Confidence and the Propagation of Demand Shocks

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Popular Narrative

- Household deleveraging or other AD shocks

  $\Longrightarrow$ Consumers spend less

  $\Longrightarrow$ Firms produce and hire less

  $\Longrightarrow$ Consumers lose confidence and spend even less

  $\Longrightarrow$ Firms produce and hire even less

  $\Longrightarrow \cdots$

  $\Longrightarrow$ The Great Recession!

Does It Make Sense?

Basic RBC: **no**

- In GE, interest rates adjust, offsetting AD shock
- N, Y, and I move in opposite direction than C

Basic NK: **perhaps**

- Only when MP does not replicate flexible price outcomes
- Translates any AD shock to a monetary expansion/contraction
- Inflation and output must co-move
- Also, hard to get C and I to comove

This Paper: Demand-driven fluctuations with flexible prices

Element 1: variable utilization + adjustment cost for K

$\Rightarrow$ intertemporal substitution in production

$\Rightarrow$ AS responds to AD along flexible-price outcomes

Element 2: confusion between idiosyncratic & agg. income fluctuations

$\Rightarrow$ confidence multiplier

(feedback loop b/w y, consumer sentiment, & investor sentiment)

1+2 $\Rightarrow$:

u, y, h, c, i comove without TFP & π

Roadmap

1. Start with FIRE (full-info, rational expectations) and no investment margin
   variable utilization $\Rightarrow$ **AS responds to AD**

2. Add info friction (or bounded rationality) $\Rightarrow$ **confidence multiplier**

3. Comovement and other implications
   - Gov spending (crowding in, front-loading vs back-loading)
   - Comovement between savers and borrowers
   - Comovement between consumption and investment
   - TFP/AS shocks vs AD shocks

Preferences and AD Curve

- Preferences (representative agent & complete info)

$$\mathcal{U}\left(c_t, n_t\right) + \beta_t \mathcal{U}\left(c_{t+1}, n_{t+1}\right) + \beta_t \beta_{t+1} \mathcal{U}\left(c_{t+2}, n_{t+2}\right) + \cdots ,$$

$$\mathcal{U}\left(c, n\right) = \frac{c^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}} - \frac{n^{1+\frac{1}{\nu}}}{1+\frac{1}{\nu}}$$

$$\log \beta_t = \left(1-\rho_\beta\right) \log \beta + \rho_\beta \log \beta_{t-1} - \underbrace{\log \eta_t}_{\text{AD shock}}$$

- Positive η_t shock = urge to consume = real AD shock

- AD curve (log-linearized, complete info):

$$y_t = -\sigma\left(R_t + \beta_t\right) + \mathbb{E}_t\left[y_{t+1}\right]$$

Technology and AS Curve

- Technology

$$y_t = (l_t)^{\alpha} (u_t k_t)^{1-\alpha}$$

$$k_{t+1} = (1 - \delta(u_t) + \Psi(\iota_t))\, k_t,$$

- Tentatively: shut down ι_t margin (infinite adjustment cost: $\Psi(0) = 0$ and $\Psi'(0) \to \infty$)

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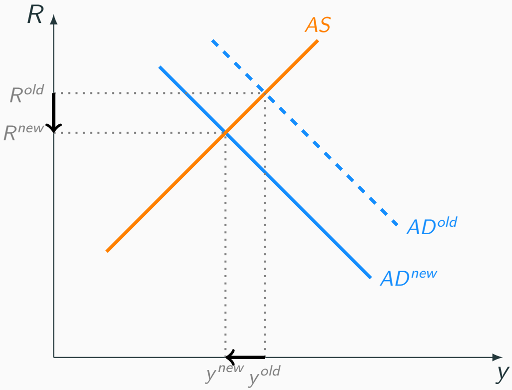
- AS curve (log-linearized):

$$y_t = (1 - \tilde{\alpha})(u_t + k_t),$$
$$u_t = \frac{\beta}{\tilde{\alpha} + \beta\phi} R_t + \beta \mathbb{E}_t [u_{t+1}],$$
$$k_{t+1} = k_t - \kappa u_t,$$

where $\tilde{\alpha} \equiv 1 - \frac{(1-\alpha)\left(1+\frac{1}{\nu}\right)}{1+\frac{1}{\nu}-\alpha+\frac{\alpha}{\sigma}}$ and $\phi \equiv \frac{\delta''(u^*)u^*}{\delta'(u^*)}$.

