Business, Liquidity, and Information Cycles

Gorkem Bostanci [1] Guillermo Ordonez [2]

[1]University of British Columbia

[2]University of Pennsylvania

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Motivation

- Stock markets play two critical roles:
  - aggregating information for resource allocation and
  - providing liquidity.
- How much agents rely on stock markets for liquidity depends on how well the banking sector provides it.
- **Questions:**
  - Does the use of stocks for liquidity enhance or weaken their role in providing information?
  - How does liquidity distress originating in the banking sector affect price informativeness?
  - How does the information content of stock prices vary with business cycles?

What We Do

1. Build a model of stock trading and misallocation
   - We allow endogenous information acquisition and noise.
   - Real sector learns from asset prices.
2. Structurally estimate price informativeness in several countries
   - It exhibits cyclicality.
   - We decompose it into contributing factors.
3. Calibrate the model for the U.S.
   - Liquidity shocks coincide with technology shocks and amplify them up to 22%.
   - Recessions can be 'cleansing' or 'sullying.' Literature

Classical RBC with Heterogenous Firms

Rep. agent and firm *i* solve

$$V(Z, K, k) = \max_{k'} u(k(1+r) - k') + \beta E[V(Z', K', k')|Z]$$

$$\Pi_i = \max_{K_i} (Z + z_i) f(K_i) - rK_i$$

Equilibrium Conditions

$$u'(k(1+r) - k') = \beta E[u'(k'(1+r') - k'')|Z]$$

$$(Z + z_i) f'(K_i) = r \ \forall i$$

$$\int K_i di = K$$

Classical RBC with Heterogenous Firms and a Stock Market

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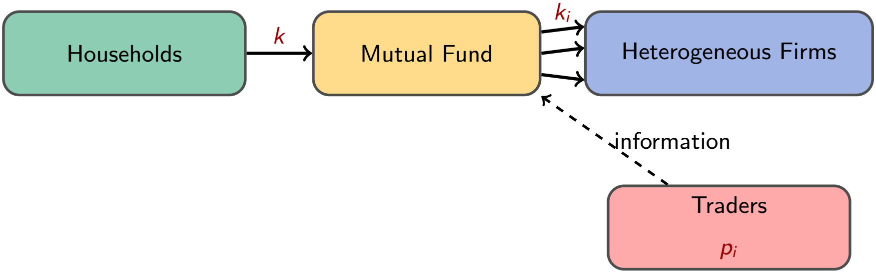
MODEL

Environment



Model Details

Information Extraction from Stock Prices

Equilibrium Pricing Equation

$$p_i = \phi_0 + \phi_n \theta_{in} + \phi_d \theta_{id}$$

Stock price for firm i reflects beliefs about:

- Productivity θ_{in}
- Liquidity characteristics θ_{id}
- ϕ depend on
  - γ : Trader composition, aggregate state
  - λ : Fraction of informed traders, endogenous

A fund uses stock prices to infer θ_{in} to allocate capital across firms.

Information Extraction from Stock Prices

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Price Informativeness (PI)

$$\mathrm{PI} = \frac{1}{1 + \frac{\sigma^2_{\theta_d}}{\sigma^2_{\theta_n}} \left(\frac{\phi_d}{\phi_n} \right)^2}$$

Higher PI means prices reveal more about productivity.

Higher γ means higher ϕ_d / ϕ_n, lower PI.

EMPIRICS

Empirical Strategy and Data Sources

We estimate the full model in two steps:

- Estimate the pricing function for each country-year pair. Keys
- Internally calibrate the remaining parameters and recover γ series as an unobserved state.

We use

- Worldscope: Monthly stock prices and yearly fundamentals
- I/B/E/S: Analyst forecasts for earnings Why forecasts?
- Liquidity Conditions from the World Bank and Baron et al. (2021)

Estimating the Pricing Function - Measurement

To compute price informativeness, we need $\phi_d, \phi_n, \sigma^2_{\theta_d}, \sigma^2_{\theta_n}$. We map $(p_i = \phi_0 + \phi_d\theta_{id} + \phi_n\theta_{in})$ Sample Restrictions Timing Misallocation Measure

- p_i: current price, Adjustments
- θ_{in} : analyst forecast for eps', andeps'_f
- θ_{id}: volatility of p_i in the previous period,

and estimate the pricing regression for each country-year pair.

PI Estimates - U.S.

