Confidence and the Propagation of Demand Shocks

George-Marios Angeletos\textsuperscript{1}  
Chen Lian\textsuperscript{2}

\textsuperscript{1}MIT and NBER  
\textsuperscript{2}UC Berkeley

July 7, 2020
Introduction

2 Element 1: Variable Utilization ⇒ AS Responds to AD

3 Element 2: Rational Confusion ⇒ Confidence Multiplier

4 Extensions
Popular Narrative

- 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?

In RBC: **no**

- In GE, interest rates adjust, offsetting AD shock

In NK: **perhaps**

- Only when MP does not replicate flexible price outcomes
- Effects of AD shock = monetary contraction
- Inflation and output co-move

**BUT**

- ZLB constraint not relevant in earlier recessions
- Philips curve elusive in the data (Mavroeidis et al., 14)
- Non-inflationary demand shocks prevalent
  - Beaudry & Portier (13), Angeletos et al. (20)
This Paper

- A theory of demand driven fluctuations with flexible prices

Element 1:
- **Variable utilization** ⇒ AS responds to AD

Element 2:
- **Rational confusion** between idiosyncratic & agg. income fluctuations
  - ⇒ **Confidence multiplier**
    - feedback loop between output, consumer & investor expectations
- A broader bounded rationality interpretation
Roadmap

Representative agent, complete info, version model

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

Introduce information frictions

- Element 2: rational confusion $\Rightarrow$ confidence multiplier

Extensions

- Comovement of consumption, output, and investment
- Fiscal policy (front-loading vs back-loading)
- TFP Shock
Outline

1. Introduction

2. Element 1: Variable Utilization ⇒ AS Responds to AD

3. Element 2: Rational Confusion ⇒ Confidence Multiplier

4. Extensions
Preferences and AD Curve

- Preference (representative agent & complete info)

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

where

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

- A positive \( \eta_t \) shock = urge to consume = positive 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

\[ y_t = (l_t)^\alpha (u_t k_t)^{1-\alpha} \]
\[ k_{t+1} = (1 - \delta(u_t) + \Psi(i_t)) k_t, \]

- Tentatively: shut down \( i_t \) and drop \( \Psi(i_t) \)
Technology and AS Curve

- Technology

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

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

- Tentatively: shut down \( i_t \) and drop \( \psi (i_t) \)

- AS curve (log-linearized):

\[ y_t = (1 - \tilde{\alpha})(u_t + k_t), \]

\[ u_t = \frac{\beta}{\tilde{\alpha} + \beta \phi} R_t + \beta E_t[u_{t+1}], \]

\[ k_{t+1} = k_t - \kappa u_t, \]

where \( \tilde{\alpha} \equiv 1 - \frac{(1-\alpha)(1+\frac{1}{v})}{1+\frac{1}{v} - \alpha + \frac{\alpha}{\sigma}} \) and \( \phi \equiv \frac{\delta''(u^*)(u^*)}{\delta'(u^*)} \).
Prop. Demand-driven business cycle without nominal rigidity

\[ \frac{\partial y_t}{\partial \eta_t} = \gamma \quad \text{and} \quad \frac{\partial R_t}{\partial \eta_t} = \frac{\sigma}{\sigma + \varsigma}, \]

where

\[ \gamma \equiv \frac{\varsigma \sigma \beta}{\sigma + \varsigma} \frac{1}{1 - \rho \beta \beta} \quad \text{and} \quad \varsigma \equiv \frac{1 - \tilde{\alpha}}{\tilde{\alpha} + \beta \phi}. \]

- \( \gamma \) increases with variability of \( u \) (decreases with \( \phi \equiv \frac{\delta''(u^*)u^*}{\delta'(u^*)} \))

- Baseline NK: natural rate of output fixed (\( \gamma = 0 \) because \( \phi = \infty \))

- Here: natural rate of output responsive to AD
1. Introduction

2. Element 1: Variable Utilization ⇒ AS Responds to AD

3. Element 2: Rational Confusion ⇒ Confidence Multiplier

4. Extensions
Full Model with Information Frictions

Supply side
- Complete info, same as above

Demand side
- Islands & idiosyncratic shocks
- Know own discount rate, current local income & interest rates
- Incomplete info of, or inattention to, the aggregate
- Rational confusion of idiosyncratic & agg. income fluctuations
AD Curve

Prop. The AD Curve

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

- \( \mathcal{B}_t \) captures misperception of permanent income

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

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

- \( \mathcal{G}_t \) captures misperception of future interest rates

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

**Hulten’s theorem:** agg permanent income $\sum_{k=0}^{+\infty} \beta^k \int y_{t+l}$ invariant to AD
\( B_t \): Misperception of Permanent Income

**Hulten’s theorem:** \( \text{agg permanent income } \sum_{k=0}^{+\infty} \beta^k \int y_{t+k} \) invariant to AD

**Prop. Pro-cyclical perceived permanent income**

\[
B_t \equiv \frac{1 - \beta}{1 - \beta \rho \xi} (1 - \lambda) y_t,
\]

- \( \rho \xi \) is the persistence of the idiosyncratic income shock \( \xi_{h,t} \)
- \( 1 - \lambda \): degree of confusion between idiosyncratic & agg.

