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INFORMATIONAL EFFICIENCY AND ASSET PRICES IN LARGE MARKETS

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HOW MUCH INFORMATION DO ASSET PRICES CONVEY?

Asset prices (potentially) contain **information about**

- investors' preferences and beliefs
- physical probabilities of the data-generating process

A variety of approaches to extract this information

- rely on large amounts of data and little structure
- structural estimation

⇒ common aim: invert mapping from prices to primitive shocks

Who extracts the information

- the econometrician / macroeconomist
- agents inside the model

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- $S_{mm'}$ investor's SDF, $\pi_{mm'}$ investor's (subjective) belief

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Ross (2015) imposes

- an invariant Markov chain structure on the state m
- separable preferences of the form

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Then β , v_m and $\pi_{mm'}$ can be identified from $p_{mm'}$ data.

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- but the assumption, despite its seeming generality, is highly restrictive (Borovička, Hansen, and Scheinkman (2016))
- omits a (potentially large) martingale component in the SDF (growth, non-separability, ...)

Structural models rely on explicit modeling of investors' demand functions

- demand functions + market clearing \implies equilibrium prices

Aggregate net demand functions must vary sufficiently with shocks to allow inversion.

2-period economy, $t = 0, 1$

- in period 0, shock ε is realized that selects the period-1 DGP distribution $\pi_{l,m}(\varepsilon)$ over M states
- Arrow–Debreu securities with time-0 prices p_m , supply (endowment) a function of m

Informed investors (I)

- correct belief $\pi_{I,m}(\varepsilon)$, $m = 1, \dots, M$

Biased investors (B)

- exogenous biased beliefs $\pi_{B,m}(\nu)$, random ν across N types

Uninformed investors (U)

- prior $\varphi_\nu(x)$ over ν , infer own subjective belief $\pi_{U,m} = \mathbb{E}[\pi_{I,m}(\nu) | \mathcal{F}_U]$ from observed prices

Demand functions depend on underlying preferences and structure of the environment.

Paper considers several alternative specifications.

- logarithmic vs CARA utility
- finite vs. (asymptotically) large number of Arrow–Debreu securities
- finite vs. (asymptotically) large number of biased investors with random biases

Fully revealing equilibrium: prices separate effect of structural shock from random belief biases

Logarithmic vs CARA utility

- logarithmic utility leads to an invertible system where CARA does not
- number of AD securities M must be sufficiently larger than number of biased investors N

Many biased investors and big data

- as number of biased investors $N \rightarrow \infty$, their random demands average out
- as number of AD securities $M \rightarrow \infty$, amount of available information grows

Prototypical investigated example

- physical probability Gaussian with variance σ_I^2
- biased investors' beliefs Gaussian with variance σ_B^2
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Fully revealing equilibrium when $\sqrt{\sigma_B^2 + 2\sigma_\nu^2} < \sigma_I$

- informed investor's demand concentrated in the tails \implies informative tails

This is a cleanly executed, transparent paper that helps clarify a range of theoretical issues.

- comments ask how the insights can be used to help us interpret empirical evidence
- most of these comments probably are beyond the scope of this paper

WHAT IS BIG DATA? (SELF-REFERENTIAL DEFINITION FROM A BIG-DATA ALGORITHM)

Big data refers to extremely large and complex sets of data that are difficult to process and analyze using traditional data processing tools and methods. It is characterized by the **three Vs**:

1. **Volume** – the vast amounts of data generated every second.
2. **Velocity** – the speed at which new data is generated and processed.
3. **Variety** – the different types of data (structured, semi-structured, and unstructured) from various sources (e.g., social media, sensors, logs, transactions).

Some definitions also include a **fourth V** (**Veracity** – the uncertainty or quality of data) and a **fifth V** (**Value** – the insights gained from analyzing the data).

Big data technologies and techniques allow organizations to extract meaningful insights, make data-driven decisions, and discover patterns or trends that would be impossible to detect using smaller datasets.

1) The 'big data' economy corresponds to number of securities $M \rightarrow \infty$.

- is this really necessary?
- do we need (asymptotically) infinitely many securities, or just the right (informative) securities?
- e.g., securities in the tails where likelihood ratios for informed and biased investors are large?
- akin a mechanism design question

2) How large and robust are distortionary effects of (near) noninvertibility of the price system?

- welfare effects? breakdown of risk-sharing?
- how do the results generalize?

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- coordination problems

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'Large agent / large state' economy relies on specific limits

- e.g., small share of informed investors
- why should this share be small? perhaps they are few but manage large amounts

3) The paper associates the conditions $\sigma_B < \sigma_I$ with overconfidence bias of biased investors.

- but this overconfidence cannot be too large so that $\sigma_I < \sqrt{\sigma_B^2 + 2\sigma_V^2}$ is not violated
- tradeoff between overconfidence and dispersion of biased beliefs

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4) Why focus on interest rates?

- Wouldn't prices of specific Arrow–Debreu securities be more revealing?

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5) Dynamics?

- static one-shot model: dispersed info provided, equilibrium (partially) reveals information
- can these insights be carried over to a dynamic world?
- e.g., repeated announcements of economic news (Ai, Han, and Xu (2022), Han (2025))

A clearly written, polished paper.

- helps understand substantial differences between seemingly innocuous changes to the structure of the economy (CARA vs logarithmic utility)
- clean tools to study asymptotically large economies

A very useful step toward a better understanding of which asset prices are most informative about the state of the economy.

- emphasize more the robustness (or nonrobustness!) of the results (importance of structural restrictions)
- gear the discussion toward potential applications

APPENDIX

Ai, Hengjie, Leyla Jianyu Han, and Lai Xu. 2022. “Information-Driven Volatility.”

Borovička, Jaroslav, Lars Peter Hansen, and José A. Scheinkman. 2016. “Misspecified Recovery.” *Journal of Finance* 71 (6):2493–2544.

Han, Leyla Jianyu. 2025. “Announcements, Expectations, and Stock Returns with Asymmetric Information.” *Journal of Monetary Economics* 151:103751.

Ross, Stephen A. 2015. “The Recovery Theorem.” *Journal of Finance* 70 (2):615–648.