Decomposition Other Countries

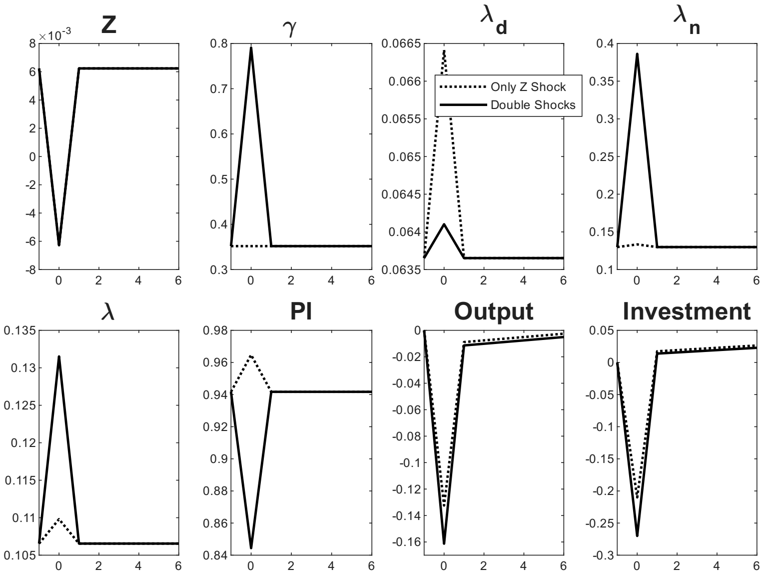
Estimates - Cyclicality of PI

	PI					
	(1)	(2)	(3)	(4)	(5)	(6)
GDP Growth Rate	0.47		2.55***			
	(0.48)		(0.38)			
Avg Earnings		3.58***		7.71***		
		(1.27)		(0.97)		
Banking Stock Perf.					0.28	0.66**
					(0.47)	(0.30)
Range	'84-'22	'84-'22	'84-'22	'84-'22	'84-'22	'84-'22
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Weights	No	No	Yes	Yes	No	Yes
Observations	344	344	344	344	319	319

Calibration

COUNTERFACTUALS

Recessions with and without Liquidity Distress Capital Allocation



Testable Implication: Not all Recessions are the Same

	PI					
	Banking Stock Perf.	Bank Capital to Assets	Bank Loan Spreads (-)	Non-performing Loans (-)	Banking Panic (-)	Banking Equity Crisis (-)
	(1)	(2)	(3)	(4)	(5)	(6)
GDP Growth	−0.99	−0.64	−0.36	−1.29	−1.32	−1.35
	(0.85)	(1.20)	(1.39)	(1.47)	(0.99)	(0.99)
Liq. Measure	0.49	0.09**	0.02***	0.03***	0.13*	0.01
	(0.56)	(0.04)	(0.01)	(0.01)	(0.07)	(0.07)
Range	'84-'22	'05-'22	'84-'22	'05-'22	'84-'16	'84-'16
Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	319	180	185	185	244	244

Counterfactual Recessions under Alternative Information Scenarios

Moments	Baseline	Fixed λ	low ν_n	low ν_d
$\Delta\lambda_{\bar{z}\underline{\gamma}\to\underline{z}\bar{\gamma}}$	0.234	0.000	0.195	0.227
$\Delta PI_{\bar{z}\underline{\gamma}\to\underline{z}\bar{\gamma}}$	-0.103	-0.624	-0.067	-0.121
$\Delta Y_{\bar{z}\underline{\gamma}\to\underline{z}\bar{\gamma}}$	-0.161	-0.230	-0.153	-0.164
$\Delta Inv_{\bar{z}\underline{\gamma}\to\underline{z}\bar{\gamma}}$	-0.270	-0.362	-0.241	-0.271

Stochastic Steady States

- Information acquisition provides a buffer against recessions.
- Lower information costs about fundamentals also buffers the recession.
- Lower information costs about liquidity magnifies the recession.

Conclusion

- We build a model of asset trading with **endogenous noise**.
- We **integrate** it into an RBC setting, simultaneously capturing information acquisition and misallocation.
- We **structurally** estimate stock price informativeness and show it declines during recessions with liquidity distress.
- A calibration to the U.S. shows that not all recessions are equal.
  - Recessions without financial distress make prices more informative, improve allocations and buffer output losses.
  - Recessions with financial distress make prices less informative, weaken allocations and magnify output losses.

Business Cycle Misallocation

- Evidence on increased misallocation:
  - Oberfield (2013) for Chile, Sandleris and Wright (2014) for Argentina.
- Evidence on reduced reallocation:
  - Eisfeldt and Rampini (2006), Cooper and Schott (2013), Foster et al. (2016), Cui (2022).
- Evidence on increased information acquisition:
  - Jiang et al. (2015) and Loh and Stulz (2018). Back

Price Information

- Baker et al. (2003) shows stock prices are important for the corresponding firm's investment when the firm is dependent on equity with external financing needs.
- Edmans et al. (2012) shows a decrease in stock prices increases the likelihood that the corresponding firm will be subject to a takeover.
- Chen et al. (2006) and Bennett et al. (2019) show that the sensitivity of the firm's investment and CEO turnover on its stock price increases as empirical measures of price informativeness increase.
- Feldman and Schmidt (2003) describes how regulators use stock prices in their decision making. Back

Impact of Liquidity

- On asset prices: Amihud and Mendelson (1986, 1988) Brennan and Subrahmanyam (1996), Brennan, Chordia, and Subrahmanyam (1998), Chalmers and Kadlec (1998), Chordia, Roll, and Subrahmanyam (2000), Pastor and Stambaugh (2001), Amihud (2002)
- Flight to liquidity during recessions: Naes et al. (2011), Chen et al. (2015), Apergis et al. (2015), Chen et al. (2018), Ellington (2018) Back

Summary Statistics - Economic Conditions

Statistic	N	Mean	St. Dev.	Min	Max
Bank Capital to Assets	180	6.865	1.954	4.109	10.565
Bank Loan Spreads	185	4.039	6.645	-0.032	39.216
Non-performing Loans	185	2.471	2.509	-0.090	16.911
Banking Panic	244	0.041	0.199	0	1
Banking Equity Crisis	244	0.037	0.189	0	1
PI	344	0.818	0.232	0.012	1.000
Avg Earnings	344	0.052	0.016	0.016	0.098
GDP Growth Rate	344	0.026	0.031	-0.102	0.120
Banking Stock Performance	319	0.103	0.049	0.015	0.294

