorenzoni, Gornemann Kuester Nakajima; **Kaplan Moll Violante; McKay Nakamura Steinsson; Auclert**; Auclert Rognlie; Bayer Luetticke Pham-Dao Tjaden; Luetticke; Ravn Sterk; Den Haan Rendahl Riegler; McKay Reis; Challe Matheron Ragot Rubio; Debortoli Galí; Hagedorn Manovskii Mitman (Luo); Ferrière Navarro; Auclert Rognlie Straub; Wolf; Fernandez-Villaverde Nuno Rachedi; **Analytical:** Acharya Dogra; Bilbiie; Broer, Hansen, Krusell, Oberg; Holm; Ravn Sterk; Werning; Cantore Freund; Holm; Bernstein; Caramp Silva
- **Determinacy in RANK**: Leeper; Woodford; Cochrane; Lubik Schorfheide; **Forward Guidance puzzle** (Del Negro, Giannoni, Patterson): ~~perfect information/rational expectations~~ Kiley; Carlstrom Fuerst Paustian; Garcia-Schmidt Woodford; Farhi Werning; Wiederholt; Andrade et al; Gabaix; Angeletos Lian; **G balance sheet**: Cochrane; Diba Loisel; Michaillat Saez; Hagedorn
- **Optimal policy TANKs** Bilbiie 08, Ascari et al; Nistico; Areosa Areosa; Bilbiie Monacelli Perotti; **HANKs**: Bhandari Evans Golosov Sargent; Nuno Thomas; Challe; Bilbiie Ragot; Cui Sterk; LeGrand Martin-Baillon Ragot; McKay Wolf, Davila Schaab

Core Model: **THANK**

Max(Micro in Macro)

s.t. Tractable

Core Model: THANK

1. representation of **several** quantitative-HANK channels

   — **The New Keynesian Cross** (*JME*): **one** channel

2. Tractable **fits purpose:** *closed-form analytical, full-blown NK*

   — policymakers, central banks, public communication, students, colleague economists

   — **complexify** in other, further dimensions

   —> **the Harry Johnson criterion**

Analytical Lessons from TANK and THANK

1. AD Amplification & Fiscal Multipliers: both Keynesian & GE (TANK)
2. Intertemporal Amplification: Determinacy, Taylor rule, FG puzzle
3. 1 + 2: Catch-22: income risk vs inequality; role of Policy & FIRE
4. Fiscal policy: Propagation, iMPCs, deficits (beyond TANK)
5. Investment in capital: different AD amplification w/ inequality
6. Inflation? Not very different ("Greed"?)
7. Optimal monetary policy – inequality; divine coincidence?
   Add Fiscal $\longrightarrow$ redistribution vs. stabilization tradeoff
8. Estimation: Micro and Macro; does this all "**matter**"?!
   (for actual macro fluctuations and policies)

Preview: The Simplest 3-Equation THANK Model

$$c_t = \delta E_t c_{t+1} - \sigma \frac{1-\lambda}{1-\lambda\chi}\left(i_t - E_t \pi_{t+1} - \rho_t\right)$$

$$: \text{(with } \delta \equiv 1 + (\chi - 1)\frac{1-s}{1-\lambda\chi}\text{)}$$

$$\pi_t = \kappa c_t + \beta E_t \pi_{t+1} + u_t$$

$$i_t = \phi \pi_t \text{ (or LQ-}\textit{optimal policy}\text{)}$$

- Heterogeneity $\sim$ colors

TANK

both
1. (Stricto sensu) Keynesian & 2. a role for General Equilibrium

Simplest TANK, Bilbiie 2008 version

- (Revisited in light of HANK: *The New Keynesian Cross*)
- A*ssets* or not; $\lambda \in [0,1]$ H hand-to-mouth, consume all <u>**their**</u> income;
- Rest savers S(complete markets within, hold & price all assets)

$$c_t^S = E_t c_{t+1}^S - \sigma r_t$$

- Aggregation $c_t = \lambda c_t^H + (1-\lambda)\, c_t^S$
- <u>idea</u>: express individual $c^j (= y^j)$ as function of aggregate $c(= y)$;

$$c_t^H = y_t^H = \underbrace{\chi}_{\text{[KEY]}} y_t;\ c_t^S = \frac{1-\lambda\chi}{1-\lambda} y_t$$

TANK: Key Aggregation –> AD

- idea: express individual $c^j (= y^j)$ as function of aggregate $c (= y)$;

$$c_t^H = y_t^H = \underbrace{\chi}_{\text{[KEY]}} y_t;\; c_t^S = \frac{1 - \lambda\chi}{1 - \lambda} y_t$$

χ model-dependent: labor market, nominal rigidity, fiscal redistribution (profits) e.g.
$\chi \equiv 1 + \varphi \left(1 - \frac{\tau^D}{\lambda}\right)$

- key channel:

$$\textit{Cyclical}\ \textbf{(Income) Inequality:}\ \gamma_t = y_t^S - y_t^H = \frac{1 - \chi}{1 - \lambda} y_t$$

