



Universität St.Gallen

# A Macroeconomy with Intuitive Thinkers

**Albert Flak**

**albert.flak@unisg.ch**

**Together with Maren Bartels (Lucerne), Johannes Binswanger (St. Gallen) and Manuel Oechslin (Lucerne)**

University of St. Gallen

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# Starting Point

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- ⇒ By how much do you expect prices to go up over the next year? Over the next five years?
- ⇒ Imperfect understanding of the “true” blueprint of the economy (Woodford, 2019)
- ⇒ Evidence of deviations from RE (Coibion et al., 2018)

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**Cognitive psychology: Dual-system cognition** (Ilut & Valchev, 2023; Kahneman, 2003)

- ⇒ Expectations blend elements of RE with non-RE features (“intuition” or mental shortcuts)



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**Idea sketch:** “Slow” and rigorous RE thinking gets perturbed by “fast” intuitive thinking.

$$\mathbb{E}_t^D[x_{t+1}] \equiv \delta \cdot \text{Rigorous Thinking}_t + (1 - \delta) \cdot \text{Intuitive Thinking}_t \quad (2)$$

I propose a simple account of **how we generate intuitive opinions on complex matters**. If a satisfactory answer to a **hard question** is not found quickly, **System 1** will find a **related question that is easier** and will answer it.

*Thinking Fast and Slow* – **Kahneman (2011)**

# Contribution: Application

**Research question:** Can intuitive thinking help us explain empirical patterns in expectations?

**Theory:** Reduced-form Phillips curve (PC) with output gap should be **upward** sloping.

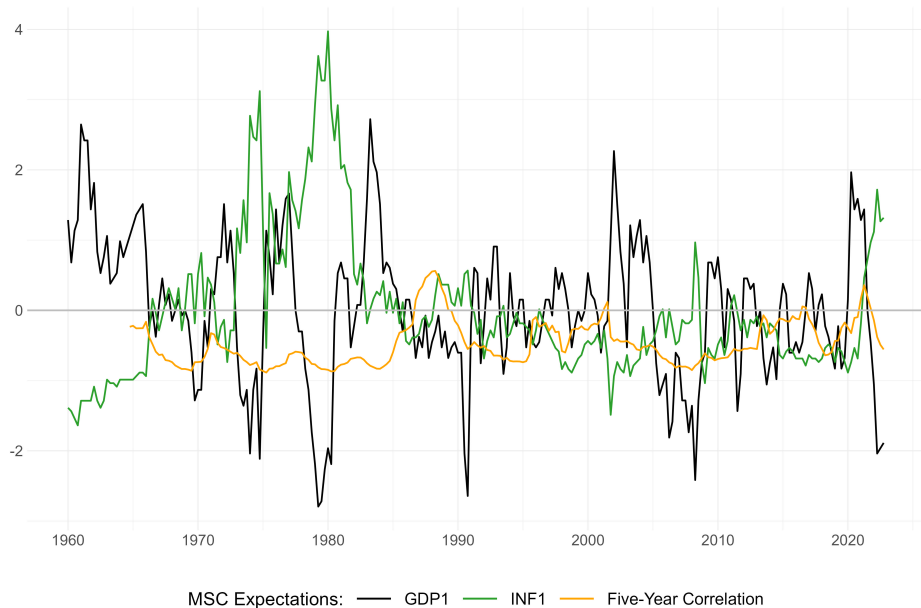
**Puzzle:** In survey (Michigan) expectations, PC is **negatively** sloping:

- US households associate future **high** (low) **inflation** with future **low** (high) **output** (Andre et al., 2022; Candia, Coibion, & Gorodnichenko, 2020; Shiller, 1997).
- Negative correlation remains after accounting for supply shocks.

