Confidence and the Propagation of Demand Shocks

George-Marios Angeletos¹  Chen Lian²
¹MIT and NBER  ²UC Berkeley

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• Household deleveraging or other AD shocks
  ➞ Consumers spend less
  ➞ Firms produce and hire less
  ➞ Consumers lose confidence and spend even less
  ➞ Firms produce and hire even less
  ➞ …
  ➞ 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
Element 1: variable utilization + adjustment cost for $K$

⇒ intertemporal substitution in production

⇒ AS responds to AD along flexible-price outcomes

Element 2: confusion between idiosyncratic & agg. income fluctuations

⇒ confidence multiplier

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

$1+2 \Rightarrow$

$u, y, h, c, i$ comove without TFP & $\pi$
1. Start with FIRE (full-info, rational expectations) and no investment margin variable utilization ⇒ **AS responds to AD**

2. Add info friction (or bounded rationality) ⇒ **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)

\[ U(c_t, n_t) + \beta_t U(c_{t+1}, n_{t+1}) + \beta_t \beta_{t+1} U(c_{t+2}, n_{t+2}) + \cdots, \]

\[ U(c, n) = \frac{c^{1-\frac{1}{\sigma}}}{1 - \frac{1}{\sigma}} - \frac{n^{1+\frac{1}{\nu}}}{1 + \frac{1}{\nu}} \]

\[ \log \beta_t = (1 - \rho_\beta) \log \beta + \rho_\beta \log \beta_{t-1} - \log \eta_t \]

- Positive \( \eta_t \) shock = urge to consume = real AD shock

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

\[ y_t = -\sigma (R_t + \beta_t) + \mathbb{E}_t [y_{t+1}] \]
Technology and AS Curve

- Technology

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

\[ k_{t+1} = (1 - \delta(u_t) + \psi(l_t)) k_t, \]

- Tentatively: shut down \( l_t \) margin (infinite adjustment cost: \( \psi(0) = 0 \) and \( \psi'(0) \to \infty \))
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- Tentatively: shut down \( \iota_t \) margin (infinite adjustment cost: \( \Psi(0) = 0 \) and \( \Psi'(0) \to \infty \))

- 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 \( \tilde{\alpha} \equiv 1 - \frac{(1-\alpha)(1+\frac{1}{\nu})}{1+\frac{1}{\nu} - \alpha + \frac{1}{\delta}} \) and \( \phi \equiv \frac{\delta''(u^*)u^*}{\delta'(u^*)} \).
Equilibrium without Info Frictions

- Resembles NK, but: $R$ vs $P$ in vertical axis, and $y^{\text{natural}}$ vs $y^{\text{gap}}$ on horizontal axis
- Flexible-price core of NK: vertical AS, $y^{\text{natural}}$ invariant to AD
- Here: Intertemporal “Econ 101”
Prop. Demand-driven fluctuations without nominal rigidity

\[ \frac{\partial y_t}{\partial \eta_t} = \gamma \equiv \frac{\varsigma \sigma \beta}{\sigma + \varsigma} \frac{1}{1 - \rho \beta} > 0 \]

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

- \( \varsigma \) and hence \( \gamma \) 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
Prop. The AD Curve

\[ y_t = -\sigma \{ R_t + \beta_t \} + \mathbb{E}_t [ y_{t+1} ] + (B_t + G_t). \]

- \( B_t \) captures avg misperception of **permanent income**

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

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

- \( G_t \) captures avg misperception of future **interest rates**

\[ G_t \equiv -\sigma \sum_{k=1}^{+\infty} \beta^k \int \left( E_t^h [ R_{t+k} ] - \mathbb{E}_t [ R_{t+k} ] \right) dh \]
To understand $B_t$, let’s study first the **true** aggregate permanent income

**Prop. Our Hulten’s Theorem**

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

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

- 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
Misperception of Permanent Income

Our Hulten’s theorem implies that $B_t$ is procyclical

Mechanism: current aggregate income $y_t$ drops
⇒ local income $y_{h,t} = y_t + \xi_{h,t}$ drops
⇒ rationally confused as drop in idiosyncratic income $\xi_{h,t}$
⇒ drop in perceived permanent income

Prop. Pro-cyclical misperception of permanent income

$$\frac{\partial B_t}{\partial \eta_t} = \frac{1-\beta}{\beta(1-\beta \rho \xi)} (1 - \lambda) \frac{\partial y_t}{\partial \eta_t} > 0$$

where $1 - \lambda$ measures degree of confusion of idiosyncratic & agg income fluctuations
\( AD \) drops ⇒ \( y \) drops ⇒ perceived permanent income drops even though actual doesn’t ⇒ \( AD \) drops further ⇒ \( y \) drops further ⇒ ...
Focus on the impact of $B_t$ (as if $G_t = 0$)

**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, $\rho_\xi$; is invariant to the persistence of AD shock $\rho_\beta$; and increases with the MPC.
Consider now the role of $G_t$

**Prop. Discounting GE**

\[
\frac{\partial G_t}{\partial \eta_t} = (1 - \lambda) \frac{\sigma^2}{\sigma + \varsigma} \frac{\beta \rho_\beta}{1 - \beta \rho_\beta} > 0
\]

- 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
### 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, $\rho_\beta$. 

Element 1: variable utilization ⇒ AS responds to AD

Element 2: info friction ⇒ amplification

In the paper: signal extraction, endogeneity/uniqueness of $\lambda$

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 $B_t$

- 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 $G_t$

- 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 $R = \text{amplification of current natural } y$
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:

$$y_t = -\sigma R_t + G_t - E_t [G_{t+1}] + E_t [y_{t+1}] + (B_t + G_t)$$

**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 in $c_t$

**Back-loading** $G_t \implies$ negative AD shock $\implies$ negative multiplier
Credit crunch:

\[ c_t^b = -\sigma R_t + \mathbb{E}_t [c_{t+1}^b] + B_t + G_t - \sigma \beta_t \]

\[ c_t^s = -\sigma R_t + \mathbb{E}_t [c_{t+1}^s] + B_t + G_t \]

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, \((c_t^s, c_t^b, y_t)\) *positively co-move.*
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
Prop. Investment-consumption comovement

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

$(c_t, i_t, y_t, n_t, u_t)$ \textbf{positively co-move.}

- Large confidence multiplier (small $\lambda$)
- Elastic utilization (small $\phi$ and large $\psi$)
- Elastic labor supply (large $\nu$)
AS Shocks

- Replace $\beta$ shock with aggregate TFP shock
- Confidence multiplier: basically absent
  - Actual permanent income moves with aggregate TFP
  - Confusion of idio and agg shocks ⇒ ambiguous $B_t$
  - Useful benchmark $B_t \approx 0$ ($\rho_\xi \approx \rho_A$)

- GE discounting: reversed
  - With FIRE: positive TFP Shock ⇒ reduces $R$ ⇒ encourages AD
  - Without: $R$ adjustment is discounted ⇒ AD moves less ⇒ $y$ 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 & $\pi$
- 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 $R$
• 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!