TANK: Cyclical (Income) Inequality

- Aggregate Euler-IS-AD: replace c_t^S in Euler S: $c_t^S = E_t c_{t+1}^S - \sigma r_t$:

$$c_t = E_t c_{t+1} - \sigma \frac{1-\lambda}{1-\lambda\chi} r_t$$

1. **TANK** *Amplification* iff $\chi > 1$: **Inequality** *Countercyclical*

   Generalizes to rich-HANK: cov(MPC,χ), Auclert JMP 2015; Direct test: Patterson 2019 JMP

   aggreg. MPC $\equiv \lambda \times 1 \times \chi + (1-\lambda) \times (1-\beta) \times \frac{1-\lambda\chi}{1-\lambda}$

- $\chi > 1$: AEIS—dc/dr—*increasing* with λ $(< \chi^{-1})$; Reason ↑
- **dampening** with $\chi < 1$ but
  - indirect share (Kaplan Moll Violante) ω increasing with λ *regardless* of χ;

The New Keynesian Cross

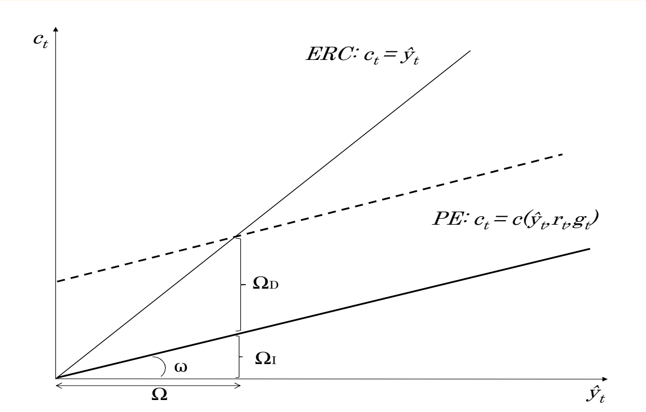
- *Aggreg. C*, **PE curve** (novel≠Campbell-Mankiw!):

$$c_t = \left[1 - \beta\left(1 - \lambda\chi\right)\right]\hat{y}_t - \left(1 - \lambda\right)\beta\sigma r_t + \beta\left(1 - \lambda\chi\right)E_t c_{t+1}$$

- Partial equilibrium, indirect effect ... **MPC!** keep y fixed
- General equilibrium, total effect ... **Multiplier**: add $c_t = \hat{y}_t \rightarrow$ Aggregate Euler

	Total effect Ω ("multiplier")	Indirect-effect share ω ("aggregate MPC")
TANK	$\frac{\sigma}{1-p}\frac{1-\lambda}{1-\lambda\chi}$	$\frac{1-\beta(1-\lambda\chi)}{1-\beta p(1-\lambda\chi)}$

The New Kenesian Cross $c_t = \omega\hat{y}_t - (1-\omega)\,\Omega r_t + (1-\omega)\,(M-1)\,g_t$



aggreg. MPC $\omega \equiv \lambda \times 1 \times \chi + (1-\lambda) \times (1-\beta) \times \frac{1-\lambda\chi}{1-\lambda}$

TANK Neutrality Special case: A-cyclical Inequality

- Campbell-Mankiw knife-edge $\chi = 1$, intertemporal substitution only difference

188 · CAMPBELL & MANKIW

accrues to individuals to consume their current income, while the remainder $(1-\lambda)$ accrues to individuals who consume their permanent income. If the incomes of the two groups are Y_{1t} and Y_{2t} respectively, then total income is $Y_t = Y_{1t} + Y_{2t}$. Since the first group receives λ of total income, $Y_{1t} = \lambda Y_t$ and $Y_{2t} = (1-\lambda)Y_t$. Agents in the first group consume their current income, so $C_{1t} = Y_{1t}$, implying $\Delta C_{1t} = \Delta Y_{1t} = \lambda \Delta Y_t$. By contrast, agents in the second group obey the permanent income hypothesis, implying $\Delta C_{2t} = (1 - \lambda)\epsilon_t$.

The change in aggregate consumption can now be written as

$$\Delta C_t = \Delta C_{1t} + \Delta C_{2t} = \lambda \Delta Y_t + (1 - \lambda)\epsilon_t. \quad (1.4)$$

  - History of thought: footnote 26 in CM's 3rd and last paper on this, EER 1991

[26] Of course, utility costs would be much larger again if some agents were consuming their *own* current income.

- **neutrality** (RANK); but *indirect effect* (one-to-one);
- Bilbiie 2008 footnote 14; Bilbiie-Straub 2012;
  - Werning 2015: generalization in a complicated model but focusing on "income risk". Here, no risk (yet)

TANK: Fiscal Multipliers and ANY "demand shocks"

- very similar logic (Keynesian Cross ....)
- see paper(s) for analysis and TANK and HANK literature
- powerful AD amplification: **same indirect effect** for ANY "demand shock"

  fiscal policies and also discount factor, risk, credit spreads, uncertainty, inequality, liquidity traps, etc.
- indeed, "AD equivalence" results for fiscal-monetary policies

  Bilbiie Monacelli Perotti 2013, 2024 in TANK; Wolf 2024 in HANK

THANK

–without and with Liquidity–

THANK Model (Ingredients)