Back

Trader's Problem

The portfolio choice problem of a night trader who is endowed with $\tilde{b}$ foreign bonds s

$$\begin{aligned}
&\max_{B_n,\{X_{in}\}_{i\in[0,1]}} E\Big[-exp\Big[-a[(1+r^F)B_n+\int_i X_{in}\big(z_{in}+p_i'-p_i\big)di]\Big]\Big] \\
&s.t.\;\; B_n+\int_i p_i X_{in} di=\tilde{b},
\end{aligned} \tag{1}$$

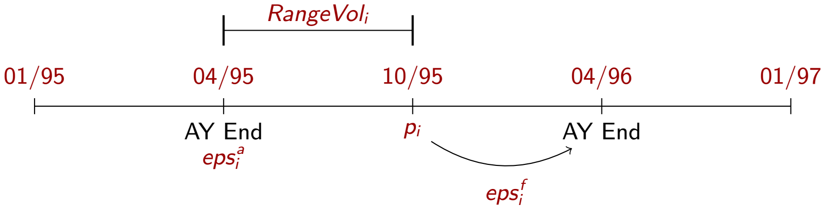
and the portfolio choice problem of a day trader becomes

$$\begin{aligned}
&\max_{B_d,\{X_{id}\}_{i\in[0,1]}} E\Big[-exp\Big[-a[(1+r^F)B_d+\int_i X_{id}\big(z_{in}-z_{id}+p_i'-p_i\big)di]\Big]\Big] \\
&s.t.\;\; B_d+\int_i p_i X_{id} di=\tilde{b}
\end{aligned} \tag{2}$$

where B_l and $\{X_{il}\}_{i\in[0,1]}$ are bond and stock demands of the traders for $l\in\{d,n\}$. Back

Estimating the Pricing Function - Measurement

For each firm, we use the following timeline



Back

Estimating the Pricing Function - Inference

The pricing function (for $\rho = 0$) is

$$p_i = \phi_0 + \phi_d \theta_{id} + \phi_n \theta_{in}$$

θ_{id} and θ_{in} are signals about the payoff; can we proxy them with the realized values z_{id} and z_{in}?

Proposition

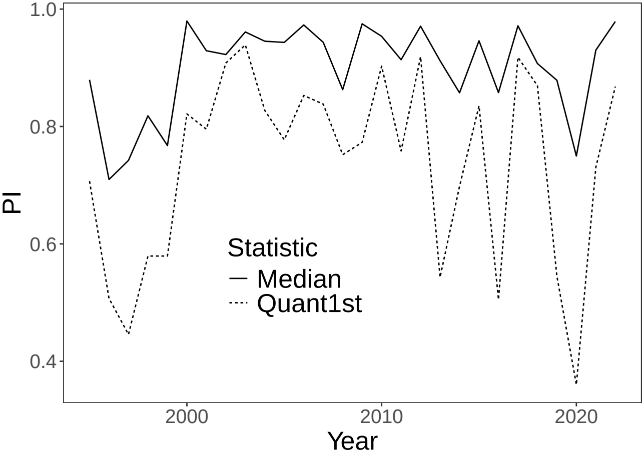
Regressing the price (p_i) on realized earnings (z_{id} and z_{in}) would give biased estimates of ϕ :

1. $E[\hat{\phi}_0^B] = \phi_0 + \frac{\bar{\theta}_n \sigma^2_{\varepsilon_n} \phi_n}{\sigma^2_{\varepsilon_n} + \sigma^2_{\theta_n}} + \frac{\bar{\theta}_d \sigma^2_{\varepsilon_d} \phi_d}{\sigma^2_{\varepsilon_d} + \sigma^2_{\theta_d}}$
2. $E[\hat{\phi}_n^B] = \phi_n \left(1 - \frac{\sigma^2_{\varepsilon_n}}{\sigma^2_{\varepsilon_n} + \sigma^2_{\theta_n}}\right)$
3. $E[\hat{\phi}_d^B] = \phi_d \left(1 - \frac{\sigma^2_{\varepsilon_d}}{\sigma^2_{\varepsilon_d} + \sigma^2_{\theta_d}}\right)$

Hence, we use **analyst forecasts** and **past values** to represent the signals.

Estimates - Global

Price Informativeness Estimates for a panel of 17 countries: Back



Data Adjustments

1. In the model, a share provides rights over one unit of installed capital. We convert all per-share values to per-dollar-of-asset values.

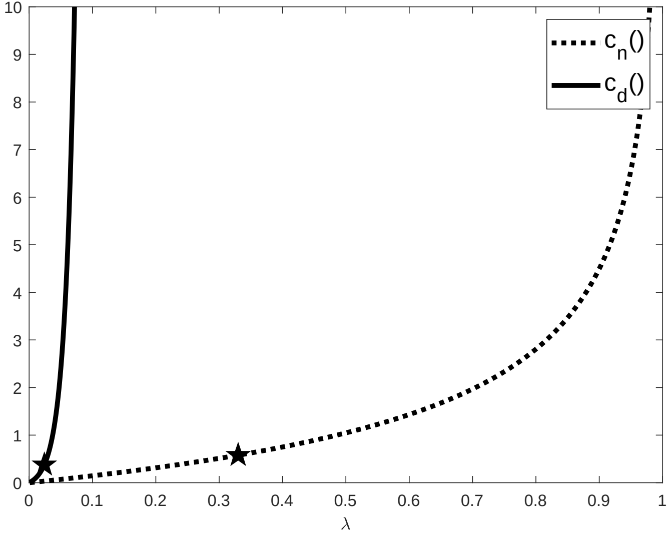
2. The model assumes $(\theta_{in}, \theta_{id}, \varepsilon_{in}, \varepsilon_{id})$ are iid across firms. Also, we assume $\bar{\theta_{in}}$ and $\bar{K_i}$ are firm-invariant. We residualize prices with the three Fama-French factors, previous earnings, and total assets.

