Barwick et al. (2024)
"From Fog to Smog: The Value of Pollution Information"

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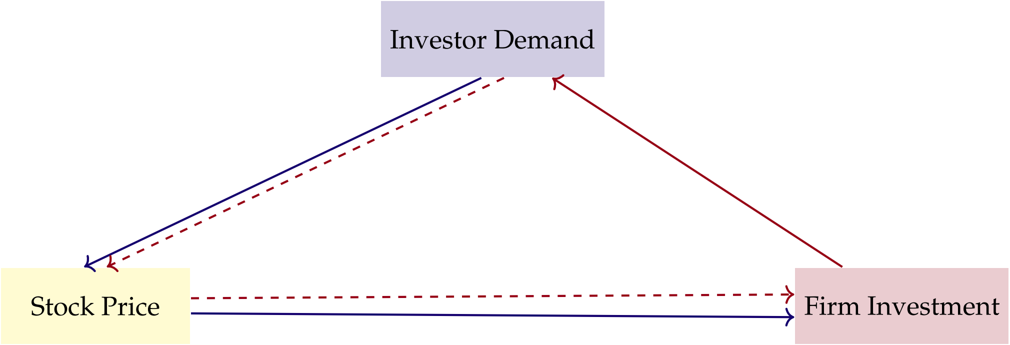
Feb 24, 2025

Introduction

- The effect of pollution information on avoidance behavior and health

$$Outcome_{ct} = \alpha Pollution_{ct} + \beta Pollution_{ct} \times Post_{ct} + X_{ct}^{'}\gamma + \varepsilon_{ct} \tag{1}$$

Introduction



- I quantify and decompose the impact of investor flows on firm's financing and investment.

Introduction

Challenges to quantify the real effect of investor flows

(1) Feedback effect

- firm's investment $\Rightarrow$ investor flows

(2) Measurement error

- Investor flows via index reconstitution, mutual fund flow, or dividend reinvestment.
  - Hypothetical investor flows
  - Active trades between investors
  - No impact on stock prices and firms (Wardlaw, 2020)

(3) Decomposition is hard!

Theory

Introduction

This paper addresses these challenges!

(1) Derive the equilibrium effect of investor flows via a demand-supply framework
- The equilibrium effects are linear functions of investor flows
- The real effects are identifiable via linear regressions

(2) Construct a granular instrumental variable to estimate the parameters

(3) Conduct counterfactual analysis for decomposition based on estimated parameters

Overview of Results

Using quarterly US data from 1999 to 2023, I find that

- Investor demand is key in determining firm's policies
  - \$1 flow induces \$.24 share issuance and \$.19 increase in firm's investment over two years
  - Investor preferences substantially diminish direct effects
- Two asymmetries
  - Stronger responses to investor inflows than outflows
  - Stronger responses during economic expansions than recessions
- Firms are key in determining stock prices
  - Firm's net issuance and changed fundamentals affect price dynamics

Literature

- This paper integrates both demand and production based models
  - Demand-Based AP: Koijen and Yogo (2019); Gabaix and Koijen (2023); Van der Beck (2024); Haddad et al. (2024)
  - Production-Based AP: Cochrane (1996); Zhang (2005); Belo (2010); Gomes and Schmid (2021)
  - The q theory of investment: Hayashi (1982); Erickson and Whited (2000); Liu et al. (2009); Bolton et al. (2011); Crouzet and Eberly (2023)

- This paper quantifies the real impact of investor demand
  - Mutual fund flows: Edmans et al. (2012); Khan et al. (2012); Hau and Lai (2013); Norli et al. (2015); Bennett et al. (2020); Xu and Kim (2022)
  - Dividend reinvestment: Hartzmark and Solomon (2024); Schmickler and Tremacoldi-Rossi (2023); Van der Beck (2024)
  - Index reconstitution: Chang et al. (2015); Chaudhry (2024); Sammon and Shim (2024); Tamburelli (2024)

Model: Setup

- N firms: $n = 1, ..., N$
  - Total shares issued $Q_t^F(n)$: normalized to 1 at the beginning of each quarter
  - Investment $X_t(n)$
- I investors: $i = 1, ..., I$
  - The investor i's ownership shares of stocks are $\boldsymbol{Q}_{i,t} = \boldsymbol{Q}_{i,t}(\boldsymbol{P}_t, \boldsymbol{X}_t, \boldsymbol{V}_t)$