- **Two states**: constrained hand-to-mouth $H$and unconstrained S
  - switch *exogenously* (idiosyncratic uncertainty).
- Insurance:
  - *full within* type (after idiosyncratic uncertainty revealed)
  - *limited across* types.
- **Two assets** and *liquidity*:
  - bonds: **liquid** (*can* use to self-insure, before idiosync. uncertainty revealed)
  - stocks: **illiquid** (cannot ——— " ———).
- Bond trading
  - equilibrium liquidity
  - or **not (***most analytical* HANK): "**Bondless** limit"

Two-state-, Two-asset, Tractable-HANK

- *Liquidity* (Kaplan et al, Bayer et al): $S \xrightarrow{1-s} H$ take **bonds** (liquid), not stock
  - **self-insurance** (bonds priced even when not traded) loglin.:

$$c_t^S = sE_t c_{t+1}^S + (1-s)\, E_t c_{t+1}^H - \sigma r_t$$

- "wealthy" H: Euler with inequality (constrained), liquidity or not
- Aggregate, replace distribution c_t^j

$$c_t = \underbrace{\left[1 + (\chi - 1)\,\frac{1-s}{1-\lambda\chi}\right]}_{\equiv \delta} E_t c_{t+1} - \sigma \underbrace{\frac{1-\lambda}{1-\lambda\chi}}_{\text{TANK}} r_t$$

Aggregate Euler in THANK

$$c_t = \underbrace{\left[1 + (\chi - 1)\frac{1-s}{1-\lambda\chi}\right]}_{\equiv \delta} E_t c_{t+1} - \sigma \underbrace{\frac{1-\lambda}{1-\lambda\chi}}_{\text{TANK}} r_t$$

- **THANK Compounding**/Discounting $\delta \gtrless 1$ iff $\chi \gtrless 1$
  - same as in **TANK** but intertemporal! (amplification to news)
  - *Not necesarily* **cyclical** risk

Oscillating THANK: No Risk

- $s = 0$ (Woodford 1990) $\lambda = 1/2$ agents **oscilate**, Aggregate Euler:

$$c_t = \frac{\chi}{2-\chi} E_t c_{t+1} - \sigma \frac{1}{2-\chi} r_t$$

$$\delta|_{s=0} = \frac{\chi}{2-\chi} \lesseqgtr 1 \text{ iff } \chi \lesseqgtr 1.$$

- general case: $\sim Y^H = Y^S \rightarrow \Gamma = 1 \rightarrow$ variance is zero to first order–*Not necesarily* **cyclical** risk

A Different Cyclical-Risk Channel

- Add $-s'(Y_{t+1}) \gtrless 0$. Twist: use contemporaneous $s(Y_t)$:
  Ravn Sterk; Werning; **Acharya Dogra**

$$c_t = \frac{\delta}{1-\eta} E_t c_{t+1} - \frac{\sigma}{1-\eta} \frac{1-\lambda}{1-\lambda\chi} r_t$$

$$\eta \equiv \frac{s_Y Y}{1-s} \left(1 - \Gamma^{-1/\sigma}\right) (1-\tilde{s})\, \sigma \frac{1-\lambda}{1-\lambda\chi} \text{ and } \Gamma = Y^S / Y^H > 1$$

- **Similar** discounting/*compounding and contemporaneous* amplification
- *Different* precautionary saving: prudence $\sigma > 0$ (Carroll Kimball Ecma 96)
- w/ $s(Y_{t+1})$: reduced-form⇔Acharya-Dogra "PRANK" (discounting, no contemp. multipliers)
- different interpretation: PRANK=CARA+normality →cyclical variance, no skewness; here: η~cyclicality of skewness, variance cyclical for two reasons

The 3-Equation THANK Model

$$c_t = \delta E_t c_{t+1} - \sigma \frac{1-\lambda}{1-\lambda\chi}\left(i_t - E_t \pi_{t+1}\right)$$

$$: (\text{with } \delta \equiv 1 + (\chi - 1)\frac{1-s}{1-\lambda\chi})$$

$$\pi_t = \kappa c_t + \beta E_t \pi_{t+1}$$

$$i_t = \phi \pi_t$$

- (*here* $\pi_t = \kappa c_t$ simple closed forms, paper NKPC)

The 1-Equation THANK Model

$$
\begin{aligned}
c_t &= \delta E_t c_{t+1} - \sigma \frac{1-\lambda}{1-\lambda\chi}\left(i_t - E_t \pi_{t+1}\right) \\
&: (\text{with } \delta \equiv 1 + (\chi - 1)\frac{1-s}{1-\lambda\chi}) \\
\pi_t &= \kappa c_t \\
i_t &= \phi \pi_t
\end{aligned}
$$

- (*here* $\pi_t = \kappa c_t$ simple closed forms, paper NKPC)

The HANK Taylor Priciple

$$c_t = \frac{\delta + \kappa\sigma\frac{1-\lambda}{1-\lambda\chi}}{1 + \phi\kappa\sigma\frac{1-\lambda}{1-\lambda\chi}} E_t c_{t+1} + shocks$$

