Incentive-driven Inattention

W. P. Gaglianone, R. Giacomini, J. V. Issler, V. Skreta

Discussion by G. Chevillon

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Saariselkä

Overview

- A Brazilian dataset on daily forecast by professional forecasters
  - Every day, about 10% of forecasts are updates
  - Mid-month a contest is organized, 40% update then
  - Updating reduces the MSFE and disagreement
- This paper explores determinants of decision to update and amount of effort
  - Model of rational inattention
  - Matches the data
  - Counterfactuals

Overview of the Discussion

1. The model
2. Assumptions
    - intertemporal decisions
    - private/public information and timing
    - identification of decision to update vs amount of attention
    - weekends
3. Method of Simulated Moments
    - weak identification
    - persistence

1. The model

- Principles: daily decisions, $t = 0, ..., T$ about forecasts of monthly inflation $y_m = \sum_{t=1}^{T} x_t$ where

$$x_t = b + \phi x_{t-1} + \varepsilon_t, \quad \varepsilon_t \overset{iid}{\sim} \mathrm{N}\left(0, \sigma_\varepsilon^2\right)$$

- Timing: at $t = 0$, a monthly forecast is made then at $t > 0$,
  1. Agent i decides to update forecast if marginal benefit of allocated time $\tilde{w}_{it} > w_{it}^0$
  2. if update, then observe $\mathcal{I}_{t-1} = \{x_{t-1}, ...\}$ and choose k_{it} is attention spent to observing ε_t, rationality is $k_{it} \to \infty$

     Forecast: $x_{t|t} = b + \phi x_{t-1} + \mathrm{E}\left[\varepsilon_t | k_{it}\right]$

     $$\mathrm{MSFE}_{it}\left(k_{it}\right) = \mathrm{E}\left[\left(y_m - \mathrm{E}\left[y_m | \mathcal{I}_{t-1}, k_{it}\right]\right)^2\right] = \sigma_\varepsilon^2 A_{T-t} + B_{T-t} \mathrm{E}\left[\left(\varepsilon_t - \mathrm{E}\left[\varepsilon_t | k_{it}\right]\right.\right.$$

  3. Rational inattention (Sims, 2003): $\mathrm{E}\left[\left(\varepsilon_t - \mathrm{E}\left[\varepsilon_t | k_{it}\right]\right)^2\right] = 2^{-2k_{it}} \sigma_\varepsilon^2$.
  4. Objective at time t :

$$\min_{(k_{i\tau})} \sum_{\tau=t}^{T} \left(\frac{w_{i\tau}}{2 \ln 2} \mathrm{MSFE}_\tau\left(k_{i\tau}\right) + c_\tau k_{i\tau} \right) 1_{\left(\tilde{w}_{i\tau} > w_{i\tau}^0\right)},$$

w_{it} benefit of accuracy, c_t cost of attention.

- At each t, a static problem,

$$\min_{k_{it}} \left(\frac{w_{it}}{2 \ln 2} \text{MSFE}_t \left(k_{it} \right) + c_t k_{it} \right) 1_{\left(\tilde{w}_{it} > w_{it}^0 \right)},$$

$$\text{MSFE}_t \left(k_{it} \right) = \sigma_\varepsilon^2 A_{T-t} + \sigma_\varepsilon^2 B_{T-t} \times 2^{-2k_{it}}, \quad k_{it} \geq 0,$$

simplified as $k_{it} > 0$ if $\tilde{w}_{it} > w_{it}^0$ and $\tilde{w}_{it} = w_{it}$ so

$$\text{MSFE}_t \left(k_{it} \right) = \begin{cases} \sigma_\varepsilon^2 A_{T-t} + c_t w_{it}^{-1}, & \text{if } w_{it} > c_t / \sigma_\varepsilon, \\ \text{MSFE}_{t-1} \left(k_{it-1} \right), & \text{otherwise.} \end{cases}$$

- This paper's questions on exogenous variables
    1. $w_{it} \sim D \left(\mu_w, \sigma_w^2 \right)$ reflects the gains from accuracy: μ_w larger on Competition Day?
    2. c_t is the cost of information: smaller on IPCA15 day?

