Life-cycle forces make monetary policy transmission wealth-centric*

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*The views expressed in this paper are those of the authors, and not necessarily those of the Bank of International Settlements, the Bank of England or its committees.

Introduction

- Standard New Keynesian model has intertemporal substitution at its core
  - But empirical estimates suggest EIS=small (Best et al., 2020)

- Much recent progress in NK-style models featuring other transmission channels
  - Financial frictions
  - Informational frictions
  - Liquidity constraints

- This paper: how do life-cycle forces affect the MTM?
  - Central role to financial wealth

Core idea

- Standard intertemporal substitution logic: lower interest rates discourage saving
- Retirement preoccupations logic: lower interest rates reduce savings growth and their flow value
  - Rajan (2013): "*Persistently-low rates may not be expansionary as savers put more money aside (...) in order to meet the savings they think to need when they retire*"
  - ABP (2019): "*Pensions are becoming increasingly expensive (...) Given the current ambitition and expectation that rates will remain low for a long time, higher premiums will be needed*"

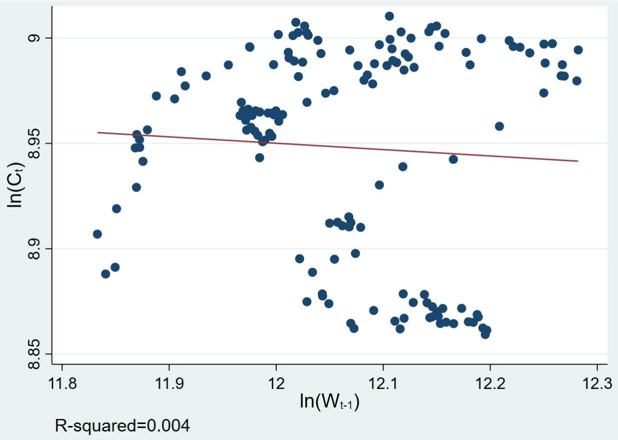
Empirical motivation

- Life-cycle forces create a “target” level for asset holdings (Modigliani)
- Not wealth *per se* that drives consumption, but wealth relative to targeted wealth (“excess wealth”)
  - Lower r tends to boost asset valuation $\rightarrow$ expansionary
  - Lower r may also increase asset demand $\rightarrow$ contractionary
- Important to control for the level of interest rates
  - Having \$100k is very different between $r = 1\%$ and $r = 5\%$
- Model tells us *how* to control for different values of r:

$$\mathcal{A}_t(r_t) = (\rho + \delta_2 + (\sigma - 1)r_t)\,(\rho + \delta_1 + \sigma g - r_t)^{1/\sigma}$$

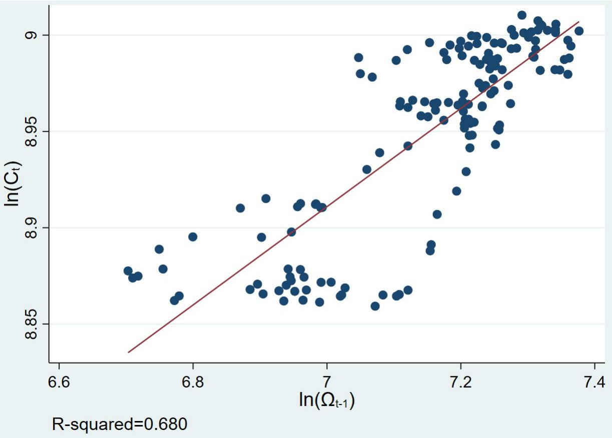
Empirical motivation

- "Raw" US household wealth levels are ∼uncorrelated with US consumption: $corr(\ln C_t, \ln W_{t-1}) = -0.064$



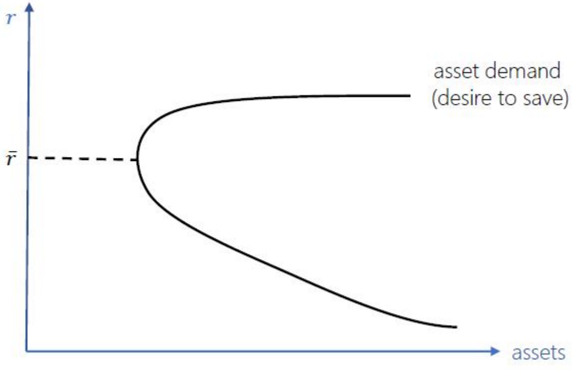
Empirical motivation

- Remarkable increase once one looks at $\Omega_t \equiv \mathcal{A}(r_t)W_t$: $corr(\ln C_t, \ln \Omega_{t-1}) = +0.825$