- $\exists!$ REE (local determinacy) with $\lambda < \chi^{-1}$:

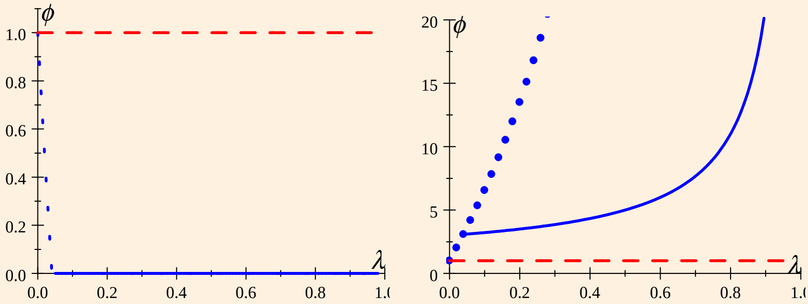
$$\phi > 1 + \frac{\delta - 1}{\kappa\sigma\frac{1-\lambda}{1-\lambda\chi}}.$$

  - **Taylor principle** $\phi > 1$ *sufficient* if:

$$\delta \leq 1 \longrightarrow \chi \leq 1 \; (\Leftrightarrow \Sigma \,(\text{iMPCs}) \geqslant 1, \text{ Auclert Rognlie Straub–see later})$$

- subsequently: Acharya Dogra (Ecma 2020) w/ **cyclical (pure) risk**: use $\delta + \eta$

The HANK Taylor Priciple and Sargent-Wallace



$\chi = 0.5$ (procyclical inequality) $\chi = 2$ (countercyclical inequality)

Fig. 2: Taylor threshold ϕ^* with $1 - s = 0$ (dash, TANK); 0.04 (solid); λ (dots). Note: determinacy above the curve.

Catch-22: No Puzzle, No Amplification?

1. **HANK Amplification-Multiplier** iff:

$$\chi > 1$$

intuition: *NK Cross*; **paper:** liquidity traps, fiscal multipliers

2. **No-puzzle** iff *HANK-Disc.* > *RANK-Comp.*

$$\nu_0 = \delta + \kappa\sigma\frac{1-\lambda}{1-\lambda\chi} < 1 \longrightarrow \chi << 1$$

Proof: $c_t = \nu_0 E_t c_{t+1} - \sigma\frac{1-\lambda}{1-\lambda\chi} i_t^* = \nu_0^{\bar{T}} E_t c_{t+\bar{T}} - \sigma\frac{1-\lambda}{1-\lambda\chi} E_t \sum_{j=0}^{\bar{T}-1} \nu_0^j i_{t+j}^*$

FG Puzzle: Resolved or Aggravated

- **Aggravated** with countercyclical inequality $\chi > 1$
- Also: discounting $\delta < 1$ not sufficient; sufficiency:

$$1 - s > 0 \text{ and } \chi < 1 - \sigma\kappa\frac{1-\lambda}{1-s} < 1$$

- **McKay Nakamura Steinsson**: *sufficient* conditions for no FG puzzle, special cases
  - analytical, $\chi = 0$, $\delta = s$, iid $s = 1 - \lambda$
  - quantitative: rebate profits uniformly, i.e. disproportionately more to bottom ("poor"), isomorphic to $\tau^D > \lambda$ so $\chi < 1$
- Hagedorn Luo Manovskii Mitman: more quantitative examples of both cases (sticky wages, redistribution, etc.)

Cyclical Inequality vs Risk: Solution to Catch-22?

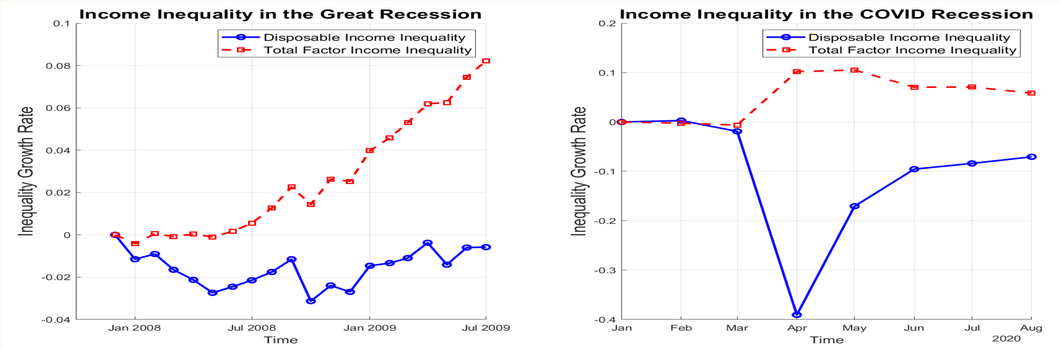
- *Proposition*: Catch-22 resolved iff one of cyclical inequality / risk **procyclical** "enough", the other is **countercyclical**, i.e.

$$\tilde{\delta} < 1 - \eta \text{ and } \frac{1-\lambda}{1-\lambda\chi} > 1 - \eta$$

$$\implies \eta \in \left(\frac{(1-\chi)\lambda}{1-\lambda\chi}, \frac{(1-\chi)(1-\tilde{s})}{1-\lambda\chi} \right).$$

- but bigger trouble if both are countercyclical ....
- a first look at the data, **last two US recessions**

Cyclical Inequality vs Risk: Solution to Catch-22?