**Agents' intuition:** Inflation and economic slack are bad, and bad things come “packaged” together.

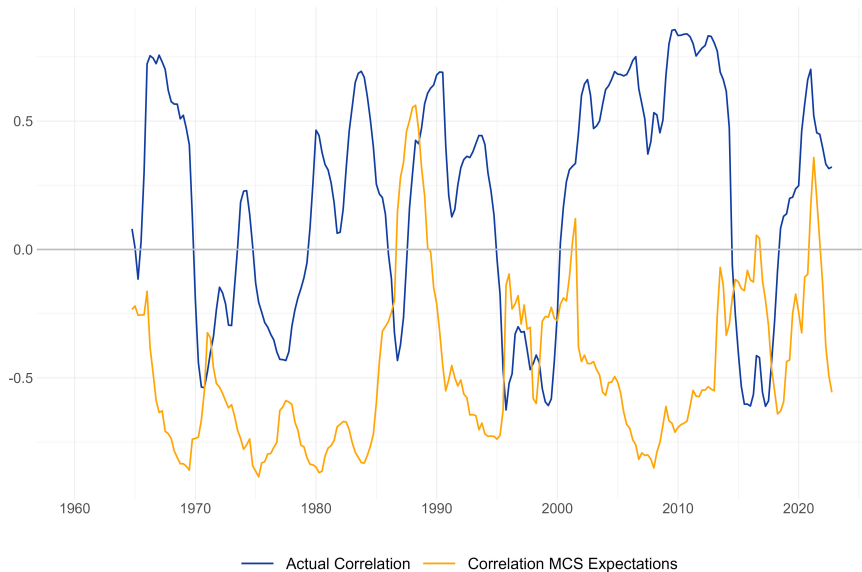
# Motivating Evidence: US Household Expectations

# Household Survey Expectations of Output and Inflation

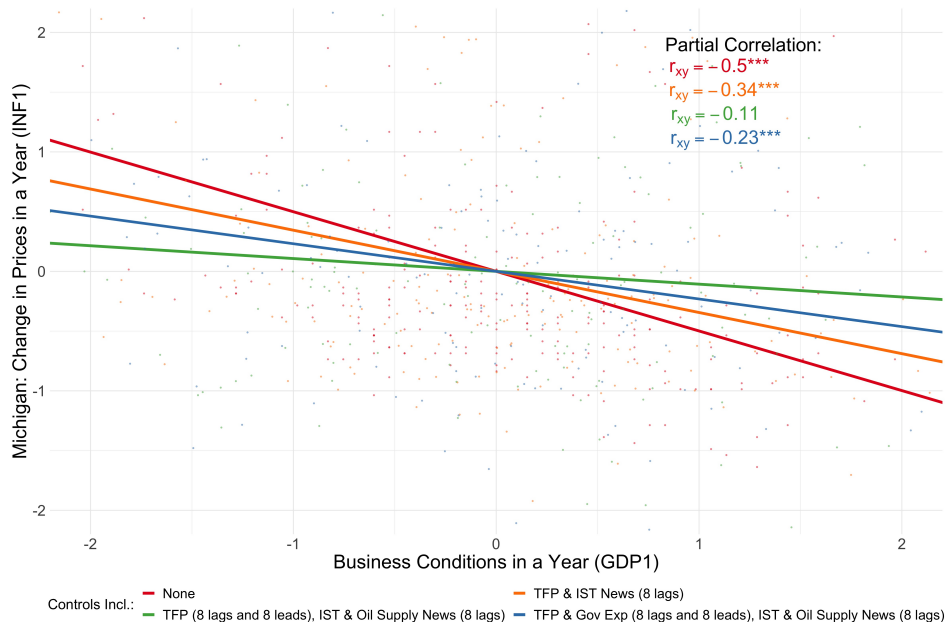


# Correlation Between Inflation and Output.

Blue: Realisations. Yellow: Expectations.