Equilibrium without Info Frictions



- Resembles NK, but: R vs P in vertical axis, and y^{natural} vs y^{gap} on horizontal axis
- Flexible-price core of NK: vertical AS, y^{natural} invariant to AD
- Here: Intertemporal "Econ 101"

Equilibrium without Info Frictions

Prop. Demand-driven fluctuations without nominal rigidity

$$\frac{\partial y_t}{\partial \eta_t} = \gamma \equiv \frac{\varsigma \sigma \beta}{\sigma + \varsigma} \frac{1}{1 - \rho_\beta \beta} > 0$$

where σ and $\varsigma \equiv \frac{1-\tilde{\alpha}}{\tilde{\alpha}+\beta\phi}$ parameterize the elasticities of AD and AS, respectively.

- ς and hence γ increase with flexibility of u (decrease with $\phi \equiv \frac{\delta''(u^*)u^*}{\delta'(u^*)}$)

Full Model with Information Frictions

Supply side

- Complete info, same as above

Demand side

- Islands & idiosyncratic shocks
- Knowledge of own discount rate, own income & own interest rates
- Incomplete info about, or inattention to, aggregate conditions
- (Rational) confusion of idiosyncratic & agg. income fluctuations

AD Curve

Prop. The AD Curve

$$y_t = -\sigma \left\{ R_t + \beta_t \right\} + \mathbb{E}_t \left[y_{t+1} \right] + \left(\mathcal{B}_t + \mathcal{G}_t \right).$$

- $\mathcal{B}_t$ captures avg misperception of permanent income

$$\mathcal{B}_t \equiv \tfrac{1-\beta}{\beta} \sum_{k=0}^{+\infty} \beta^k \int \left(E_t^h \left[y_{h,t+k} \right] - \mathbb{E}_t \left[y_{h,t+k} \right] \right) dh,$$

where $y_{h,t} = y_t + \xi_{h,t}$ is local/idiosyncratic income at t.

- $\mathcal{G}_t$ captures avg misperception of future interest rates

$$\mathcal{G}_t \equiv -\sigma \sum_{k=1}^{+\infty} \beta^k \int \left(E_t^h \left[R_{t+k} \right] - \mathbb{E}_t \left[R_{t+k} \right] \right) dh$$

Our Hulten's Theorem

To understand $\mathcal{B}_t$, let's study first the <u>true</u> aggregate permanent income

Prop. Our Hulten's Theorem

Aggregate permanent income is **invariant to the AD shock η_t**. Instead, it is instead pinned down by technology/capital alone:

$$\sum_{k=0}^{+\infty} \beta^k \int \mathbb{E}_t \left[y_{t+k} \right] = \tfrac{1-\tilde{\alpha}}{1-\beta} k_t$$

- Standard Hulten's theorem: static. Here: dynamic
- Key assumption: efficient production (both within and across periods)
- Note: current agg output/income *does* move
  - intertemporal substitution without altering present discounted value

$\mathcal{B}_t$: Misperception of Permanent Income

Our Hulten's theorem implies that $\mathcal{B}_t$ is procyclical

Mechanism: current aggregate income y_t drops

$\Rightarrow$ local income $y_{h,t} = y_t + \xi_{h,t}$ drops

$\Rightarrow$ rationally confused as drop in idiosyncratic income $\xi_{h,t}$

$\Rightarrow$ drop in perceived permanent income

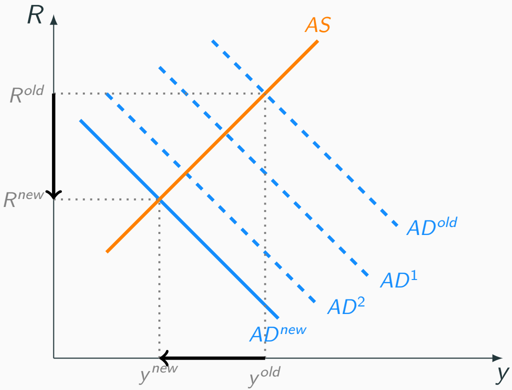
Prop. Pro-cyclical misperception of permanent income

$$\frac{\partial \mathcal{B}_t}{\partial \eta_t} = \frac{1-\beta}{\beta(1-\beta\rho_\xi)}(1-\lambda)\frac{\partial y_t}{\partial \eta_t} > 0$$

where $1-\lambda$ measures degree of confusion of idiosyncratic & agg income fluctuations

Confidence Multiplier

AD drops $\Rightarrow$ y drops $\Rightarrow$ perceived permanent income drops even though actual doesn't $\Rightarrow$ AD drops further $\Rightarrow$ y drops further $\Rightarrow$ ...