3. A market is defined as a country-year pair. We assign each firm to a country based on where their stocks are traded.

4. We winsorize prices and earnings at 5%. Back

Estimated Cost Functions

Back



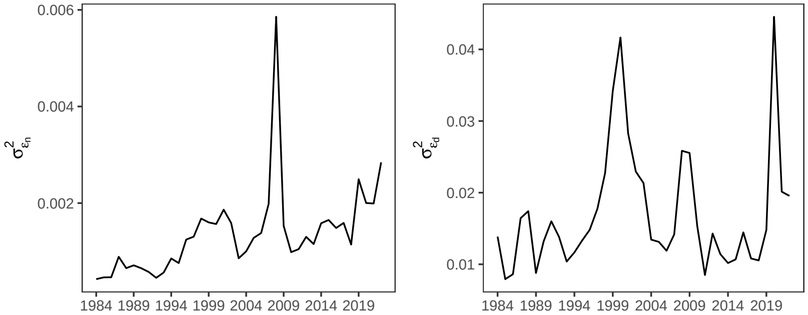
Sample Restrictions

We remove observations for which

1. firms are ever cross-listed, or are in finance-insurance sectors,
2. accounting year-end dates are inconsistent with the date of the stock price,
3. financial statements are announced too early or too late,
4. earnings forecasts indicate losses bigger than 10% of total assets, and
5. the market has too few observations to credibly compute the Fama-French factors. Back

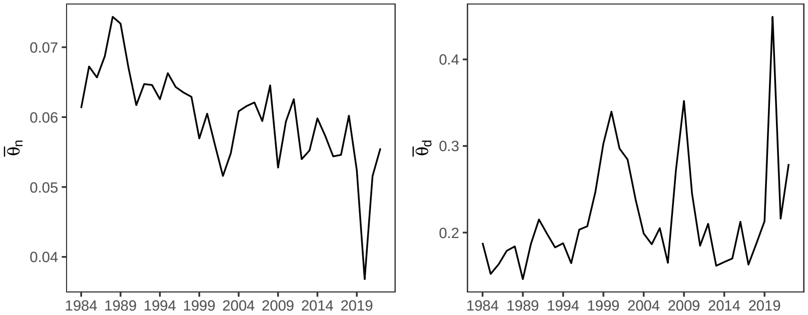
Other Parameter Estimates

Forecast Error Variance Estimates in the U.S. for a Balanced Panel of Companies Back



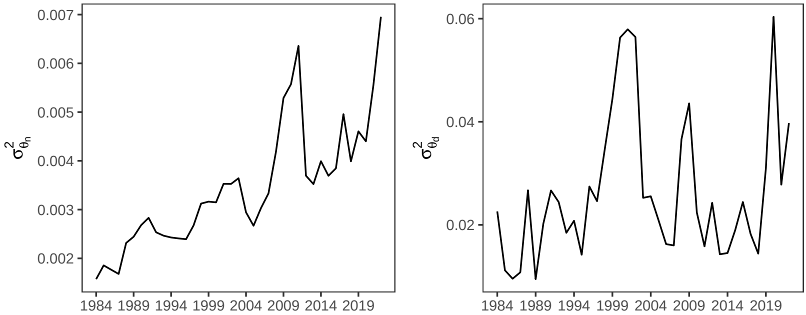
Other Parameter Estimates

Median Earnings and Volatility Signals in the U.S. for a Balanced Panel of Companies Back



Other Parameter Estimates

Variances of the Earnings and Volatility Signals in the U.S. for a Balanced Panel of Companies Back



Price Informativeness and Capital Allocation

	Dispersion of Investment			
	(1)	(2)	(3)	(4)
PI	0.004**	0.004**	0.005**	0.005**
	(0.002)	(0.002)	(0.002)	(0.002)
GDP Growth		0.036**		0.060*
		(0.018)		(0.031)
Range	'84-'22	'84-'22	'84-'22	'84-'22
FE	Yes	Yes	Yes	Yes
Weights	No	No	Yes	Yes
Obs	344	344	344	344

Back

Counterfactual Steady State Averages

Moments	Baseline	Fixed λ	low ν_n	low ν_d
Y	0.110	0.099	0.113	0.109
C	0.050	0.044	0.051	0.050
Inv	0.060	0.055	0.061	0.060
PI	0.865	0.607	0.913	0.847
λ_n	0.254	0.130	0.328	0.272
λ_d	0.064	0.082	0.065	0.074

