Macroeconomics 2 Presentation

Article review :
Gabaix, Xavier. 2020. ”A Behavioral New Keynesian Model.” American Economic Review, 110(8): 2271-2327

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Outline

Introduction

1. Introduction

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1.3 Conclusions of the paper

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Goal of the paper

This paper aims to introduce behavioral economics in the New Keynesian model.

- Behavioral Economics :
  Since Kahneman et Tversky (1979), aims to introduce deviation to the expected utility theory and the perfect rationality assumption.
- New-Keynesian framework :
  General Equilibrium with frictions, what we saw in throughout this class.

How to integrate coginitive limitations in the New Keynesian model ?

Method of the paper

- Baseline model
- Direct conclusions
- Consequences on policy
- Refinment of the baseline model
- Consequences of refinment

Conclusions of the paper

In a behavioral model :

- Forward guidance is less powerful
- The Taylor rule is changed
- The equilibrium determinacy is easier to reach
- The Zero Lower Bound (ZLB) consequences are changed
- The optimal policy are different
- Fiscal policies are more powerful
- Theoretical contradictions are solved, such as the Neo-Fisherian paradoxes

Literature of the topic

Literature on the topic :

General New Keynesian Framework : Woodford 2003b and Galí 2015

- Strength of Forward guidance : Del Negro, Giannoni, and Patterson (2015) and McKay, Nakamura, and Steinsson (2016)
- Taylor Principle and Equilibrium determinacy : Blanchard and Kahn (1980)
- ZLB and Equilibrium determinacy : Cochrane (2018) on the case of Japan
- Policy optimality : Clarida, Galí, and Gertler (1999), and rationality of firms
- Neo-Fisherian paradoxes : Cochrane (2018) on the inconsistency of the New-Keynesian model

Literature of the topic

Behavioral economics : How to incorporate cognitive limits in Macroeconomic models ?

- Limited information updating : Gabaix and Laibson (2002), Mankiw and Reis (2002)
- Related differential salience : Bordalo et al. (2018)
- Noisy signals Maćkowiak and Wiederholt (2015), Caplin, Dean, and Leahy (2017)
- Microfoundation : Gabaix (2014)
- Woodford (2013) for a literature review on the topic.

There is a lot of literature on how to model behavioral agents (check pages 5 and 6 of the articles), but the goal of the present article lies elsewhere : Exhaustivity in the model and analysis of implications on policy.

Baseline model of the paper

2. Baseline model of the paper

2.1 Household's Problem

2.2 Firms

2.3 Solution

2.4 Synthesis Of A Behavioral New Keynesian Model

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Consequences

3. Consequences

Implications for monetary policy

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5. Implications for fiscal policy

Behavioral Enrichments of the Model

6. Behavioral Enrichments of the Model

6.1 Term Structure of Consumer Attention

6.2 Flattening of the Phillips Curve via Imperfect Firm Attention

6.3 Nonconstant Trend Inflation and Neo-Fisherian Paradoxes

Term Structure of Consumer Attention

It is plausible that consumers **do not equally pay attention to all economic variables**, even in the present. We could therefore introduce attention discount factors that are variable specific, yielding **perceived variables** under Bounded Rationality :

- $\hat{r}^{BR}$ the perceived interest rate under bounded rationality
- $\hat{y}^{BR}$ the perceived income under bounded rationality

Prior to this, consumers perceived perfectly variables at the current period, now, they do not anymore.

Directly affects the consumer maximisation program.

Term Structure of Consumer Attention

The law of motion of the personal wealth of the consumer becomes thus a **perceived law of motion**

$$\begin{aligned} k_{t+1} &= G^k(c_t, N_t, k_t, \boldsymbol{X}_t) \\ &:= (1 + \bar{r} + \hat{r}(\boldsymbol{X}_t))(k_t + \bar{y} + \hat{y}(N_t, \boldsymbol{X}t) - c_t) \end{aligned} \tag{6}$$

Turns into :

$$\begin{aligned} k_{t+1} &= \mathbf{G}^{k,BR}(c_t, N_t, k_t, \mathbf{X}_t) \\ &:= (1 + \bar{r} + \hat{r}^{BR}(\mathbf{X}_t))(k_t + \bar{y} + \hat{y}^{BR}(N_t, \mathbf{X}_t) - c_t) \end{aligned} \tag{49}$$

What could be functional forms of $\hat{r}^{BR}$ and $\hat{y}^{BR}$?