Confidence Multiplier

Focus on the impact of $\mathcal{B}_t$ (as if $\mathcal{G}_t = 0$)

Prop. Equilibrium Impact of Confidence Multiplier

$$\frac{\partial y_t}{\partial \eta_t} = \gamma \cdot m^{\text{conf}}(\lambda, \rho_\xi),$$

where the "confidence multiplier" is given by

$$m^{\text{conf}}(\lambda, \rho_\xi) \equiv \frac{\varsigma + \sigma}{\varsigma + \sigma - \varsigma \frac{1-\beta}{1-\beta\rho_\xi}(1-\lambda)} > 1;$$

increases with the degree of confusion, $1-\lambda$; increases with the persistence of idiosyncratic income, ρ_ξ;; is invariant to the persistence of AD shoc ρ_β; and increases with the MPC.

$\mathcal{G}_t$: Discounting GE Adjustment in Interest Rate

Consider now the role of $\mathcal{G}_t$

Prop. Discounting GE

$$\frac{\partial \mathcal{G}_t}{\partial \eta_t} = (1-\lambda)\frac{\sigma^2}{\sigma+\varsigma}\frac{\beta\rho_\beta}{1-\beta\rho_\beta} > 0$$

- Neoclassical GE: interest rates R_{t+k} drop
  - discourages consumption
  - goes against the direct impact of the AD shock
- Here: cannot fully perceive R_{t+k} drop
  - arrests the Neoclassical GE effect
  - i.e., amplifies the impact of the AD shock
- Bottom line: this mechanism reinforces confidence multiplier

Full Equilibrium

Prop. Two Multipliers

The equilibrium response of aggregate output is given by

$$\frac{\partial y_t}{\partial \eta_t} = \gamma \cdot m^{\text{conf}}(\lambda, \rho_\xi) \cdot m^{\text{GE}}(\lambda, \rho_\beta),$$

where

$$m^{\text{GE}}(\lambda, \rho_\beta) \equiv 1 + \beta \rho_\beta \frac{\sigma}{\sigma + \varsigma}(1 - \lambda) \geq 1$$

increases with degree of confusion, $1 - \lambda$, and with persistence of AD shock, ρ_β.

Taking Stock

Element 1: variable utilization $\Rightarrow$ **AS responds to AD**

Element 2: info friction $\Rightarrow$ **amplification**

In the paper: signal extraction, endogeneity/uniqueness of λ

Next:

- Bounded rationality interpretations
- Comovement (savers & borrowers; investment & consumption)
- Other shocks (fiscal, TFP)

Bounded Rationality

So far: agents are imperfectly informed but super rational

Broader interpretation of confidence multiplier $\mathcal{B}_t$

- Key: the response of $c_{h,t}$ to $y_{h,t}$ independent from idio. vs agg.
- Rule of thumb (Kahneman, 2011)
- Extrapolation (Barberis, Greenwood, Jin, Shleifer, 2014)
- One-factor representation (Molavi, 2019)

Broader interpretation of GE discounting $\mathcal{G}_t$

- Lack of common knowledge (Angeletos & Lian, 18)
- Level-k thinking (Farhi & Werning, 19; Garcia-Schmidt & Woodford, 19)
- Cognitive discounting (Gabaix, 20)
- There: GE discounting of future output gaps = attenuation of current gaps
- Here: GE discounting of future natural R = amplification of current natural y

Government Spending

- Same AS as above
- Only shut down wealth effect of G on labor supply (for simplicity)
- No confusion about tax burden (Ricardian equiv still holds)
- AD with G shocks:

$$y_t = -\sigma R_t + G_t - E_t\left[G_{t+1}\right] + E_t\left[y_{t+1}\right] + \left(\mathcal{B}_t + \mathcal{G}_t\right)$$