Model: Investor Side

- Market clearing condition: $Q_t^F = \sum_{i=1}^{I} Q_{i,t}$
  - Firms don't issue shares: $Q_t^F = \sum_{i=1}^{I} Q_{i,t} = 1$
  - Firms net issue shares: $Q_t^F = \sum_{i=1}^{I} Q_{i,t} > 1$
  - Firms net repurchase shares: $Q_t^F = \sum_{i=1}^{I} Q_{i,t} < 1$

Model: Investor Side

- The aggregate demand elasticity to asset prices is $\boldsymbol{\zeta}_t^P$.

$$\boldsymbol{\zeta}_t^P = \sum_{i=1}^{I} \operatorname{diag}(\boldsymbol{Q}_{i,t}) \boldsymbol{\zeta}_{i,t}^P \tag{2}$$

where $\zeta_{i,t}^P(n,n) = -\frac{\partial \ln(Q_{i,t}(n))}{\partial \ln(P_t(n))}$ and $\zeta_{i,t}^P(n,m) = -\frac{\partial \ln(Q_{i,t}(n))}{\partial \ln(P_t(m))}$.

- The aggregate demand elasticity to firm characteristics is $\boldsymbol{\zeta}_t^X$.

$$\boldsymbol{\zeta}_t^X = \sum_{i=1}^{I} \operatorname{diag}(\boldsymbol{Q}_{i,t}) \boldsymbol{\zeta}_{i,t}^X \tag{3}$$

where $\zeta_{i,t}^X(n) = \frac{\partial \ln(Q_{i,t}(n))}{\partial \ln(X_t(n))}$ and $\zeta_{i,t}^X(n,m) = \frac{\partial \ln(Q_{i,t}(n))}{\partial \ln(X_t(m))}$.

Model: Investor Side

- Assume an exogenous shock $\Delta \boldsymbol{V}_t$
- The impact of the demand shock (1st Order Taylor Approximation)
  - Firm level demand shock: $\Delta \boldsymbol{D}_t \stackrel{\text{def}}{=} \left(\sum_{i=1}^{I} \frac{\partial \boldsymbol{Q}_{i,t}}{\partial \boldsymbol{V}_t} \right) \Delta \boldsymbol{V}_t$
  - Asset price: $\Delta \boldsymbol{P}_t = \frac{\partial \boldsymbol{P}_t}{\partial \boldsymbol{V}_t} \Delta \boldsymbol{V}_t$
  - Share issuance: $\Delta \boldsymbol{Q}_t^F = \frac{\partial \boldsymbol{Q}_t^F}{\partial \boldsymbol{V}_t} \Delta \boldsymbol{V}_t$
  - Firm's real investment: $\Delta \boldsymbol{X}_t = \frac{\partial \boldsymbol{X}_t}{\partial \boldsymbol{V}_t} \Delta \boldsymbol{V}_t$

Model: Investor Side

Lemma 1

The equilibrium effects of investor flows satisfy

$$\Delta \boldsymbol{D}_t = \zeta_t^P \underbrace{\operatorname{diag}(\boldsymbol{P}_t)^{-1} \Delta \boldsymbol{P}_t}_{\text{Price Effect}} + \underbrace{\Delta \boldsymbol{Q}_t^F}_{\text{Financing Effect}} - \zeta_t^X \underbrace{\operatorname{diag}(\boldsymbol{X}_t)^{-1} \Delta \boldsymbol{X}_t}_{\text{Investment Effect}} \tag{4}$$

where ζ_t^P and ζ_t^X are demand elasticities.