Term Structure of Consumer Attention

The perceived values of interest rate and income are defined such that :

$$\begin{cases} \hat{r}^{BR} = m_r \cdot \hat{r}(\mathbf{X}_t) \\ \hat{y}^{BR}(N_t, \mathbf{X}_t) = m_y \cdot \hat{y}(\mathbf{X}_t) + \omega(\mathbf{X}_t)(N_t - N_t(\mathbf{X}_t)) \end{cases} \tag{50}$$

Equation (50) is a possible functional form. The main changes are the attention discount factor.

Now, what would be the expectation under behavioral expectation of those perceived values ?

Term Structure of Consumer Attention

Consumers already have a general attention discount factor $\bar{m}$, from Lemma 1 in equation (11) :

$$\mathbb{E}_t^{BR}\left[z\left(\boldsymbol{X}_{t+k}\right)\right] = \bar{m}^k \cdot \mathbb{E}_t\left[z\left(\boldsymbol{X}_{t+k}\right)\right] \tag{11}$$

Applied to the perceived interest rate and perceived income, we thus get the **Lemma 5 (Term Structure of Attention)**:

$$\begin{cases} \mathbb{E}_t^{BR}\left[\hat{r}^{BR}(\mathbf{X}_{t+k})\right] = m_r \cdot \bar{m}^k \cdot \mathbb{E}_t\left[\hat{r}(\mathbf{X}_{t+k})\right] \\ \mathbb{E}_t^{BR}\left[\hat{y}^{BR}(\mathbf{X}_{t+k})\right] = m_y \cdot \bar{m}^k \cdot \mathbb{E}_t\left[\hat{y}(\mathbf{X}_{t+k})\right] \end{cases} \tag{51}$$

Term Structure of Consumer Attention

What are consequences of this enriched attention structure term ?

When we solve for consumption, we get **Proposition 8** (Behavioral Consumption Function) :

$$\hat{c}_t = \mathbb{E}_t \left[\sum_{\tau \geq t} \frac{\bar{m}^{\tau-t}}{R^{\tau-t}} \Big(b_r m_r \hat{r}(\mathbf{X}_\tau) + m_Y \frac{\bar{r}}{R} \hat{y}(\mathbf{X}_\tau) \Big) \right] \tag{52}$$

With :

$$\begin{cases} c_t = c_t^d + \hat{c}_t \\ c_t^d = \bar{y} + b_k \cdot k_t \\ b_k := \frac{\bar{r}}{R} \cdot \frac{\phi}{\phi+\gamma} \end{cases}$$

$$\begin{cases} m_Y = \frac{\phi \cdot m_y + \gamma}{\phi+\gamma} \\ b_r := -\frac{1}{\gamma \cdot R^2} \end{cases}$$

Term Structure of Consumer Attention

Interest rate has **direct** and **indirect** effects on consumption.
For a consumer, a decrease in future interest rate :

- increases their present consumption, because it is more profitable to consume right now (direct effect)
- increases other consumers future consumption, increasing their future income, increasing their current consumption (indirect effect)

Therefore, the aggregate consumption multiplies the positive effect on consumption of a decrease in future interest rate.
What does this behavioral model imply for this multiplicator ?

Term Structure of Consumer Attention

In the **rational consumer** case :

If we derive from equation (52), we get the direct effect :

$$\Delta^{\text{direct}} := \left.\frac{\partial \hat{c}_0}{\partial \hat{r}_\tau}\right|_{(y_t)_{t\geq 0} \text{ held constant}} = -\alpha \cdot \frac{1}{R^\tau}$$

If we derive from equation (26), we get the indirect effect :

$$\Delta^{GE} := \frac{\partial \hat{c}_0}{\partial \hat{r}_\tau} = -\alpha R$$

Put together :

$$\frac{\Delta^{GE}}{\Delta^{\text{direct}}} = R^{\tau+1} \tag{53}$$

Term Structure of Consumer Attention

In the **behavioral consumer** case :

If we derive from equation (52), we get the direct effect :

$$\Delta^{\text{direct}} := \left.\frac{\partial \hat{c}_0}{\partial \hat{r}_\tau}\right|_{(y_t)_{t\geq 0} \text{ held constant}} = -\alpha \cdot m_r \cdot \bar{m}^\tau \frac{1}{R^\tau}$$

If we derive from equation (26), we get the indirect effect :

$$\Delta^{GE} := \frac{\partial \hat{c}_0}{\partial \hat{r}_\tau} = -\alpha m_r \cdot M^\tau \frac{R}{R - r \cdot m_Y} R$$

Put together :

$$\frac{\Delta^{GE}}{\Delta^{\text{direct}}} = \left(\frac{R}{R - r m_Y}\right)^{\tau+1} \in \left[1, R^{\tau+1}\right] \qquad (54)$$

Term Structure of Consumer Attention

In a behavioral framework, the multiplicative effect is dampened by bounded rationality.