2.A. Assumption: no dynamic substitution of attention

- The problem is a static allocation of attention.
- $w_{it} > 0$ implies there is a cost attributed to all forecast errors.
  In their objective function, agents only consider cost of forecast errors if update

$$\min_{(k_{i\tau})} \sum_{\tau=t}^{T} \left(\frac{w_{i\tau}}{2 \ln 2} \text{MSFE}_{\tau}\left(k_{i\tau}\right) + c_{\tau} k_{i\tau} \right) 1_{\left(\tilde{w}_{i\tau} > w_{i\tau}^{0}\right)},$$

- but if $k_{i\tau} = 0$ then $\text{MSFE}_{\tau}\left(k_{i\tau}\right) = \text{MSFE}_{\tau-1}\left(k_{i\tau-1}\right)$ so why not consider the entire stream of forecasts?

$$\min_{(k_{i\tau})} \sum_{\tau=t}^{T} \frac{w_{i\tau}}{2 \ln 2} \text{MSFE}_{\tau}\left(k_{i\tau}\right) + c_{\tau} k_{i\tau} 1_{\left(\tilde{w}_{i\tau} > w_{i\tau}^{0}\right)}$$

- Now decisions depend on future profiles of w_{it} and c_t so agents anticipate, e.g., Competition days and IPCA15 releases.
  They know their forecast errors linger so they may exert more effort before a planned increase in c_{t+1} or w_{it+1}

2.B. Private vs public information and timing of decisions

- Here
  1. Agents first decide whether to update then they observe public information
  2. Agents decide on the level of attention to ε_t, a public/common signal that is costly to acquire (*private*?)
- Timing swapped in Bec, Bouccekkine & Bardet (2017, BoFrance) who use Alvarez, Lippi & Paciello (2011, QJE)
  1. Agents decide when to observe public information and hence the optimal forecast
  2. Then whether to communicate/update their official forecast (is it worth adjusting given the time left until the realization?)

  Empirically: adjustment costs $<$ cost of acquiring information

2.C. Assumption 5: If agents update, they devote positive attention

- Hard to distinguish decision to update from that of paying attention
- Agents may simply decide to update using only the public signal:

$$MSFE_t(0) - MSFE_{t-1}(k_{t-1}) = -\left[\frac{1-\phi^{T-t+2}}{1-\phi}\right]^2 \mathsf{E}\left[\left(\varepsilon_{t-1} - \mathsf{E}\left[\varepsilon_{t-1} | k_{it-1}\right]\right)^2$$

- It would be useful to find a way to fully distinguish between the decision to update and then the amount of attention, not just a decision about $k_{it} \in [0, \infty)$.

2.D Daily inflation forecasts

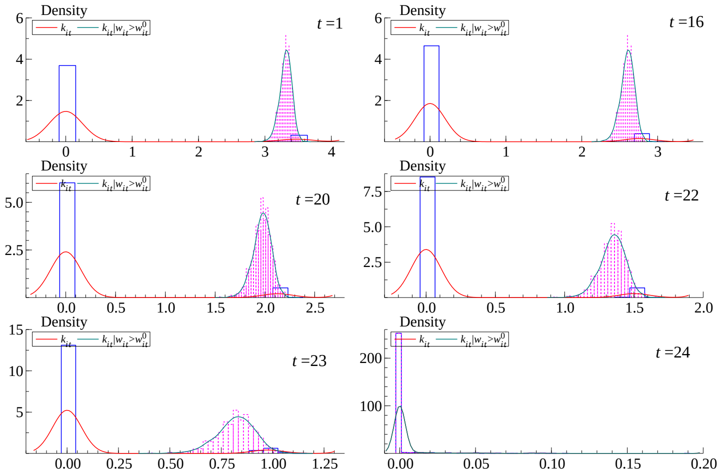
- Past daily inflation $\{x_{t-1}, \ldots, x_1\}$ is public information at time t and agents forecast

$$y_m = \underbrace{\sum_{\tau=1}^{t-1} x_\tau}_{\textit{observed}} + \sum_{\tau=t}^{T} x_\tau$$