Back

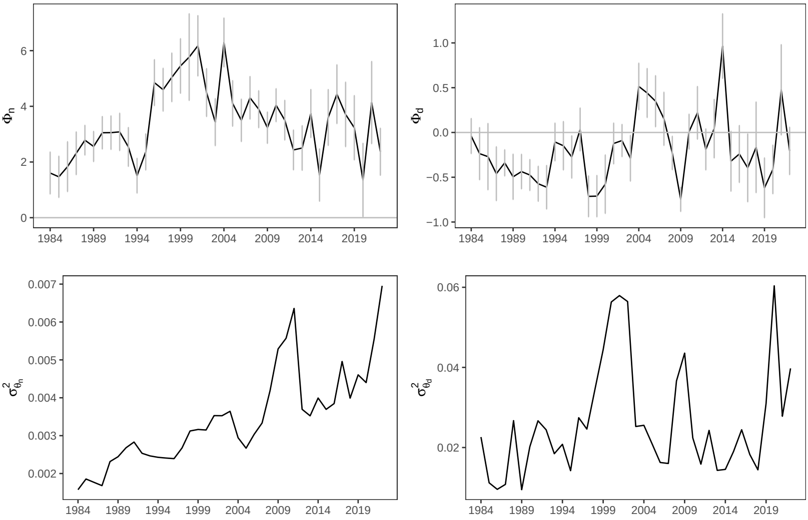
Estimating the Pricing Function - Strategy

- The pricing function can be estimated **outside the model.**
  - The asset payoffs are independent of the consumers' investment.
- The pricing function can be estimated **independently for each year.**
  - The traders' problems are static.
  - The pricing function is allowed to vary freely across years.
- For each market-year pair, we use the **cross-sectional variation.**
  - PI becomes the ability of prices to distinguish productive firms in a market.
  - Provides a PI measure for each country-year. Back

Literature

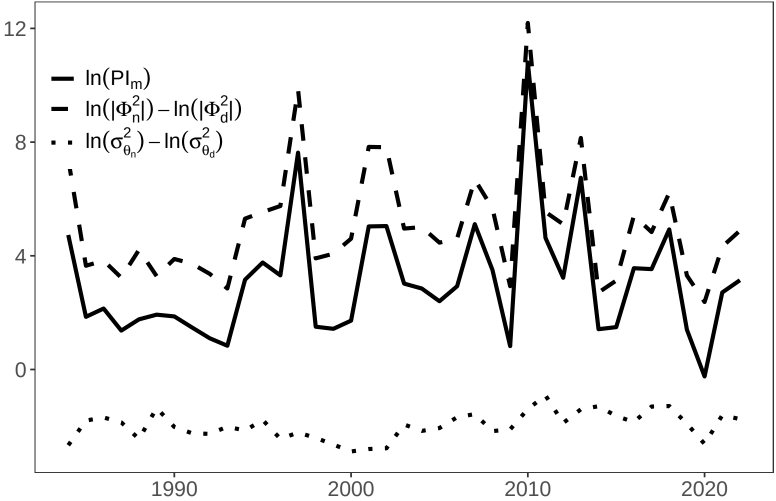
- The Real Effects of Stock Prices
  - Micro: Baker et al. (2003), Feldman and Schmidt (2003), Chen et al. (2006), Edmans et al. (2012), Dow et al. (2017), Bennett et al. (2019)
  - Macro: Benhabib et al. (2019), David et al. (2016), David and Venkateswaran (2019)
  - Contribution: We combine Business and Liquidity Cycles
- Cyclicality of Misallocation Evidence
  - Eisfeldt and Rampini (2008), Ordonez (2013), Khan and Thomas (2013), Cooper and Schott (2023), Fuchs et al. (2016), Fajgelbaum et al. (2017), Straub and Ulbricht (2023)
  - Contribution: Two Roles of Stock Markets. Relation with Banking Liquidity
- Measuring Price Informativeness
  - Theory: Stein (1987) and Vives (2014)
  - Contribution: Implications of Endogenous Noise
  - Empirics: Bai et al. (2016) and Dávila and Parlatore (2018)
  - Contributions: Structural measure, which is relevant for allocations.
    Multi-Country Analysis Back

PI Estimates - U.S.



Decomposition U.S.: Price Loadings vs. Variances

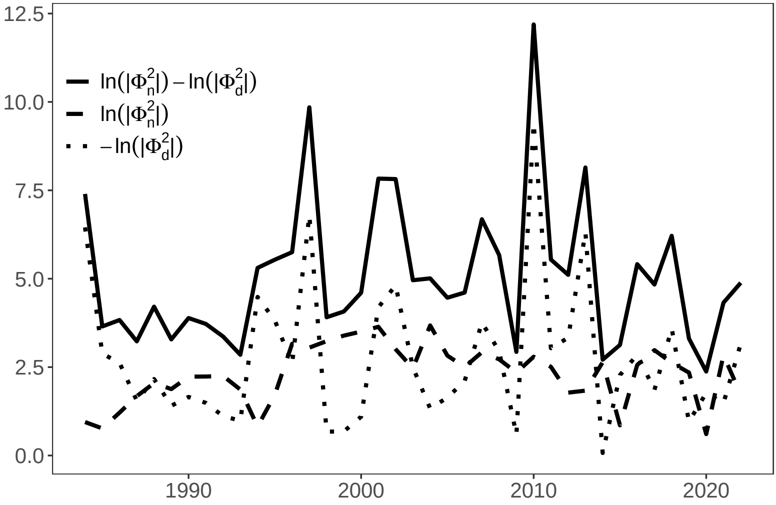
$$ln\left(\frac{PI}{1-PI}\right) = \underbrace{ln(\phi_n^2) - ln(\phi_d^2)}_{\texttt{Price Loading}} + \underbrace{ln(\sigma_{\theta_n}^2) - ln(\sigma_{\theta_d}^2)}_{\texttt{Variances}}.$$