An attention discount factor that is variable specific allows to explain why forward guidance is not as strong as what theory predicts.

What about variable specific attention deficiency for firms now ?

Flattening of the Phillips Curve via Imperfect Firm Attention

If we introduce variable specific inattention for firms, equation (15), defining the real profit of the firm :

$$v\left(q_{it}, \boldsymbol{X}\tau\right) := v^0\left(q_{it} - \Pi(\boldsymbol{X}\tau), \mu(\boldsymbol{X}\tau), c(\boldsymbol{X}_\tau)\right) \tag{15}$$

Turns into a perceived real profit of the firm :

$$v^{BR}(q_{it}, (\mathbf{X}_\tau)) := v^0\left(q_{it} - m_\pi^f \cdot \Pi(\mathbf{X}_\tau), m_x^f \cdot \mu(\mathbf{X}_\tau), c(\mathbf{X}_\tau)\right) \tag{55}$$

Where :

- m_π^f is the attention deficit to inflation
- m_x^f is the attention deficit to marginal cost

Flattening of the Phillips Curve via Imperfect Firm Attention

The maximisation program of equation (16) :

$$\max_{q_{it}} \mathbb{E}_t \left[\sum_{\tau=t}^{\infty} (\beta\theta)^{\tau-t} \frac{c\left(\boldsymbol{X_\tau}\right)^{-\gamma}}{\left(\boldsymbol{X_t}\right)^{-\gamma}} v\left(q_{it}, \boldsymbol{X}\tau\right) \right] \tag{16}$$

turns into :

$$\max_{q_{it}} \mathbb{E}_t^{BR} \left[\sum_{\tau=t}^{\infty} (\beta\theta)^{\tau-t} \frac{c(\mathbf{X}_\tau)^{-\gamma}}{c(\mathbf{X}_t)^{-\gamma}} v^{BR}(q_{it}, \mathbf{X}_\tau) \right] \tag{56}$$

Flattening of the Phillips Curve via Imperfect Firm Attention

Solving it yields :

$$p_t^* = p_t + (1-\beta\theta) \cdot \sum_{k=0}^{\infty} (\beta\theta\bar{m})^k \, \mathbb{E}_t \left[m_\pi^f (\pi_{t+1} + ... + \pi_{t+k}) - m_x^f \mu_{t+k} \right] \tag{57}$$

In comparison, we had in the baseline model :

$$p_t^* = p_t + (1-\beta\theta) \sum_{k=0}^{\infty} (\beta\theta\bar{m})^k \cdot \mathbb{E}_t \left[\pi_{t+1} + ... + \pi_{t+k} - \mu_{t+k} \right] \tag{27}$$

Flattening of the Phillips Curve via Imperfect Firm Attention

We also get :

$$M^f = \bar{m}\left(\theta + m_\pi^f \cdot (1-\theta) \cdot \frac{1-\beta\cdot\theta}{1-\beta\cdot\theta\cdot\bar{m}}\right) \in [0,1]$$

$$\kappa = m_x^f \bar{\kappa} \tag{58}$$

Where

- M^f is the general attention factor of the firm
- m_x^f is the attention deficiency to the output gap
- $\kappa = m_x^f \cdot \bar{\kappa}$, is the perceived value of the importance of outputgap on inflation

Flattening of the Phillips Curve via Imperfect Firm Attention

If we solve the Phillips curve, the equation (29) :

$$\pi_t = \beta \cdot M^f \cdot \mathbb{E}_t \left[\pi_{t+1}\right] + \kappa \cdot x_t \tag{29}$$