# Supply Shocks Do Not Explain the Negative Association





# A Model of Dual-System Expectations

# Defining Dual-System Expectations

**Application:**  $x_t$  contains output and inflation.  $u_t$  standard shocks. DSGE: Galí (2015, Ch. 3)

$$x_t = A\mathbb{E}_t^D [x_{t+1}] + u_t \quad (3)$$

Rigorous thinking uses the “true” blueprint of the economy in (3) and iterates forward...

## Dual-System Expectations

$$\mathbb{E}_t^D x_{t+1} \equiv \delta \underbrace{\left( A\mathbb{E}_t^D [x_{t+2}] + \mathbb{E}_t [u_{t+1}] \right)}_{\text{rigorous thinking}} + (1 - \delta) \underbrace{s_t}_{\text{intuitive thinking}} \quad (4)$$

**Interpretation** of  $\delta$ : A “deep parameter” related to the prevalence of “professional forecasters” and economic literacy.  $\delta \in [0, 1]$ .

► Step-by-step

# Defining Dual-System Expectations

## Dual-System Expectations

$$\mathbb{E}_t^D [x_{t+1}] \equiv \delta \underbrace{(A\mathbb{E}_t^D [x_{t+2}] + \mathbb{E}_t [u_{t+1}])}_{\text{rigorous thinking}} + (1 - \delta) \underbrace{s_t}_{\text{intuitive thinking}} \quad (4)$$

**Interpretation:**  $s_t$  is agent assigning weights to signals which would be almost (pure) noise in an RE world (for example, price of bread at the local grocery store).

**Key assumption:** The agent is unable to forecast his future intuitions, i.e.  $\mathbb{E}_t^D [s_{t+h}] = s_t$ .

► Step-by-step

# Defining Dual-System Expectations

## Dual-System Expectations

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**Interpretation:**  $s_t$  is agent assigning weights to signals which would be almost (pure) noise in an RE world (for example, price of bread at the local grocery store).

**Note:**  $s_t$  stands for “sentiments”. Sentiments *perturb* rigorous expectations **with each iteration**.

$$\mathbb{E}_t^D [x_{t+2}] = \delta \underbrace{\left( A\mathbb{E}_t^D [x_{t+3}] + \mathbb{E}_t [u_{t+2}] \right)}_{\text{rigorous thinking}} + (1 - \delta) \underbrace{s_t}_{\text{intuitive thinking}}$$

► Step-by-step

# Results: Application

# Intuitive Thinking and Cognitive Discounting

**Application:**  $x_t = (\hat{y}_t, \pi_t)$ , and  $s_t = (s_t^{\hat{y}}, s_t^{\pi})$ . DSGE: Galí (2015, Ch. 3).  $\delta \in (0, 1)$ .

The **solution** under dual-system expectations for  $x_t$  is

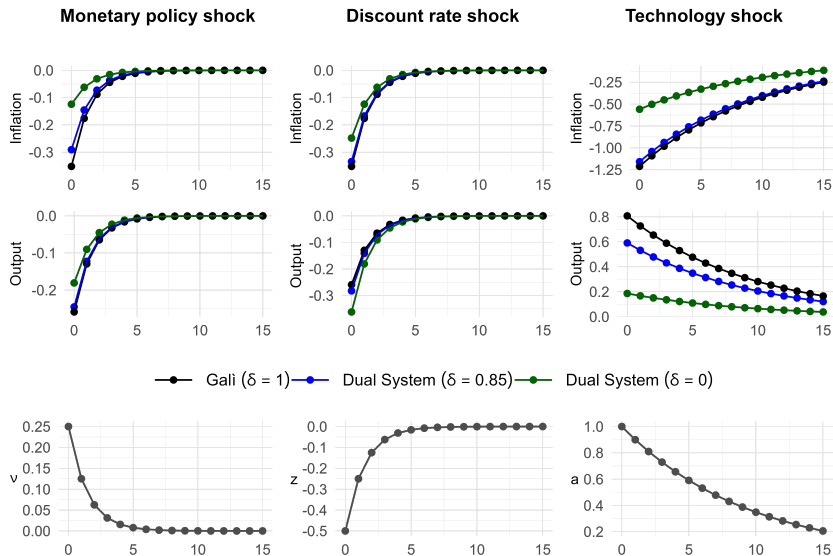
$$x_t = \boxed{u_t + \delta A \mathbb{E}_t u_{t+1} + \delta^2 A^2 \mathbb{E}_t [u_{t+2}] + \dots} + \boxed{(1 - \delta) A s_t + (1 - \delta) \delta A^2 s_t + \dots} \quad (5)$$

