Discussion on “The Statistical Limits to Arbitrage” by Da, Nagel and Xiu

Yao Zeng, Wharton School, University of Pennsylvania
A little more color on background

I’m reluctant to give this team advice on financial econometrics or machine learning

My “Xiu-number” is 2: Jianqing Fan as a shared co-author
A little more color on background

But, I immediately say yes when asked as a discussant; a fascinating read and a polished paper

Keywords: *learning* and *arbitrage*

Discussion today focuses on putting paper into context and potential follow-up work
Understanding expectation formation
Adaptive expectations (pre-Lucas)
Rational expectations revolution (1970-90s)
STICKY INFORMATION VERSUS STICKY PRICES: A PROPOSAL TO REPLACE THE NEW KEYNESIAN PHILIPS CURVE

N. GREGORY MANKIW AND RICARDO REIS

This paper examines a model of dynamic price adjustment based on an assumption that information disseminates slowly throughout the population. Compared with the commonly used sticky-price model, this sticky-informational model displays three related properties about the effects of monetary policy (although announced disinflation). Second, monetary policy shocks have a substantial delay. Third, information flows with the level of economic activity.

LEARNING FROM INFLATION EXPERIENCES

ULRIKE MALMENDIER AND STEFAN NAGEL

How do individuals form expectations about future inflation? We propose that individuals overweight inflation experienced during their lifetimes. This approach modifies existing adaptive learning models to allow for age-dependent updating of expectations in response to inflation surprises. Young individuals update their expectations more strongly than older individuals since recent experiences account for a greater share of their accumulated lifetime history. We find support for these predictions using 57 years of microdata on inflation expectations from the Reuters/Michigan Survey of Consumers. Differences in experiences strongly predict differences in expectations, including the substantial disagreement between young and old individuals in periods of highly volatile inflation, such as the 1970s. It also explains household borrowing and lending behavior, including the choice of mortgages. JEL Codes: E03, G02, D03, E31, E37, D84, D83, D14.

Implications of rational inattention

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Abstract

Observations only through a communication channel may allow for a role very similar to that of a rational expectations theory to standard control problems. The resulting expectations theories suggest that it is rational to assign policy actions to different agents.
A new agenda: statistical learning under big data

Martin-Nagel (2021, *JFE*)

- Investors learn about cash flows, facing a high-dimensional inference problem
- Investors never learn perfectly, leading to *in-sample* (but not OOS) predictability

Da-Nagel-Xiu (2023, this paper)

- Arbitragers learn about model parameters, facing a high-dimensional inference problem
- Arbitragers never learn perfectly, leading to an *upper bound* of feasible Sharpe ratio

Key contribution: learning *persistence* as limit to arbitrage (a lower bound won’t do the job)

- **Suggestion:** highlight contribution and agenda more in the context of expectation formation
Econometric and statistical learning
Learning in macroeconomics and finance

Recall: learning *persistence* as limit to arbitrage

- Stems from a high-dimensional inference problem

Past macro literature has explored learning and its aggregate and policy implications

- Introduces explicit learning dynamics, or, “*econometric learning*”
- Agents’ forecasts at time $t$ derived from an econometric model, estimated using data up until $t$
- Typically under low-dimensional inference environment (see, e.g., Sargent)
- Focus on conditions under which convergence to REE happens, or, “*learnability*”
Constant-gain econometric learning


- Goal: explain existence of *persistent macroeconomic fluctuations* from the dynamics induced by *evolving estimates* of the coefficients of people’s forecasting rules
- Intuition: agents believe that the coefficients of the correct forecasting model may shift over time, and consequently place more weight on the most recent observations in their estimates
- *Predicted unconditional macro moments* (analogous to Martin-Nagel’s in-sample predictability)

Suggestion: highlight paper contribution against the econometric learning literature

Suggestion: follow-up macro papers on, e.g., optimal monetary policy design under big data?

- Big data (e.g., satellite, digital footprints) increasingly relevant in macroeconomic predictions
Quantifying the difficulty of learning
Using the “wedge” approach to quantify learning difficulty

Recall: upper bound of Sharpe ratio as main contribution to ML-based asset pricing literature

• Section 2.5 constructs $S^{OPT}$
• Section 2.6 estimates $S^{*}$

The difference of these two constructs an explicit “wedge” from data

Any economic friction implies a “wedge” from a frictionless complete-market economy

• See, e.g., Chari-Kehoe-McGrattan (2007, ECMA), Lustig-Verdelhan (2019, AER)
• Allows for a quantification of underlying frictions using observable data

Suggestion: formalize relationship between “wedge” and friction following the literature
Conclusion

Beautiful and important paper on the statistical limit of arbitrage

- Learning persistence in a high-dimensional world as limit of arbitrage
- An upper bound of feasible Sharpe ratio
- A new agenda in understanding the formation of expectations under big data

I made a few suggestions for follow-up work

- Econometric and statistical learning: optimal macro policy under big data?
- A formal “wedge” approach of measuring the difficulty of learning in a big-data economy?