- Weekends: 3-day forecasting exercise on Fridays so we expect more updates/effort, $3/7 \approx 0.4$
  - Here: T is the number of working days $\rightarrow$ then the distribution of x_t differs on Mondays
  - Alternatively, use T : calendar days and explicitely consider the three-day forecasting exercise on Fridays.
- Focusing on daily inflation is a nice way to convey the idea
  - Yet, under the model, the release of IPCA15 is **private** (not public) information but it occurs on day $t \approx 20$-22 so it should already be observed.
- Is it reasonable to assume individual agents (not representative) know the DGP for daily inflation over the coming year (estimated ex post by the econometrician)

3.A. Method of Simulated Moments: Weak identification

- Probability to update $\lambda_t = \Pr\left(w_{it} > \frac{c}{\sigma_\varepsilon^2}\right)$ with $w_i \sim TN\left(.49, .06^2\right)$ and $\frac{c}{\sigma_\varepsilon^2} = \frac{1.4\times10^{-5}}{.005^2} = .56$
- Distribution of attention k_{it} conditional on updating or not, ($T = 25$)



Method of Simulated Moments: Weak identification

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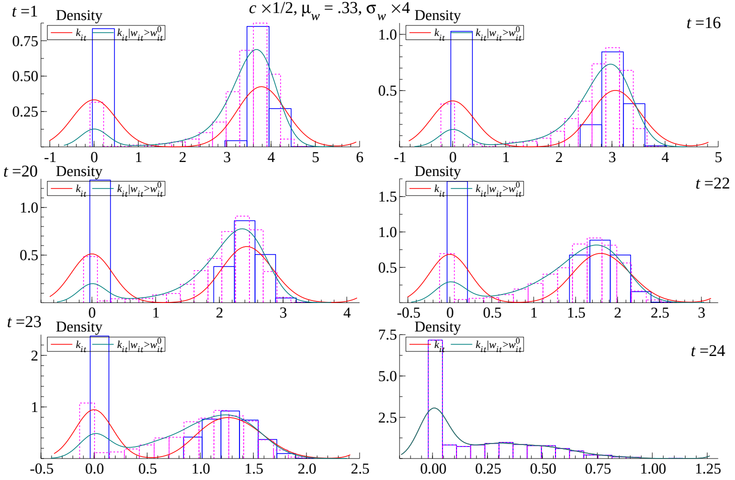
- New parameters, $(T = 25)$



3.B Method of Simulated Moments: persistence

- Inflation is known to be persistent (Altissimo, Monjon & Zaffaroni, 2009)
- Here ARMA$(1, 1)$ monthly inflation estimated over 2000-2009 implies for daily (approx.)

$$x_t = 7 \times 10^{-4} + .98 x_{t-1} + \varepsilon_t, \quad \varepsilon_t \sim \mathsf{N}\left(0, .0025^2\right)$$

  almost a random walk.

- ARFIMA for monthly

$$\Delta^{\underset{(.08)}{.33}} y_m = \underset{(.18)}{.52} \left(1 + \underset{(.08)}{.37} L\right) v_t$$

  better fit (AIC) than ARMA$(1, 1)$.

- If agents forecast with AR(1) processes with slope ϕ_i, the aggregate forecast may be persistent (Granger, 1980)
- Consequences: long term forecast errors dominate, MSFEs correlate, forecasts may be biased... MSM may be very susceptible to initialization of the algorithm.

A cool dataset
An interesting model
A nice paper to read!

Thanks!