**Mechanism:** current aggregate income \( y_t \) drops

\[ \implies \text{rationally confused as drop in idiosyncratic income } \xi_{h,t} \]

\[ \implies \text{drop in perceived permanent income} \]
Confidence Multiplier

\[ R \]

\[ R^{\text{old}} \]

\[ R^{\text{new}} \]

\[ y^{\text{new}} \]

\[ y^{\text{old}} \]

\[ \text{AS} \]

\[ \text{AD}^{\text{old}} \]

\[ \text{AD}^{\text{new}} \]

\[ \text{AD}^{1} \]

\[ \text{AD}^{2} \]
Confidence Multiplier

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

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

- Increases with the persistence of idiosyncratic income $\rho_\xi$
- Increases with the confusion $1 - \lambda$
$\mathcal{G}_t$: Dampening GE of Interest Rate Adjustments

**Prop. Misperception of Future Interest Rate Adjustment**

$$
\mathcal{G}_t = (1 - \lambda) \sigma \sum_{k=1}^{+\infty} \beta^k \frac{\partial \mathbb{E}_t[R_{t+k}]}{\partial \eta_t} \eta_t
$$

$$
= (1 - \lambda) \frac{\sigma^2}{\sigma + \varsigma} \frac{\beta \rho_{\beta}}{1 - \beta \rho_{\beta}} \eta_t
$$

Persistent negative AD shock

- Neoclassical GE: future interest rate $R_{t+k}$ drops
  - goes against the impact of the AD shock
- Here: cannot fully perceive $R_{t+k}$ drop
  - $\mathcal{G}_t$ negative
  - Further amplifies the impact of the AD shock
Full Equilibrium

Prop. Full Equilibrium

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

\[ m_{\text{GE}}(\lambda, \rho_{\beta}) \equiv 1 + \beta \rho_{\beta} \frac{\sigma}{\sigma + \zeta} (1 - \lambda) \geq 1 \]

- Increases with the persistence of AD shock \( \rho_{\beta} \)
- Increases with the confusion \( 1 - \lambda \)
Bounded Rationality

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 (Kahnman, 11)
- Extrapolation (Barberis Greenwood, Jin, Shleifer, 14)
- One-factor representation (Molavi, 19)

Broader interpretation of GE dampening \( G_t \)
- Lack of common knowledge (Angeletos & Lian, 18)
- Level-k thinking (Farhi & Werning, 19; Garcia-Schmidt & Woodford, 19)
- Cognitive discounting (Gabaix, 20)
Outline

1. Introduction

2. Element 1: Variable Utilization ⇒ AS Responds to AD

3. Element 2: Rational Confusion ⇒ Confidence Multiplier

4. Extensions
Investment

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

Complete info (with small wealth effect on labor supply)

- Positive AS & comovement between \( c \) and \( y \)
- **Negative comovement between \( i \) and \( c \)**
  - negative AD shock, \( c \downarrow, R \downarrow, i \uparrow \)
Investment

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

Complete info (with small wealth effect on labor supply)

- Positive AS & comovement between \( c \) and \( y \)
- **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 comovement

With strong enough info friction, \((c,i,y)\) all co-move
Fiscal Multiplier

Q: How does confidence multiplier impact fiscal policy?

Here, for simplicity, shut down wealth effect of $G$ on labor supply

- Same AS as above

AD:

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

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

Prop. Front-loading government spending

With strong enough info friction, $G_t$ can crowd in $c_t$

Back-loading $G_t \Rightarrow$ negative AD shock $\Rightarrow$ negative multiplier
Fiscal Multiplier

Q: How does confidence multiplier impact fiscal policy?

Here, for simplicity, shut down wealth effect of G on labor supply

- Same AS as above

AD:

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

**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
TFP Shock

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

- **No confidence multiplier**
  - Actual permanent income moves with aggregate TFP
  - Rational confusion \( \implies \) Ambiguous \( B_t \)
  - Useful benchmark \( B_t \approx 0 (\rho_\xi \approx \rho_A) \)

- Dampening of GE has **reverse effect**
  - Negative TFP Shock \( \implies \) positive \( R_t \) \( \implies \) Positive \( G_t \)

**Prop. TFP Shock**

Info friction dampens the relative impact of AS vs AD shock

- Consistent with the importance of non-inflationary AD shock
Main Business Cycle Shock (Angeletos, Collard, Dellas, 20)

- $u, y, h, c, i$ comove without TFP & $\pi$
- Utilization accounts for pro-cyclicality in labor prod
- Non-accommodative MP and procyclical real $R$
- Intertemporal substitution in production
Sticky Prices

- A theory why & how the natural output responds to AD shock
- Main insights go through sticky prices
- Additional mechanism: misperception of output gaps (MP)
  - existing literature on forward guidance etc.
Conclusion

Two contributions:

- A theory of demand-driven fluctuations without sticky prices
- A theory of amplifications for AD shock (but not AS shocks)