Deviating from the RE hypothesis

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There is growing literature analyzing the consequences of deviating from the standard assumption of RE. There are a few approaches:

- **Rational inattention approach** (Sims, 2003; Adam, 2007; Mackowiach and Wiederholt, 2009; ...; *Mackowiach and Wiederholt, 1st paper*)
- **k-level of thinking:** following pioneering publications reviewed by Crawford, Costa-Gomes and Iriberri (2013), recently a few papers are using this approach to address macroeconomic issues (Farhi and Werning, 2017; Garcıa-Schmidt and Woodford, 2019; *Iovino and Sergeyev, 2nd paper*)
- **Adaptive learning (AL) approach:** following the pioneering publications by Marcet and Sargent (1989) and Evans and Honkapohja (2001) many papers adopted this approach (Preston, 2005; Orphanides and Williams, 2005; Branch and Evans, 2006; Milani, 2007, 2008, 2011; Eusepi and Preston, 2011, 2018; Levine, Pearlman, Perendia and Yang, 2012; Slobodyan and Wouters, 2012a, 2012b; Ormeño and Molnár, 2015; ...; *Slobodyan and Wouters, 3rd paper*)

- **Sticky information approach** (Mankiw and Reis, 2002; Reis, 2009; ...)
- **Imperfect information approach** (Svensson and Woodford, 2004; Coenen, Levin and Wieland, 2005; ...)
- **Limited information defined by real-time data** (Aruoba, 2004; Pruitt, 2012; Casares and Vázquez, 2016; ...)
- ... Of course, these approaches highlighted here do not exhaust the possibilities of deviating from RE. Most likely you are aware of others, e.g. AERp&p: *Foundations of Belief Formation: Perceptual and Cognitive Biases, Emotional Coloring, and the Role of Memory*

Any approach emphasizes a particular way of deviating from RE
Focusing on the approaches followed in this session:

- *Rational inattention* suggests that agents have limited capacity for processing information (Sims, 2003)
- *k-level thinking* suggests that agents have limited ability to envision the reaction of other agents to changes in policy (or in the economic environment)
- *Adaptive learning* suggests that agents have incomplete knowledge about the economic environment (i.e. the true model)

Any of these approaches by no means implies a single way of deviating from RE. For instance, in the *adaptive learning* literature one can distinguish two main alternative approaches

- "Minimum state variable" approach: agents' forecasting models are functions of state-variables realizations (Milani, 2007, 2008, 2011; Eusepi and Preston, 2011)
- "Euler equation learning" approach: agents use small forecasting models based on observable endogenous variables (Evans and Honkapohja, 2001; Slobodyan and Wouters, 2012a, 2012b)

- One might be tempted to think that it is possible to discriminate between alternative approaches. I believe this is at least a hard (if not impossible) task
- As often occurs in Economics, an assumption is useful to address some specific questions, but it is not good for many others. Similarly, a particular deviation from RE can be useful for understanding some issues, but not for others
- Now, briefly, let me discuss each of the papers presented in this section

Main result: *the optimal signal* (chosen by rational inattentive agents) *is a one-dimensional signal about the elements of the state vector*

Main implication: *rational inattention results in a mix of backward-looking delay in actions (due to noise in the optimal signal) and forward-looking actions (due to forward-looking information choice)*. Put differently, *the optimal signal depends on both the current optimal action and the best predictor of next period's optimal action*

Questions/comments:

- What is the interpretation of κ in the information flow constraint? As far as I understood, the information flow constraint is not linked to any sort of time or resource constraint. Alternatively, κ features the ability of an individual to process information
- IRFs in Figure 4 suggest that rational inattention brings about a strong capital smoothing and a slightly excess volatility in consumption. How do these IRFs change when $\phi \neq 0$?

Main results:

- *CB interventions are effective under level-k thinking, while they are neutral in the RE equilibrium*
- *As the average level of sophistication k increases, the implied (reflective) equilibrium converges to the RE equilibrium*
- *CB interventions have "major" effects on asset prices, but "minor" effects on aggregate output*

Questions/comments:

- I like the approach used (level-k thinking, constant prices, closed-form solutions) to analyze the impact of a (novel) heterodox monetary policy (QE policy)
- I guess k-level thinking implies a recursive problem, which makes it more tractable. However, k-level thinking is based on a quite rigid structure: each agent assumes that the others share the immediate lower level of thinking. Is this correct?