Decomposition U.S.: Among Price Loadings

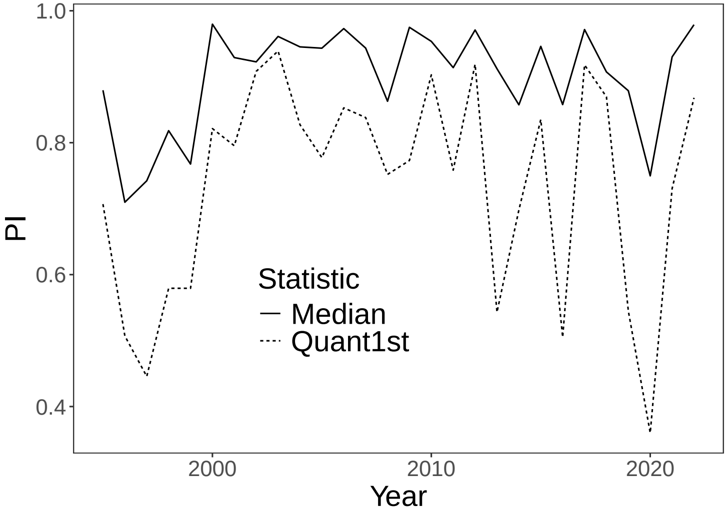
Back

$$ln\left(\frac{PI}{1-PI}\right) = \underbrace{ln(\phi_n^2) - ln(\phi_d^2)}_{\texttt{Price Loading}} + \underbrace{ln(\sigma_{\theta_n}^2) - ln(\sigma_{\theta_d}^2)}_{\texttt{Variances}}.$$



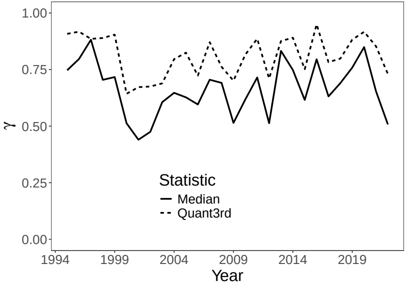
PI Estimates - Balanced Sample

Price Informativeness: median and the 1st quantile. Back



The Hidden State: Trader Composition (γ)

The fraction of day traders: Back



CALIBRATION TO THE U.S.

Step 2: Recovering the Liquidity Needs: γ

Remember the earlier result:

$$\frac{|\phi_n|}{|\phi_d|} = 1 + \frac{(1-\gamma)\lambda_n(\sigma_{\varepsilon_d}^2 + Var(z_{in} + p'_{in}))}{\gamma\lambda_d Var(z_{in} + p'_{in})}.$$

We can recover γ if we can compute λ and $Var(z_{in} + p'_{in})$.

- To recover $Var(z_{in} + p'_{in})$ we estimate:

  $$\hat{\Phi}_t = B\hat{\Phi}_{t-1} + U + W_t,$$

  where $\hat{\Phi}_t = [\hat{\phi}_0 \;\; \hat{\phi}_n \; \hat{\phi}_d]$.

- To recover λ, we use

  $$e^{ac_n(\lambda_{in})}\sqrt{\frac{Var[z_{in} + p'_i|\theta_i]}{Var[z_{in} + p'_i|p_i]}} = 1, \qquad e^{ac_d(\lambda_{id})}\sqrt{\frac{Var[z_{in} - z_{id} + p'_i|\theta_i]}{Var[z_{in} - z_{id} + p'_i|p_i]}} = 1$$

  which provides λ_n/λ_d for a given $c()$.

Step 3: Calibrating the Full Model

- Let's start with a guess for $c_j(\lambda_j) = \nu_j \left(\frac{1}{1-\lambda_j}\right)^{\psi_j} - \nu_j$.
- Two state variables: the aggregate productivity shock (Z, measured), and the liquidity shock (γ, backed out), modeled as a VAR.
- We measure $\sigma^2_{\varepsilon_n}$, $\sigma^2_{\varepsilon_d}$, $\sigma^2_{\theta n}$, and $\sigma^2_{\theta d}$ directly. Estimates

s	Z	γ	σ_{θ_n}	σ_{θ_d}	σ_{ε_n}	σ_{ε_d}	Years
1	0.049	0.35	0.059	0.17	0.036	0.14	'95-'97, '01, '02, '13, '16
2	0.049	0.79	0.059	0.17	0.036	0.14	'89, '90, '91-'94, '98-'00, '03, '09, '15, '17,
3	0.061	0.35	0.059	0.14	0.038	0.12	'84,'04,'07,'08,'10,'11,'18
4	0.061	0.79	0.059	0.14	0.038	0.12	'85-'88,'05,'06,'12, '14, '22

Step 3: Calibrating the Full Model

Three new components for the quantitative model:

- $\theta^s_{in} \sim N(\theta_{in}, \sigma^2_{\theta^s_{in}})$: some price information may already be known by the mutual fund
- $\epsilon^s_{in} \sim N(\epsilon_{in}, \sigma^2_{\epsilon^s_{in}})$: the mutual fund may have information orthogonal to the price
- $p^s_i \sim N(p_i, \sigma^2_{p^s_i})$: other potential pricing factors