Income inequality (top/bottom 50%) in the last two recessions; realtimeinequality.org data (Blanchet et al, 2023)

Other ways out of Catch-22?

- move away from "FIRE", relax either FI or RE.
  - $\rightarrow$Separate source of Euler discounting, if enough $\rightarrow$amplification from incomplete-mkt mechanisms wo puzzles
  - Gabaix (behavioral, sparsity); Angeletos Lian (imperf. common knowledge); Garcia-Schmidt Woodford (reflective equilibrium); etc.
- combination THANK + ...: Gallegos; Pfäuti Seyrich; Meichtry; etc.
- speaks to virtues of "tractable"$\rightarrow$ amenable to extensions in other relevant dimensions

Other Solutions to Catch-22: Policy

- **Catch-22** (like the FG puzzle!): **Conditional** on policy rule ....
- Indeterminacy w/ Taylor pervasive w/ countercyclical inequality +++ countercyclical risk

Virtuous Policies in HANK: Wicksellian & Debt Rules

- = *Amplification, Determinacy & No Puzzle even with* $\tilde{\delta} + \eta > 1$
- **Wicksellian** price-level-targeting: ∃! REE w/

$$i_t = \phi_p p_t \text{ with } \phi_p > 0$$ (Woodford & Giannoni in RANK)

  - Intuition: **PID control**–bygones *not* bygones.
- With Liquidity: Nominal **Debt-quantity rule** *(Hagedorn)*

$$b_{t+1}^N \equiv b_{t+1} + p_t = 0 \text{ or } \phi_b p_t$$

  - →**always determinate** w/ well-defined bonds demand
  - Intuition: ... **"money" rule**

THANK

–with Bonds-Liquidity–

iMPCs in THANK w/ liquidity

- Equilibrium with government-provided liquidity:
- well-defined precautionary-savings (liquidity) demand function, in and out of Steady State
- Like in Aiyagari Bewley Huggett etc models but **solved analytically, closed-form**.
- **Auclert Rognlie Straub**; Hagedorn Manovskii Mitman
  - *fiscal policy*
- most compelling critique of **TANK** ... **not of THANK!**
- better still: χ helps match data (Fagereng Holm Natvik)

iMPCs in THANK (w/ liquidity)

- loglin. BCs, replace in self-insurance Euler $\rightarrow$ liquidity demand:

$$E_t b_{t+2} - \Theta b_{t+1} + \beta^{-1} b_t = \frac{1-\lambda}{s} \left[s E_t \hat{y}^S_{t+1} + (1-s) E_t \hat{y}^H_{t+1} - \hat{y}^S_t \right], \quad (1)$$

$\Theta \equiv \frac{1}{s} + \beta^{-1} \left[1 + \frac{1-s}{s} \left(\frac{1-s}{\lambda} - 1 \right) \right]$. Solve backward-forward

- at given income (no govt BC): take partial derivative wrt aggregate income shock, keeping fixed everything
- Special oscillating case: $s = 0$ and $\lambda = \frac{1}{2}$. Simplest.

iMPCs in THANK (w/ liquidity)

- Proposition: iMPCs in oscillating model $s = 0$

$$\frac{dc_T}{d\hat{y}_T} = \frac{2 - \chi + \beta\chi}{2\,(1+\beta)};\ \frac{dc_{T+1}}{d\hat{y}_T} = \frac{2-\chi}{2\,(1+\beta)};\ \frac{dc_{T-1}}{d\hat{y}_T} = \frac{\beta\chi}{2\,(1+\beta)}$$

$\frac{dc_t}{d\hat{y}_T} = 0$ o/w

General proposition: paper (still closed-form)

- Alternative analytics for iMPCs: TANK & bonds in utility w/ adjustment costs, Cantore Freund 2021

iMPCs in THANK (w/ liquidity)

- iMPCs to t=0 shock ($\chi = 1$):

$$\frac{dc_t}{d\hat{y}_0} = \begin{cases} 1 - \frac{1-\lambda}{s} + \frac{1-\lambda}{s}\left(1 - \beta x_b\right)\frac{1-x_b}{1-\beta x_b^2}, & \text{if} \quad t = 0; \\ \frac{1-\lambda}{s}\left(1 - \beta x_b\right) x_b^t & \text{if} \quad t \geq 1. \end{cases}$$

  x_b stable root of (liquid-)asset accummulation eq.:

$$x_b = \frac{1}{2}\left(\Theta - \sqrt{\Theta^2 - 4\beta^{-1}}\right),$$

  where $\Theta \equiv \frac{1}{s} + \beta^{-1}\left[1 + \frac{1-s}{s}\left(\frac{1-s}{\lambda} - 1\right)\right]$.