Questions/comments:

- There is a sort of asymmetry: household understand the intertemporal budget constraint faced by the Treasury, but they do not understand central bank's budget constraint
- When RE agents are allowed, it is not clear to me whether these RE agents are aware in your model of the existence of a fraction of level-k thinkers in the population. Put differently, does it makes sense that RE agents may act differently depending on the fraction of level-k thinkers in order to exploit any arbitrage opportunity?
- The focus on the great moderation period in the empirical exercise carried out at the end of the paper is at odds with the focus on the great recession motivating the first part of the paper (featured by QE policies and the highly stylized model with constant prices)

Main result:

- *Survey data on inflation expectations help to identify separately the innovations in the persistent component of (price and wage) markup processes*

Main implications:

- *Model inflation expectations resemble those reported in the SPF*
- *Belief models must be sufficient flexible to capture SPF inflation information: it might be necessary to augment belief specifications with a minimum set of latent shocks revealing the relevant signals*

Questions/comments:

- SPF forecasts are usually considered to discipline (AL and RE) expectations: This is important because AL may add many degrees of freedom. In this paper, SPF forecasts are, in addition, used to identify persistent from transitory innovations to price and wage markup shocks driving inflation dynamics

Questions/comments:

- Why i.i.d. forecast measurement errors? One may think (Orphanides and Kim, 2012) that the survey forecasts only serve as a noisy source of information on market expectations. Hence, one may allow the data to determine the extent of this noise
- As pointed by Cohen, Hördahl and Xia (2018), surveys may not always capture actual expectations of market participants well (for instance because forecasters compete for business or for influence through their forecasts or because one or more large players have a disproportionate impact on the market)
- Based on the potential departures between survey and market expectations, one may consider the possibility of allowing for a flexible, yet simple, structure in the noise (in particular, the possibility of serial correlation) to accommodate a realistic departure of market forecasts from survey forecasts (Aguilar and Vázquez, 2019)

More specific comments:

- PLMs (7)-(8) imply that agents observe and distinguish both type (persistent and transitory) innovations: this is somehow at odds with the incomplete knowledge assumed under AL. It would be interesting to analyze what happen if the sum of the two innovations enter in the PLM instead of the two innovations separately
- It is not clear to me whether the timing assumptions of the model expectations are in line with the SPF forecasts in the measurement equation: you seem to associate inflation expectations in the model, $E_t\pi_{t+1}$, with the nowcast of π_{t+1} reported in the SPF

Table 3. Example: Forecast Horizons for Nominal GDP at Three Survey Dates

Survey Date (Year, Quarter)		Quarterly Historical Value	Quarterly Projections: Quarter Forecast					Annual-Average Projections: Year Forecast	
(1) Year	(2) Quarter	(3) NGDP1	(4) NGDP2	(5) NGDP3	(6) NGDP4	(7) NGDP5	(8) NGDP6	(9) NGDPA	(10) NGDPB
2005	3	2005:Q2	2005:Q3	2005:Q4	2006:Q1	2006:Q2	2006:Q3	2005	2006
2005	4	2005:Q3	2005:Q4	2006:Q1	2006:Q2	2006:Q3	2006:Q4	2005	2006
2006	1	2005:Q4	2006:Q1	2006:Q2	2006:Q3	2006:Q4	2007:Q1	2006	2007

Table notes. The table shows how we organize the survey's median (or mean) responses for three survey dates: 2005:Q3, 2005:Q4, and 2006:Q1. The entries in columns (1) - (2) show the year and quarter when we conducted the survey. The entry in column (3) shows the observation date for the last known historical quarter at the time we sent the questionnaire to the panelists. The entries in columns (4) - (8) show the quarterly observation dates forecast. The entries in columns (9) - (10) show the annual observation dates forecast: Notice how the annual-average forecast horizons are fixed within a calendar year and change in each first-quarter survey. Moody's now views the historical values for the Aaa and Baa corporate bond yields (BOND and BAABOND) as proprietary. Accordingly, the Philadelphia Fed is not permitted to release these historical values to the public.

At each survey date, we record the projections for various horizons in the same row. **NGDP1** is the real-time quarterly historical value for the previous quarter—that is, the quarter before the quarter when we conducted the survey. **NGDP2** is the forecast (nowcast) for the current quarter—that is, the quarter when we conducted the survey. **NGDP3 to NGDP6** are the forecasts for the following four quarters. **NGDPA and NGDPB** are the annual-average projections for the current year (the year when we conducted the survey) and the following year.