Back

Step 3: Calibrating the Full Model

- The rest: Latent Liq State Cost Functions

Par	Value	Mom.	Par	Value	Moment	Model	Target
$\bar{k}/\xi$	825	Norm.	ν_n	4.58	λ_d	0.06	0.02
η	2	Ext.	ν_d	0.11	λ_n	0.26	0.33
a	0.05	Ext.	ψ_n	0.3	$\underline{PI}$	0.87	0.87
δ	0.06	Ext.	ψ_d	60	$\Delta\lambda$	0.23	0.22
r^F	0.02	Ext.	β	0.98	r	0.02	0.02
			$\sigma_{p_i^s}$ for $\underline{\gamma}$	4.9	R-sq for $\underline{\gamma}$	0.44	0.44
			$\sigma_{p_i^s}$ for $\overline{\gamma}$	2.5	R-sq for $\overline{\gamma}$	0.44	0.44
			$\sigma_{\varepsilon_{in}^s}$	0.02	$cor(p_i, k_i)$	0.39	0.37
			$\sigma_{\theta_{in}^s}$	0.11	$cor(PI, std(k_i))$	0.22	0.22

Back

Equilibrium Characterization

Proposition

Under a squared loss function, $E[\theta_{in}|p_i]$ is unbiased for θ_{in}. Its ex-ante and interim (conditional on p_i) risk equals:

$$R(\theta_{in}, E[\theta_{in}|p_i]) = \frac{1}{\frac{1}{\sigma^2_{\theta_n}} + \frac{1}{\sigma^2_{\theta_d}}\left(\frac{\phi_n}{\phi_d}\right)^2} = \sigma^2_{\theta_n}[1 - PI].$$

The PI measure is inversely proportional to the extent of capital misallocation!

Back

Equilibrium Characterization

Proposition

There exists a market price for stock i with the form $p_i = \phi_{i0} + \phi_{id}\theta_{id} + \phi_{in}\theta_{in}$ where

$$\frac{|\phi_{in}|}{|\phi_{id}|} = 1 + \frac{(1-\gamma)\lambda_{in}(\sigma^2_{\varepsilon_{id}} + Var(z_{in} + p'_{in}))}{\gamma\lambda_{id} Var(z_{in} + p'_{in})}.$$

Corollary

Ceteris paribus, price becomes less informative about θ_{in} when
(i) a larger fraction of traders are day traders,
(ii) a larger fraction of day traders are informed compared to night traders,
(iii) the day payoff is less volatile conditional on θ_{id} compared to night payoff conditional on θ_{in}.

Back

Environment

- **Agents and Preferences** Traders who live for one period, infinitely-lived consumers, and a mutual fund.
  - $\gamma \in (0,1)$ **day traders**, $1-\gamma$ **night traders**. Follows a Markov process.
  - Traders' utility $u(W) = -e^{-aW}$, consumers' CRRA
- **Technology** Cont. of firms whose stocks are traded on markets:

$$\Pi_i = z_{in}(\bar{K}_i + K_i) - r_i K_i - \xi K_i^2/2\bar{K}_i$$

Environment

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  - Traders' utility $u(W) = -e^{-aW}$, consumers' CRRA
- **Technology** Cont. of firms whose stocks are traded on markets:

$$\Pi_i = z_{in}(\bar{K}_i + K_i) - r_i K_i - \xi K_i^2 / 2\bar{K}_i$$

- **Assets** The assets are (1) capital, (2) shares of the firms, and (3) a foreign bond.
  - Capital: Consumers $\overbrace{\longrightarrow}^{r}$ mutual fund $\overbrace{\longrightarrow}^{r_i}$ firms
  - Traders own the shares. Night traders get $z_{in} + p_i'$, day traders get $z_{in} - z_{id} + p_i'$ per share.
  - The bond promises a fixed return r^F to traders.

Environment

- **Information**

$$z_{in} = Z + \theta_{in} + \varepsilon_{in} \qquad \theta_{in} \sim \mathcal{N}(\bar{\theta}_{in}, \sigma^2_{\theta_{in}}) \;\;\&\;\; \varepsilon_{in} \sim \mathcal{N}(0, \sigma^2_{\varepsilon_{in}})$$

and

$$z_{id} = \theta_{id} + \varepsilon_{id} \qquad \theta_{id} \sim \mathcal{N}(\bar{\theta}_{id}, \sigma^2_{\theta_{id}}) \;\;\&\;\; \varepsilon_{id} \sim \mathcal{N}(0, \sigma^2_{\varepsilon_{id}})$$

where $\theta_{id}, \theta_{in}, \varepsilon_{id}, \varepsilon_{in}$ are *iid*.

  - Z is an additive aggregate productivity shock
  - For each firm i, night traders can pay $c(\lambda_{in})$ and day traders can pay $c(\lambda_{id})$ to learn θ.
  - λ_{ik} is the eqbm fraction of $k \in \{d, n\}$ traders that are informed about firm i.

