Demand System Asset Pricing
Introduction

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Structure of the course

- Lectures take place on May 8, May 15, and May 22.
- There are three problem sets to familiarize you with the data, model estimation, and counterfactuals.
- You can post questions in the chat, which will be monitored by Moto or Ralph.
- Feel free to follow up by email if you have questions: `myogo@princeton.edu` / ralph.koijen@chicagobooth.edu.

Agenda

1. Week 1:
    - Introduction to demand system asset pricing.
    - Micro foundations of an empirically-tractable demand system.
    - Data construction.
    - Discuss PS #1.
2. Week 2:
    - Demand estimation and identification.
    - Counterfactuals.
    - Discuss PS #2.
3. Week 3:
    - Applications.
    - Open research questions.
    - Discuss PS #3.

Modern approaches to asset pricing

- Much of asset pricing evolves around models of the stochastic discount factor (SDF, "M").
- Broadly speaking, there are four classes of models:
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- Econometric tests connect asset prices to the model's state variables or their innovations (e.g., Euler equation tests).

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- Objective: Match investor-level data on portfolio holdings and thus model the asset demand system.
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  3. Limited econometric tools to identify demand elasticities.
     - Unstable/unidentified estimates or impose mean-variance preferences to capture substitution patterns (Frankel, 1985).
     - Solution: Creative new instruments have been proposed in recent years.

Connecting the SDF and demand system approaches

- Any asset pricing model that starts from preferences, beliefs, . . . , implies
  1. An SDF that can be used to price assets using $\mathbb{E}[MR] = 1$.
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- Additional reasons to study asset demand systems
  1. Testing theories Demand curves depend on ex-ante information and can provide more powerful tests of asset pricing models than Euler equation tests that average ex-post returns.
  2. New moments By testing the model's implications for demand curves (e.g., demand elasticities and cross-elasticities), we expand the set of testable moments in a meaningful way.

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- As we will see, it makes asset pricing more "tangible" and removes some of the "dark matter."

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- To provide credible quantitative answers to these questions, we need a well-specified asset demand system.
- See here for a detailed discussion.

Poll: How elastic is investors' demand?

- The demand elasticity wrt price, $\frac{\partial \ln Q}{\partial \ln P}$, is a key parameter
- To form a prior, consider the following question:
  "If an investor gradually sells 10% of a stock's total shares outstanding for liquidity reasons over the course of a quarter, how large is the decline in the stock price?"
- Poll answers:
  1. 0
  2. -0.001%
  3. -0.01%
  4. -0.1%
  5. -1%
  6. -10%
  7. $< -10\%$

Demand elasticities in standard asset pricing models

- We first compare our priors to asset pricing theory and then review the empirical evidence.
- Asset pricing theories generally imply downward-sloping demand.
  - Risk aversion, intertemporal hedging demand (Merton, 1973), price impact (Wilson, 1979 and Kyle, 1989).
- It is a quantitative question: What is the slope of the demand curve?
- Let us consider a standard CAPM calibration following Petajisto (2009) to fix ideas.

Demand elasticities in standard asset pricing models

CARA - normal model:

- N stocks with supply u_n each.
- Risk-free rate with infinitely-elastic supply, normalized to 0.
- Liquidating dividend for stock n

$$X_n = a_n + b_n F + e_n,$$

where F is the common factor and e_n the idiosyncratic risk.

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- There exists a continuum of investors that aggregate to a representative consumer with CARA preferences

$$\max_{\theta_i} E[-\exp(-\gamma W)], \qquad W = W_0 + \sum_{n=1}^{N} \theta_n (X_n - P_n).$$

Demand elasticities in standard asset pricing models

- Solving for equilibrium demand and set it equal to supply, u_n

$$P_n = a_n - \gamma \left[\sigma_m^2 \left(\sum_{m \neq n} u_m b_m \right) b_n + (\sigma_m^2 b_n^2 + \sigma_e^2) u_n \right].$$

The price discount will be dominated by the first term, not supply (the second term).

Demand elasticities in standard asset pricing models

- Calibration
  - $N = 1000$, $a_i = 105$, $b_i = 100$, $\sigma_e^2 = 900$, $\sigma_m^2 = 0.04$, $u_i = 1$, $\gamma = 1.25 \times 10^{-5}$.
    $\Rightarrow$ Market risk premium equals 5%, all stocks have a price of 100, a market beta of 1, and a standard deviation idiosyncratic risk of 30%.
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  - The price of the stock increases by 0.16bp.
  - Part of this increase is due to the reduction in the aggregate market risk premium as there is less aggregate risk $\Rightarrow$ All stocks increase by 0.05bp.
  - Hence, the differential impact is only 0.11bp. This is what we mean with virtually flat demand curves.
  - Intuitively, stocks are just very close substitutes. What matters most is a stock's beta and its contribution to aggregate risk.