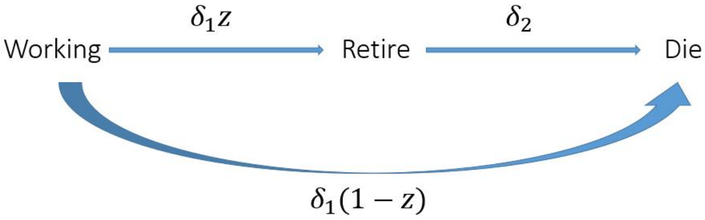
Empirical motivation

- When $\sigma > 1$ ($EIS < 1$), $\mathcal{A}_t(r_t)$ is C-shaped:



Model - demographic structure

- FLANK: Finitely-Lived Agent New Keynesian model
- Blanchard-Yaari + retirement state (as in Gertler 1999)
  - Measure 1 of households who work $\rightarrow$ retire $\rightarrow$ die
  - Working households retire with prob $\delta_1 z$; die immediately with prob $\delta_1 (1 - z)$
  - Retired households die with prob δ_2



Model - retired households

- Retired households only derive income from interest r on accumulated stock of savings, a_t^r

$$V^r\left(\tilde{a}_t^r\right) = \max_{c_t^r}\left\{\frac{\left(c_t^r\right)^{1-\sigma}}{1-\sigma} + \beta\mathbb{E}_t\left[\left(1-\delta_2\right)V^r\left(\tilde{a}_{t+1}^r\right)\right]\right\}$$

$$s.t.\ \tilde{a}_{t+1}^r = r_{t+1}\left(\tilde{a}_t^r - c_t^r\right)$$

- Optimality conditions yield $V^r\left(\tilde{a}_t^r, \Gamma_t\right) = \frac{\left(\tilde{a}_t^r\right)^{1-\sigma}}{1-\sigma}\Gamma_t$ and

$$c_t^r = \tilde{a}_t^r \Gamma_t^{-\frac{1}{\sigma}}$$

$$\left(\Gamma_t^{\frac{1}{\sigma}} - 1\right)^{\sigma} = \left(1-\delta_2\right)\beta\mathbb{E}_t\left[\left(r_{t+1}\right)^{1-\sigma}\Gamma_{t+1}\right]$$

  - Γ captures expected future rate path, working over $\tilde{a}^r$

Model - working households

- Households work and own firms:

$$V^w\left(\tilde{a}_t^w\right) = \max_{c_t^w, a_t^w}\left\{\frac{\left(c_t^w\right)^{1-\sigma}}{1-\sigma} - \chi\frac{\left(\ell_t\right)^{1+\varphi}}{1+\varphi} + \beta\mathbb{E}_t\left[\begin{array}{c}\left(1-\delta_1\right)V^w\left(\tilde{a}_{t+1}^w\right) + \\ \delta_1 z_s V^r\left(\tilde{a}_{t+1}^r, \Gamma_{t+1}\right)\end{array}\right]\right\}$$

$$s.t.\ \tilde{a}_{t+1}^w = r_{t+1}(\tilde{a}_t^w - c_t^w + w_t\ell_t + \tau_t)$$

  - $z_s = z + \varpi$ is *subjective* prob of surviving retirement shock
- Optimality conditions:

$$w_t = \chi\left(c_t^w\right)^\sigma\left(\ell_t\right)^\varphi$$

$$\left(c_t^w\right)^{-\sigma} = \beta\mathbb{E}_t\left\{\begin{array}{c}\left(1-\delta_1\right)\left[\left(c_{t+1}^w\right)^{-\sigma} r_{t+1}\right] + \\ z_s\delta_1\left(a_{t+1}^w\right)^{-\sigma}\Gamma_{t+1}r_{t+1}\end{array}\right\}$$