**Result:** Cognitive discounting (Gabaix, 2020); The terms of the standard solution are shrunk by  $\delta$ .

**Exogenous sentiments:**  $s_t = 0$  for all  $t$  lead to:

- Steady-state acts as a *psychological anchor*.
- Impulse-responses are shrunk towards the anchor.
- The DSGE model is stable for a broader set of parameters (e.g., passive monetary policy).
- No forward-guidance puzzle.

# Galí (2015, Ch. 3) with steady-state anchoring



# Application to the Reduced-Form Phillips Curve

**Recap:** Negative slope of PC in US household expectations.

**Our model implies:**

$$\mathbb{E}_t^D [x_{t+1}] = (1 - \delta)(I - \delta A)^{-1} s_t \quad (6)$$

## Key finding

Two ways our model can explain negative correlation between the two expectations **in**  $\mathbb{E}_t^D [x_{t+1}]$ :

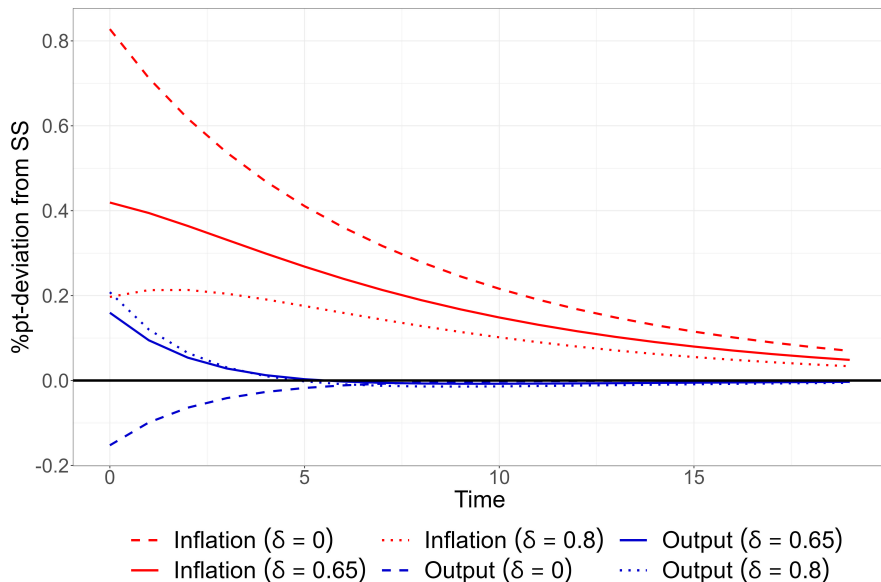
1. For  $\delta$  close to 1: Multiplying  $\mathbb{E}_t^D [x_{t+1}]$  with  $(I - \delta A)$  identifies structural (uncorrelated) sentiment shocks.
2. For  $\delta \ll 1$ : **Microfounded** intuitive thinking (a model for  $s_t$ ) leads to a **negative correlation** for the elements **in**  $s_t$ .