Turns into a Phillips Curve with Behavioral Firms, allowing for imperfect attention to inflation and costs (**Proposition 10**) :

$$\pi_t = \beta \cdot \bar{m} \left(\theta + m_\pi^f \cdot (1-\theta) \cdot \frac{1-\beta\cdot\theta}{1-\beta\cdot\theta\cdot\bar{m}} \right) \cdot \mathbb{E}_t \left[\pi_{t+1}\right] + m_x^f \cdot \bar{\kappa} \cdot x_t$$

Nonconstant Trend Inflation and Neo-Fisherian Paradoxes

Now, let's change the way we consider inflation. Instead of a steady state, agents perceive a default value. The article proposes the following functional form :

$$\pi_t^d = (1-\zeta)\bar{\pi}_t + \zeta\bar{\pi}_t^{CB} \tag{59}$$

The IS curve is unchanged, and is the same as equation (28) :

$$x_t = M\mathbb{E}_t\left[x_{t+1}\right] - \sigma\left(i_t - \mathbb{E}_t\left[\pi_{t+1}\right] - r_t^n\right) \tag{60}$$

Nonconstant Trend Inflation and Neo-Fisherian Paradoxes

The Phillips curve of equation (29) :

$$\pi_t = \beta \cdot M^f \mathbb{E}_t \left[\pi_{t+1}\right] + \kappa \cdot x_t \tag{29}$$

Turns into :

$$\hat{\pi}_t = \beta \cdot M^f \cdot \mathbb{E}_t \left[\hat{\pi}_{t+1}\right] + \kappa \cdot x_t \tag{61}$$

The only difference is through $\hat{\pi}_t$, with $\pi_t = \pi_t^d + \hat{\pi}_t$.

Nonconstant Trend Inflation and Neo-Fisherian Paradoxes

Finally, the equilibrium condition changes through ζ the weight given to the Central Bank declaration. Equation (34) in the Baseline model :

$$\phi_\pi + \frac{(1-\beta M^f)}{\kappa}\phi_x + \frac{(1-\beta M^f)(1-M)}{\kappa\sigma} > 1 \tag{34}$$

Turns into :

$$\phi_\pi + \zeta\frac{(1-\beta M^f)}{\kappa}\phi_x + \zeta\frac{(1-\beta M^f)(1-M)}{\kappa\sigma} > 1 \tag{62}$$

The term ζ can be considered as the weight of central bank guidance.

- What if it is 0 ?
- What are the consequences for Central Bankers ?

Nonconstant Trend Inflation and Neo-Fisherian Paradoxes

Neo-fisherian neutrality : In the long-run, inflation (money) should not affect output.

In the New-Keynesian framework, it does not work : if inflation is permanently higher, then output is permanent higher. Let $M^f = 1$, then :

$$\pi_t = \beta \cdot M^f \cdot \mathbb{E}_t\left[\pi_{t+1}\right] + \kappa \cdot x_t \tag{29}$$

Turns in the steady state into :

$$\pi = \beta \cdot \pi + \kappa \cdot x$$

$$\iff$$

$$\pi \cdot \frac{1-\beta}{\kappa} = x$$

Nonconstant Trend Inflation and Neo-Fisherian Paradoxes

In the current extension, it is not the case :

Trend in inflation :

$$\pi_t = \pi_t^d + \hat{\pi}_t$$

Perception of the trend :

$$\pi_t^d = (1-\zeta)\cdot\bar{\pi}_t + \zeta\cdot\bar{\pi}_t^{CB} \tag{59}$$

Phillips curve :

$$\hat{\pi}_t = \beta\cdot M^f\cdot\mathbb{E}_t\left[\hat{\pi}_{t+1}\right] + \kappa\cdot x_t \tag{61}$$

IS curve :

$$x_t = M\cdot\mathbb{E}_t\left[x_{t+1}\right] - \sigma\left(i_t - \mathbb{E}_t\left[\pi_{t+1}\right] - r_t^n\right) \tag{60}$$

We find $\implies i = r^n + \bar{\pi}$ and no impact of long run inflation over output.

Conclusion of those enrichments :

- Variable specific attention deficiency allows for more detail in the specification.
- Allows to highlight even more the conclusions of the general model
- Answer both empirical problems and pure theoretical questions

Discussion of the Behavioral Assumptions

- Theoretical Microfoundation
- Lucas Critique
- Long-Run Learning
- Parsimony and New Degrees of Freedom
- Reasonable Variants

Conclusion

8. Conclusion

Limits and Critics

9. Limits and Critics