Model - good-producing firms

- A measure 1 of monopolistically competitive firms produce differentiated goods using technology:

$$y_t = A\ell_t$$

- Maximize profits subject to Rotemberg (1982) cost of price adjustment relative to trend inflation rate $\bar{\pi} = 1$

- Gives rise to the NKPC:

$$(\pi_t - 1)\,\pi_t = \kappa\,(mc_t - 1) + \mathbb{E}_t\left[\Lambda_{t,t+1}\,(\pi_{t+1} - 1)\,\pi_{t+1}\frac{y_{t+1}}{y_t}\right]$$

Model - public sector

- Government issues short- and long-term bonds, in constant supply:

$$s_t = s$$
$$b_t = b$$

- Let $\eta \equiv qb/(s + qb)$ denote the share of long-term bonds
  - $\eta \approx$ duration

- Monetary policy is set according to a Taylor-type rule:

$$i_t = r\bar{\pi}\left(\frac{\mathbb{E}_t\left[\pi_{t+1}\right]}{\bar{\pi}}\right)^{1+\phi} e^{\varepsilon_t}$$

Model - simplification

- Role played by retirees is relatively clear: lower r contracts their consumption possibilities

- Focus on the impact of life-cycle forces on working households

- "Prudent perpetual youth (PPY)" assumption
  - No household actually makes it to the retired state, yet they all *think* they will
    - No household survives the retirement shock: $z = 0$
    - Subjective survival probability is $z_s = \varpi > 0$ (ϖ is degree of over-estimation)
  - All retirement savings are "prudent"

Monetary transmission mechanism

- When introducing retirement preoccupations ($\delta_1 > 0$), MTM moves away from intertemporal substitution
- Log-linearized Euler equation:

$$\hat{y}_t = (1-\delta_1)\left[\mathbb{E}_t \hat{y}_{t+1} - \frac{1}{\sigma}\mathbb{E}_t \hat{r}_{t+1}\right] + \delta_1 \left[\eta \hat{q}_t + \frac{\sigma-1}{\sigma}\mathbb{E}_t \hat{r}_{t+1} - \frac{1}{\sigma}\mathbb{E}_t \hat{\Gamma}_{t+1}\right]$$

- Additional effects from $r \uparrow$
  1. Higher current income flow on asset stock $\Rightarrow \hat{y}_t \uparrow$
  2. Higher future income flow on asset stock $\Rightarrow \hat{y}_t \uparrow$
  3. Lower asset prices ($q_t \downarrow$) $\Rightarrow \hat{y}_t \downarrow$
- These factors become more important as $\delta_1 \uparrow$
  - For $\delta_1 < \bar{\delta_1} \equiv (1-\beta)/(\sigma-\beta)$, IS > asset flow effect
  - For $\delta_1 > \bar{\delta_1}$, asset flow effect > IS
    - ★ Asset valuation channel becomes *necessary* to obtain conventional signs

Effects of monetary shocks (i)

- We work with $\phi = 0$ (constant real rate) $\Rightarrow$ determinacy
- Defining $\overline{\varepsilon} \equiv \sum_{t=0}^{\infty} \rho_{\varepsilon}^{t} v_0 = v_0/(1-\rho_{\varepsilon})$, impact responses are:

$$\hat{y}_0 = -\frac{1-\rho_\varepsilon}{\sigma} \frac{1-\delta_1 \frac{\sigma(1-\eta)-\rho_\varepsilon\beta}{1-\rho_\varepsilon\beta}}{1-\rho_\varepsilon(1-\delta_1)} \overline{\varepsilon}$$

$$\hat{\pi}_0 = \kappa \frac{1+\varphi}{1-\rho_\varepsilon\beta} \hat{y}_0$$

- For $\delta_1 = 0$ (standard NKM):

$$\hat{y}_0 = -\frac{\overline{\varepsilon}}{\sigma}$$

Effects of monetary shocks (ii)

- **Proposition 1.** *The ability of a surprise interest rate cut* $\overline{\varepsilon} < 0$ *(hike,* $\overline{\varepsilon} > 0$*) to boost (contract) output and inflation is decreasing in retirement preoccupations* δ_1.