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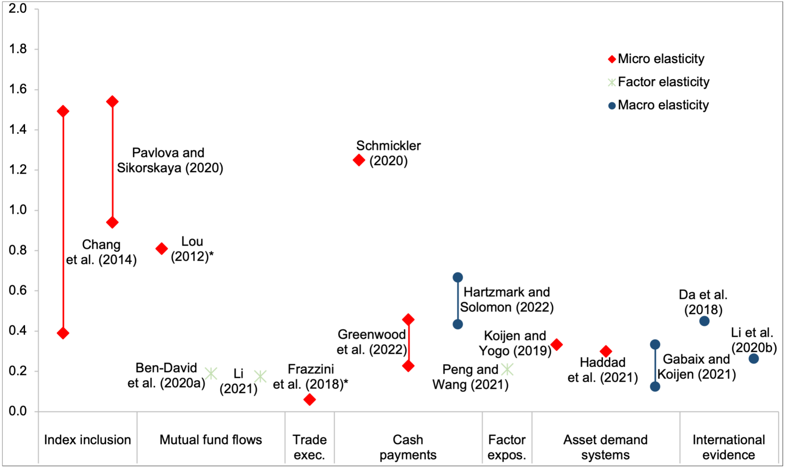
  - Hence, the differential impact is only 0.11bp. This is what we mean with virtually flat demand curves.
  - Intuitively, stocks are just very close substitutes. What matters most is a stock's beta and its contribution to aggregate risk.
  - Price elasticity of demand: $-\frac{\Delta Q/Q}{\Delta P/P} = \frac{0.10}{0.000016} \simeq 6,250$.

Micro versus macro elasticities

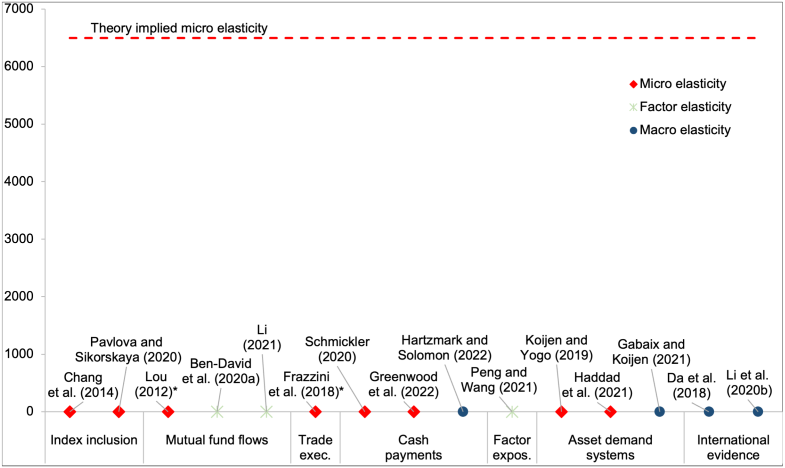
- Most of the literature focuses on individual securities (stocks, bonds, ...).
- This measures a micro elasticity.
- When aggregating to higher levels, such as factors (e.g., size and value) and the market, elasticities fall in standard models.
- Intuitively, two bio-tech firms are closer substitutes than stocks and bonds.
- See Gabaix and Koijen (2022) for an analysis of the macro elasticity.
  - In modern macro-finance models, the macro elasticity is around 20 $\Rightarrow$ More than 10 times larger compared to the empirical estimates for the micro elasticity.

Empirical evidence on demand elasticities



Source: Gabaix and Koijen (2022)

Empirical evidence on demand elasticities vs micro theory



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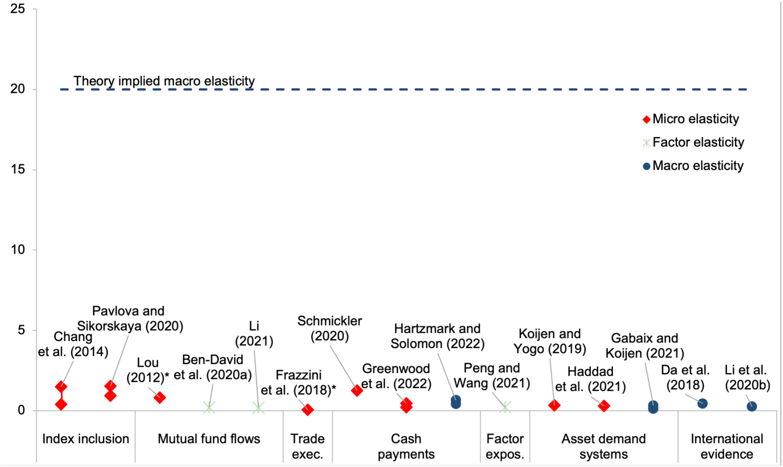

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Open research question

- Why is demand so inelastic?
- Potential mechanisms:
  - Investors are uncertain about expected returns or how to interpret price movements, making them less reactive.
  - Benchmarking / investment mandates / buy-and-hold investors.
  - Inertia.
  - ...
- A quantitative exploration of various mechanisms is an interesting direction for future research.

Next steps

- Micro-foundations of an empirical demand system.
- Data sources and construction to estimate asset demand systems.
- The econometrics of demand estimation.
- Estimation results.
- Applications.