- 1. impact, 2. scale down from t=1; 3. exponential decay
  - 3 sufficient statistics, 3 deep parameters (λ, s, β),
- *stable root of asset accumulation equation* = clear economics (AR coeff. in equil. assets' dynamics)

iMPCs in THANK (w/ liquidity)

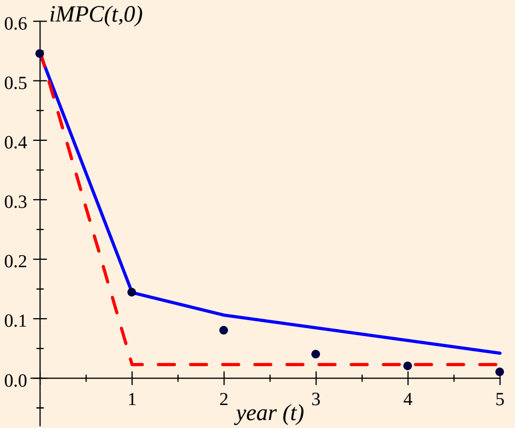


Figure 3: iMPCs in THANK (blue solid); TANK (red dash); Data (dots)

THANK with Illiquid Capital

Based on Bilbiie, Känzig, and Surico (JME 2022)

Isolating K Inequality

- ~Samuleson *1939* **multiplier-accelerator** (A. Hansen)
- S also invest, isoelastic
$$i_t = \eta y_t$$
- Assume that income is perfectly redistributed $\chi = 1$:
$$c_t^H = y_t$$
$$C_Y c_t^S + \frac{I_Y}{1-\lambda} i_t = Y_Y^S y_t.$$
- Aggregate Euler - Demand:
$$c_t = E_t c_{t+1} - \underbrace{\frac{1-\lambda}{1-\lambda\frac{1-I_Y}{1-\eta I_Y}}}_{\text{multiplier}} r_t$$

Another Keynesian-Cross-Like Multiplier

- Aggregate Euler - Demand:

$$c_t = E_t c_{t+1} - \underbrace{\frac{1-\lambda}{1-\lambda\frac{1-I_Y}{1-\eta I_Y}}}_{\text{multiplier}} r_t$$

- Another Keynesian-cross multiplier iff $\eta > 1$ (dah):

the savings rate (of S) acts as an MPC (of H)

S's saving-investment $\longrightarrow$ K **income, redistribution** $\longrightarrow$ H, **not** saving

  - Novel analytical isolation$\longrightarrow$any HA w/ *some* K (net saving);

- Also in quantitative HANK (Auclert Rognlie Straub)

The Multiplier ... of the Multiplier

- both K and Y inequality

$$\left|\frac{\partial c_t}{\partial r_t}\right| = \frac{1-\lambda}{1-\lambda\chi\frac{1-I_Y}{1-\eta I_Y}}$$

- two indirect effects interact non-linearly at each round, multiplying each other
- **Complementarity** if Y ineq. countercyclical $\chi > 1$ and investment share procyclical $\eta > 1$:

$$\left|\frac{\partial c_t}{\partial r_t}\Big|_{\text{K, Y ineq}}\right| > \left|\frac{\partial c_t}{\partial r_t}\Big|_{no\ \text{K, Y ineq}}\right| \times \left|\frac{\partial c_t}{\partial r_t}\Big|_{\text{K, no Y ineq.}}\right|$$

The Multiplier ... of the Multiplier

- Someone's saving/investment is (capital) **income**
- partly received by someone who is **not** saving ...
  - *labor income, fiscal redistribution, etc.*

A picture worth 1/(1-x) words

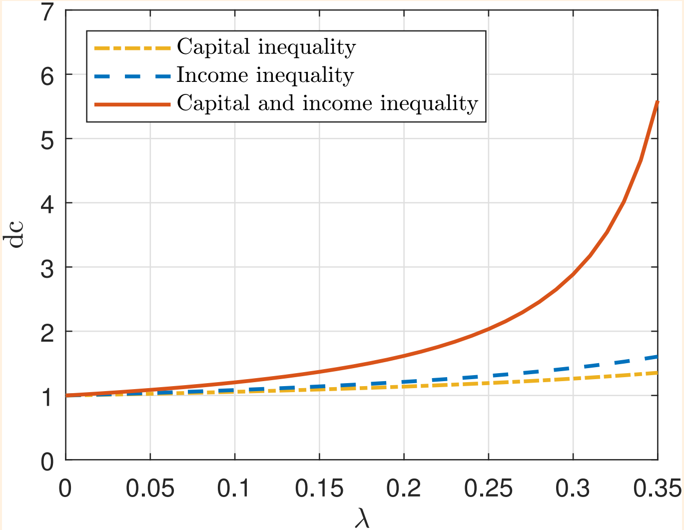


Figure: C multipliers as a function of λ ($\alpha = 0.33, \beta = 0.99, \chi = 1.7$).