- Defining $\hat{y}_0 = -\frac{1-\rho_\varepsilon}{\sigma}\frac{1-\delta_1\frac{\sigma(1-\eta)-\rho_\varepsilon\beta}{1-\rho_\varepsilon\beta}}{1-\rho_\varepsilon(1-\delta_1)}\overline{\varepsilon} \equiv -\frac{1-\rho_\varepsilon}{\sigma}\Psi\overline{\varepsilon}$, we get:

$$\frac{\partial\Psi}{\partial\delta_1} = -\frac{(1-\beta)\rho_\varepsilon + (1-\rho_\varepsilon)\sigma\,(1-\eta)}{(1-\rho_\varepsilon\beta)\left[1-\rho_\varepsilon\,(1-\delta_1)\right]^2} < 0$$

  - Pushing $\delta_1 \uparrow$ (i) decreases role of IS, while (ii) increasing asset flow effect

- Proofs of other propositions are similar

Effects of monetary shocks (iii)

- **Proposition 2.** *With $\delta_1 > 0$, the ability of an interest rate cut ($\bar{\varepsilon} < 0$) to boost output and inflation is increasing in the duration of assets held by the public (η).*

- When assets held by households are of lower duration, the asset valuation effect is weaker
  - On the lower arm of the C-shape, this is the crucial channel working in the conventional direction!

- QE can be seen as the central bank $\downarrow \eta \Rightarrow$ conventional MP less potent
  - In a post-QE world, rates may need to move *by more* to achieve a given effect
    - Implications for financial stability

Effects of monetary shocks (iv)

- **Proposition 3.** *If* $\eta < (\sigma - 1)/\sigma$, *then there exists a* $\delta_1^* \in \left(\bar{\delta}_1, 1\right)$ *such that an interest rate hike becomes expansionary for all* $\delta_1 > \delta_1^*$.

- Can show that $\delta_1^* \in \left[\bar{\delta}_1, 1\right]$ $\Rightarrow$ perverse effects can only occur on lower arm of C-shape

- On lower arm, asset flow effect $>$ IS $\Rightarrow$ valuation effect *needed* to deliver conventionally-signed responses
  - Valuation effect is weak when η is low (assets are interest-rate insensitive)

Effects of monetary shocks (v)

- **Proposition 4.** *With $\delta_1 > 0$, the ability of a surprise rate cut ($\bar{\varepsilon} < 0$) to boost output is decreasing in its persistence ρ_ε.*

- Remember that standard NKM has
$\hat{y}_0 = -\bar{\varepsilon}/\sigma \Rightarrow \partial^2 \hat{y}_0 / \partial\bar{\varepsilon}\partial\rho_\varepsilon = 0$

- With $\delta_1 > 0$, more persistent changes affect output and inflation by less
  - Persistent rate changes do less to IS

Effects of monetary shocks (vi)

- Effect of time-T MP shock pre-annoucned at time-0 in FLANK:

$$\hat{y}_0 = \hat{y}_T + \left[1 - (1 - \delta_1)^T\right](1 - \delta_1)(1 - \eta)\,\varepsilon_{T;0}$$

  - Standard NKM ($\delta_1 = 0$) has:

$$\hat{y}_0 = \hat{y}_T$$

- **Proposition 5.** *When $\eta < 1$, the effect that pre-announced monetary policy shocks have on current output is decreasing in δ_1 and the announcement horizon T.*
  - FLANK mitigates FG puzzle by weakening IS
  - NKM has FG puzzle increase in the length of the pre-announcement horizon T
  - FLANK captures notion that pre-announced shocks far into the future ($T \to \infty$) do less today

Conclusions

- Retirement preoccupations matter for monetary policy!
  - Moves MTM away from intertemporal substitution, becomes "wealth-centric"
  - Financial channel reflects impact of $\triangle r$ on both asset supply and asset demand
    - Asset demand (flow): $r \uparrow \Rightarrow$ asset demand $\downarrow \Rightarrow$ expansionary
    - Asset supply (price): $r \uparrow \Rightarrow q \downarrow \Rightarrow$contractionary

- Implications:
  - Valuation effect becomes *crucial* on lower arm of C-shape
  - Potency of MP is decreasing in retirement preoccupations
  - Conventional MP less powerful in a post-QE world
  - "Smoother" MP less powerful
  - Financial shocks may require a "Greenspan put"