Front-loading $G_t \implies$ positive AD shock $\implies$ confidence multiplier

Prop. Front-loading government spending

With strong enough info friction, G_t can crowd <u>in</u> c_t

Back-loading $G_t \implies$ negative AD shock $\implies$ negative multiplier

Borrowers and Savers

Credit crunch:

$$c_t^b = -\sigma R_t + \mathbb{E}_t\left[c_{t+1}^b\right] + \mathcal{B}_t + \mathcal{G}_t - \sigma\beta_t$$
$$c_t^s = -\sigma R_t + \mathbb{E}_t\left[c_{t+1}^s\right] + \mathcal{B}_t + \mathcal{G}_t$$

With FIRE, as R_t adjusts, c_t^s moves in the opposite direction than c_t^b

Prop. Borrowers and Savers

With enough noise/bounded rationality, $\left(c_t^s, c_t^b, y_t\right)$ **positively co-move.**

Investment

Allow for investment, with positive but non-infinite adjustment cost

$$k_{t+1} = [1 - \delta(u_t) + \Psi(\iota_t)]\, k_t.$$

Complete info (with small wealth effect on labor supply)

- Positive comovement between c and y
  - non-vertical AS thanks to the forward-looking u
- Negative comovement between i and c
  - negative AD shock, $c\downarrow$, $R\downarrow$, $i\uparrow$

Our resolution:

- **Investment** subject to **confidence multiplier** too
- Feedback between y_t & investor expectations of returns

Investment

Prop. Investment-consumption comovement

There exist $\bar{\lambda}, \bar{\phi}, \underline{\nu}, \underline{\psi} > 0$. If $\lambda < \bar{\lambda}$, $\phi < \bar{\phi}$, $\nu > \underline{\nu}$ and $\psi > \underline{\psi}$,

$(c_t, i_t, y_t, n_t, u_t)$ **positively co-move.**

- Large confidence multiplier (small λ)
- Elastic utilization (small ϕ and large ψ)
- Elastic labor supply (large ν)

AS Shocks

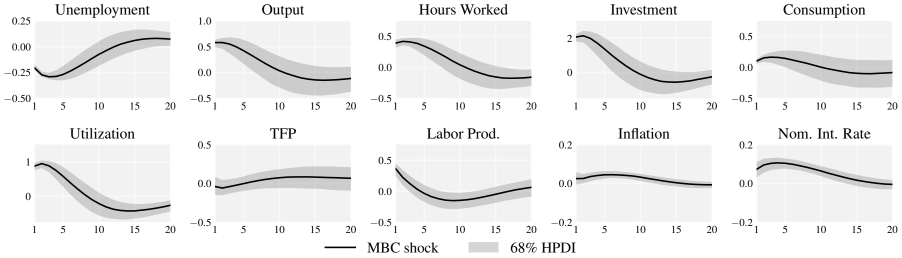
- Replace β shock with **aggregate TFP shock**
- Confidence multiplier: basically <u>absent</u>
  - Actual permanent income moves with aggregate TFP
  - Confusion of idio and agg shocks $\Rightarrow$ ambiguous $\mathcal{B}_t$
  - Useful benchmark $\mathcal{B}_t \approx 0$ ($\rho_\xi \approx \rho_A$)
- GE discounting: <u>reversed</u>
  - With FIRE: positive TFP Shock $\Rightarrow$ reduces R $\Rightarrow$ encourages AD
  - Without: R adjustment is discounted $\Rightarrow$ AD moves less $\Rightarrow$ y also moves less

Prop. AS vs AD Shock

Friction **dampens AS shocks** at the same time it **amplifies AD shocks**

Circling Back to Motivating Facts

- Main Business Cycle Shock (Angeletos, Collard & Dellas, 2020)



- Not only: u, y, h, c, i comove without TFP & π
- But also: **evidence of intertemporal substitution in utilization/production**
- Plus: Utilization accounts for pro-cyclicality in labor prod
- And: non-accommodative MP and procyclical real R

Conclusion

- Evidence calls for theories that make room for Keynesian narrative, and let AD drive business cycles, without strict reliance on sticky prices and Phillips curves
- This echoes the older literature on coordination failures and multiple equilibria
- Newer literature shifts focus on belief, financial, and other frictions on the demand side
- More to be done on both the empirical and theoretical front!