Optimal Policy in THANK

- Solve Ramsey. Optimal long-run inflation rate (SS of Ramsey):

$$\pi^* = 0 \text{ (like RANK)}$$

- Approx aggreg. welfare around **1st-best, perf.-insurance** y^* (Woodford 2003 RANK, Bilbiie 2008 TANK)[1]

$$\min_{\{c_t,\pi_t\}} \frac{1}{2} E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \underbrace{\pi_t^2 + \alpha_y y_t^2}_{\text{RANK}} + \underbrace{\alpha_\gamma \gamma_t^2}_{\text{ineq.-THANK}} \right\},$$

$$\alpha_y \equiv \left(\sigma^{-1} + \varphi\right) / \psi; \quad \alpha_\gamma \equiv \lambda \left(1 - \lambda\right) \sigma^{-1} \varphi^{-1} \alpha_y$$

- more general, around target efficient y^*, change constraint – cost-push shocks

$$\pi_t = \beta E_t \pi_{t+1} + \kappa y_t + u_t,$$

[1] Relevant TANK extensions: Ascari et al sticky wages; Areosa Areosa different labor types; Nistico switching, wealth, financial regulation, etc.

Optimal Policy in THANK

- key features: 1. no linear term; 2. recall γ prop. to y

$$\gamma_t = y_t^S - y_t^H = \frac{1-\chi}{1-\lambda} y_t$$

- **result:** risk *irrelevant* (around perf-insurance equil.)
- heterogeneity $\longrightarrow$less π *stabilization* (key: **profits**)$\rightarrow$*more* π *volatility*

discretion: $\pi_t = -\frac{\alpha_y}{\kappa}\left(1 + \frac{\lambda}{1-\lambda}\sigma^{-1}\varphi^{-1}(\chi - 1)^2\right) y_t$

  - cyclicality of Γ irrelevant (note *square*) survives in quant-HANK: Bhandari Evans Golosov Sargent
- commitment: similar+price-level targeting eventually (determinacy)
- proportionality γ–$y$gap breaks down generally: quant.(Bhandari et al, Bilbiie Ragot, Legrand et al); analytical (Bilbiie et al, Acharya et al)

Optimal Policy in THANK

- NB "divine coincidence": in TANK (Bilbiie 2008) and THANK (Bilbiie 2024)

$$\min_{\{c_t,\pi_t\}} \frac{1}{2} E_0 \sum_{t=0}^{\infty} \beta^t \left\{ \underbrace{\pi_t^2 + \alpha_y y_t^2}_{\text{RANK}} + \underbrace{\alpha_\gamma \gamma_t^2}_{\text{ineq.-THANK}} \right\},$$

- corollary: Taylor~optimal, flex-price RANK~TANK (&HANK)–> heterogeneity~irrelevant (Debortoli Gali 2024 NBER MA)

- deviations w/ unequal incidence, e.g. fiscal transfers

$$\gamma_t = \frac{1-\chi}{1-\lambda} c_t - \frac{1}{1-\lambda} f_t$$

f_t =ineficiency wedge, novel

- Bilbiie Monacelli Perotti: optimal f_t–> separation (also in HANK, McKay Wolf)
- Else, Stabilization vs Redistribution tradeoff

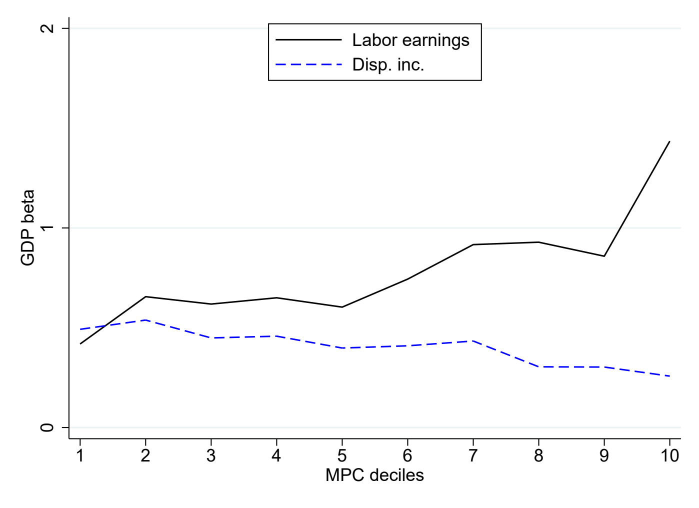
Empirical Evidence 1: Micro Mechanisms

Empirical Evidence 1: Micro Mechanisms

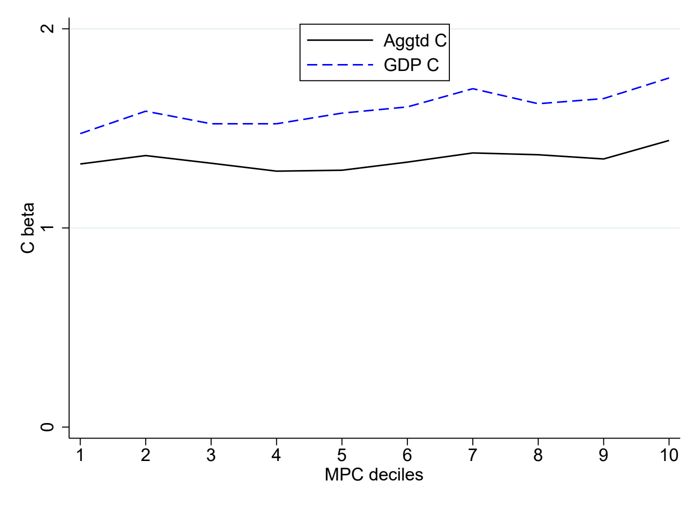
- earnings inequality and (thus) risk countercyclical (Heathcote et al, Guvenen et al, etc.)
- positive covariance w/ MPCs–> amplification (Patterson 2023)
- **Bilbiie Galaasen Gürkaynak Maehlum Molnar: HANKSSON**
- Norwegian transactions consumption data and admin income and wealth data
- Estimate population MPC distribution with *actual* consumption
- Compute "earnings" but also "disposable income" betas in this dimension, different picture
- "Aggregate MPC"
- Compute "Consumption betas" directly