## Microfoundations of $s_t$ :

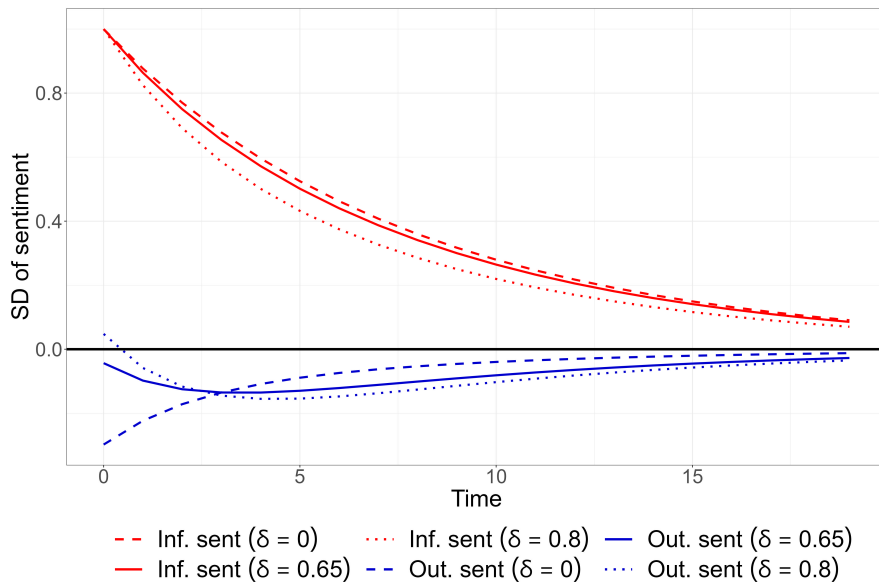
- **Diagnostic expectations** (Bordalo, Gennaioli, & Shleifer, 2018) of inflation and output lead to negative correlation in  $s_t$ .



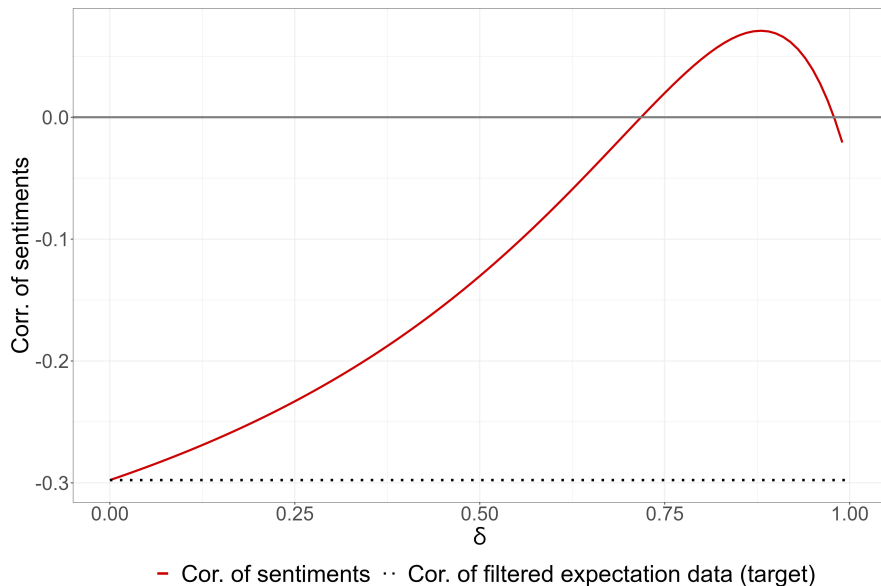
# A Shock in Inflation Sentiments: Self-Fulfilling Prophecies



# IRFs in Sentiments



# Correlation in Sentiments as Function of $\delta$



# Conclusion

- New tractable framework of introducing dual-system expectations for general equilibrium models, applied to puzzling patterns in data on inflation and output expectations
- Key results: theoretical framework, cognitive discounting, self-fulfilling prophecies, identification of sentiments with Michigan data
- For further research:
  - What is an appropriate value for  $\delta$ ?
  - Larger and alternative DSGE models.
  - Greater understanding of equilibrium dynamics.
  - Heterogeneous levels of understanding of the structure of the economy, endogenous  $\delta$ .

*Thank you for your attention!*

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