Equilibrium Conditions

Asset Demand The demand for risky asset by the informed (I) and uninformed (U) traders as follows: Trader Problem

$$X_{in}^{I*} = \frac{E[z_{in} + p_i'|\theta] - (1+r^F)p_i}{aVar[z_{in} + p_i'|\theta]} \qquad X_{id}^{I*} = \frac{E[z_{in} - z_{id} + p_i'|\theta] - (1+r^F)p_i}{aVar[z_{in} - z_{id} + p_i'|\theta]}$$

$$X_{in}^{U*} = \frac{E[z_{in} + p_i'|p_i] - (1+r^F)p_i}{aVar[z_{in} + p_i'|p_i]}, \qquad X_{id}^{U*} = \frac{E[z_{in} - z_{id} + p_i'|p_i] - (1+r^F)p_i}{aVar[z_{in} - z_{id} + p_i'|p_i]},$$

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$$X_{in}^{U*} = \frac{E[z_{in} + p_i'|p_i] - (1 + r^F)p_i}{aVar[z_{in} + p_i'|p_i]}, \qquad X_{id}^{U*} = \frac{E[z_{in} - z_{id} + p_i'|p_i] - (1 + r^F)p_i}{aVar[z_{in} - z_{id} + p_i'|p_i]},$$

Market clearing For stocks,

$$\gamma\left[\lambda_{id}X_{id}^{I} + (1 - \lambda_{id})X_{id}^{U}\right] + (1 - \gamma)\left[\lambda_{in}X_{in}^{I} + (1 - \lambda_{in})X_{in}^{U}\right] = \bar{K}_i$$

Equilibrium Conditions

Asset Demand The demand for risky asset by the informed (I) and uninformed (U) traders as follows: Trader Problem

$$X_{in}^{I*} = \frac{E[z_{in} + p_i'|\theta] - (1 + r^F)p_i}{aVar[z_{in} + p_i'|\theta]} \qquad X_{id}^{I*} = \frac{E[z_{in} - z_{id} + p_i'|\theta] - (1 + r^F)p_i}{aVar[z_{in} - z_{id} + p_i'|\theta]}$$

$$X_{in}^{U*} = \frac{E[z_{in} + p_i'|p_i] - (1 + r^F)p_i}{aVar[z_{in} + p_i'|p_i]}, \qquad X_{id}^{U*} = \frac{E[z_{in} - z_{id} + p_i'|p_i] - (1 + r^F)p_i}{aVar[z_{in} - z_{id} + p_i'|p_i]},$$

Market clearing For stocks,

$$\gamma\left[\lambda_{id}X_{id}^I + (1-\lambda_{id})X_{id}^U\right] + (1-\gamma)\left[\lambda_{in}X_{in}^I + (1-\lambda_{in})X_{in}^U\right] = \bar{K}_i$$

Lemma

Information Acquisition *In an interior equilibrium,*

$$e^{ac_n(\lambda_{in})}\sqrt{\frac{Var[z_{in} + p_i'|\theta_i]}{Var[z_{in} + p_i'|p_i]}} = 1, \qquad e^{ac_d(\lambda_{id})}\sqrt{\frac{Var[z_{in} - z_{id} + p_i'|\theta_i]}{Var[z_{in} - z_{id} + p_i'|p_i]}} = 1$$

Equilibrium Conditions

Real Sector The representative consumer solves

$$H(s,K,k) = \max_{k'} \quad u\left(k(1+r(s,k)) - k'\right) + \beta \sum_{s'} q_{ss'} H(s',K',k')$$

$$s.t. \;\; K' = G(K)$$

The mutual fund allocates the capital according to:

$$K_i = \max\left\{\bar{K}_i \left(\frac{E[z_{in}|p] - r}{\xi}\right), 0\right\} \quad \forall i$$

Market clearing For capital,

$$\int_i K_i = K$$

Equilibrium

Definition

$H, r, k', G, \{K_i, r_i, X^I_{id}, X^U_{id}, X^I_{in}, X^U_{in}, \lambda_{id}, \lambda_{in}, \phi_{i0}, \phi_{id}, \phi_{in}, p_i\}_{i\in(0,1)}$ constitute a Linear Rational Expectations Equilibrium such that

1. $p_i = \phi_{i0} + \phi_{id}\theta_{id} + \phi_{in}\theta_{in}$, where ϕ_{i0}, ϕ_{id}, and ϕ_{in} clear stock markets.
2. $X^I_{id}, X^U_{id}, X^I_{in}$, and X^U_{in} solve the traders' problem.
3. r, K_i, r_i solve the mutual fund's problem and clear the capital market.
4. $\lambda_{id}, \lambda_{in}$ are consistent with traders' problem.
5. k' and H solve consumers' problem.
6. G is consistent with k'.

All the objects are a function of $s = \{Z, \gamma, ...\}$, the aggregate state!

- Changes in Z are TFP shocks.
- Changes in γ are changes in the trader composition.

Equilibrium Characterization

We define **Price Informativeness (PI)** for firm i as

$$PI_i = \frac{Var[z_{in}] - Var[z_{in}|p_i]}{Var[z_{in}] - Var[z_{in}|\theta_{in}]} \in [0, 1].$$

Equilibrium Characterization

We define **Price Informativeness (PI)** for firm i as

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Assumption

The parameters $\bar{K}_i, \bar{\theta}_{in}, \bar{\theta}_{id}, \sigma^2_{\varepsilon_n}$, $\sigma^2_{\varepsilon_d}$, $\sigma^2_{\theta n}$, and $\sigma^2_{\theta d}$ are firm invariant.

Under this assumption, λ, ϕ, and PI are firm invariant, and

$$PI = \frac{1}{1 + \frac{\sigma^2_{\theta_d}}{\sigma^2_{\theta_n}} \left(\frac{\phi_d}{\phi_n}\right)^2}.$$

Pricing Ratio Misallocation Back

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