Earnings vs Net Income Betas by MPC Distribution

Key graph(s) from Bilbiie Galaasen Gürkaynak Maehlum Molnar (Preview)



Consumption Betas by MPC Distribution



*to be rescaled

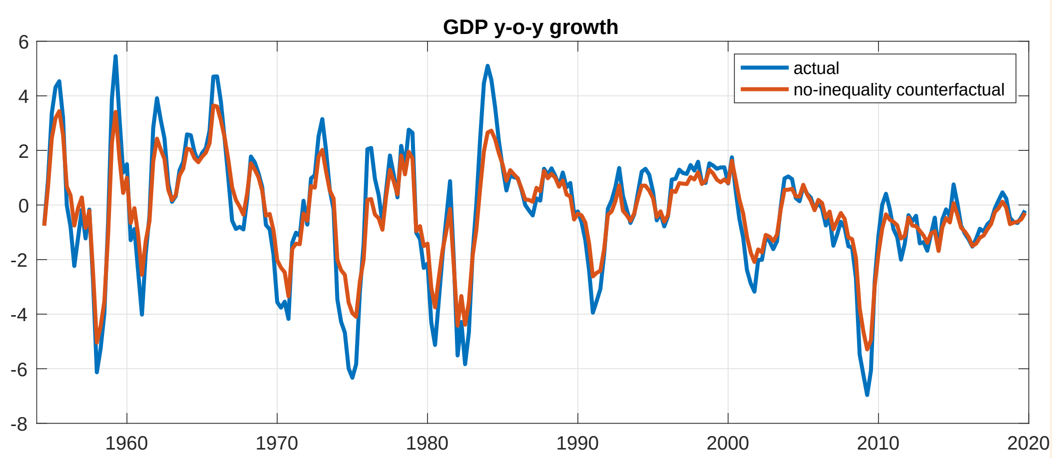
Empirical Evidence 2: Macro Estimation

Empirical Evidence 2: Macro Estimation

- recent years, several ways to estimate HANK (versions), each with pros and cons; hard choices
- Bayer Born Luetticke AER, Auclert Rognlie Straub AER, Del Negro et al (forecasting)
- empirical: Berger Bocola Dovis, Chang Chun Schorfheide
- unclear if HA matters for aggregate fluctuations
- our answer(s) in Bilbiie Primiceri Tambalotti using THANK+DSGE:

1. yes it does, a lot! (30% of GDP standard deviation)
2. how? through *cyclical risk+long-run inequality* (and not through cyclical inequality!)

Inequality Matters for Aggregate Fluctuations



Source: Bilbiie Primiceri Tambalotti "Inequality and Business Cycles"

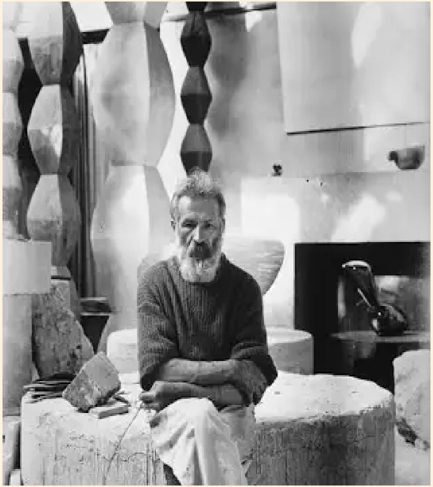
Analytical Lessons from TANK and THANK

1. AD Amplification & Fiscal Multipliers: both Keynesian & GE (TANK)
2. Intertemporal Amplification: Determinacy, Taylor rule, FG puzzle
3. 1 + 2: Catch-22: income risk vs inequality; role of Policy & FIRE
4. Fiscal policy: Propagation, iMPCs, deficits (beyond TANK)
5. Investment in capital: different AD amplification w/ inequality
6. Inflation? Not very different ("Greed"?)
7. Optimal monetary policy – inequality; divine coincidence?
   Add Fiscal $\longrightarrow$ redistribution vs. stabilization tradeoff
8. Estimation: Micro and Macro; does this all "**matter**"?!
   (for actual macro fluctuations and policies)

Further Convergence Dimensions and Challenges

1. Data, data, and data
2. FIRE deviations, behavioural
3. Supply-side: firms, entry-exit, growth, networks
4. Banking, **Finance**, Intermediaries
5. ...

On Simplicity: Inspiration from Art



"Simplicity is not an end in art, but one arrives at it in spite of oneself, in approaching the real sense of things."
(Constantin Brâncuşi)

THANK YOU!