- If no financing and investment effects, the price effect $\operatorname{diag}(\boldsymbol{P}_t)^{-1} \Delta \boldsymbol{P}_t = (\zeta_t^P)^{-1} \Delta \boldsymbol{D}_t$.
  - Price effect by estimating ζ_t^P (Gabaix and Koijen, 2023; Van der Beck, 2024; Haddad et al., 2024)
- Evidence shows non-zero financing and investment effects

Model: Firm Side

(1) Q-theory of investment

- Hayashi (1982); Liu et al. (2009); Bolton et al. (2011)
- Assume CRS and quadratic adjustment cost
- Investment is linear in Tobin's q: $\text{diag}(\boldsymbol{X}_t)^{-1}\Delta\boldsymbol{X}_t = \boldsymbol{\Lambda}^X\text{diag}(\boldsymbol{P}_t)^{-1}\Delta\boldsymbol{P}_t$

(2) Information role of stock prices

- Bond et al. (2012); Foucault and Fresard (2014); Dessaint et al. (2019)
- Assume price as a noisy indicator of MPK: $\boldsymbol{P}_t = \boldsymbol{MPK}_t + \boldsymbol{u}_t$
- Investment is linear in stock prices: $\text{diag}(\boldsymbol{X}_t)^{-1}\Delta\boldsymbol{X}_t = \boldsymbol{\Lambda}^X\text{diag}(\boldsymbol{P}_t)^{-1}\Delta\boldsymbol{P}_t$

$\Rightarrow$ Total shares and investment are linear functions of stock prices

- $\Delta\boldsymbol{Q}_t^F = \boldsymbol{\Lambda}^F\text{diag}(\boldsymbol{P}_t)^{-1}\Delta\boldsymbol{P}_t$ and $\text{diag}(\boldsymbol{X}_t)^{-1}\Delta\boldsymbol{X}_t = \boldsymbol{\Lambda}^X\text{diag}(\boldsymbol{P}_t)^{-1}\Delta\boldsymbol{P}_t$

Model: Equilibrium

Proposition 1

The equilibrium effects of investor flows on firm's share issuance and investment are

$$\Delta Q_t^F = \underbrace{\boldsymbol{\Lambda}_t^F(\zeta_t^P + \boldsymbol{\Lambda}_t^F - \zeta_t^X \boldsymbol{\Lambda}_t^X)^{-1}}_{\stackrel{\text{def}}{=} M_t^F} \Delta D_t \tag{5}$$

$$\text{diag}(X_t)^{-1} \Delta X_t = \underbrace{\boldsymbol{\Lambda}_t^X(\zeta_t^P + \boldsymbol{\Lambda}_t^F - \zeta_t^X \boldsymbol{\Lambda}_t^X)^{-1}}_{\stackrel{\text{def}}{=} M_t^X} \Delta D_t \tag{6}$$

Challenges Identification

Model: No Feedback Effects

The direct impact of investor flows ($\zeta_t^X = 0$):

$$\Delta \boldsymbol{Q}_t^F = \boldsymbol{\Lambda}_t^F (\boldsymbol{\zeta}_t^P + \boldsymbol{\Lambda}_t^F)^{-1} \Delta \boldsymbol{D}_t \tag{7}$$

$$\operatorname{diag}(\boldsymbol{X}_t)^{-1} \Delta \boldsymbol{X}_t = \boldsymbol{\Lambda}_t^X (\boldsymbol{\zeta}_t^P + \boldsymbol{\Lambda}_t^F)^{-1} \Delta \boldsymbol{D}_t \tag{8}$$

How much the feedback effect diminishes the direct effect:

$$\Delta^X = \frac{(\boldsymbol{\zeta}_t^P + \boldsymbol{\Lambda}_t^F - \boldsymbol{\zeta}_t^X \boldsymbol{\Lambda}_t^X)^{-1}}{(\boldsymbol{\zeta}_t^P + \boldsymbol{\Lambda}_t^F)^{-1}} - 1. \tag{9}$$

Data and Sample

Data

- Quarterly firm data: Compustat
- Stock data: CRSP
- Quarterly institutional holdings: Factset Ownership v5

Sample

- Industrial firms: exclude financial and utilities firms
- Common stocks listed in NYSE, AMEX, and NASDAQ
- 1999Q1 – 2023Q4

Identification

The identification strategy is based on Gabaix and Koijen (2024).

- The demand-supply system to be estimated:

$$\Delta q_{i,t}(n) = -\zeta^P(n)R_t(n) + \zeta^X(n)\Delta x_t(n) + \gamma_i(n)\eta_t(n) + \varepsilon_{i,t}(n) \tag{10}$$

$$\Delta Q_t^F(n) = \lambda^F(n)R_t(n) + \mu_t(n) \tag{11}$$

$$\Delta x_t(n) = \lambda^X(n)R_t(n) + \nu_t(n) \tag{12}$$

- Assumptions
  (1) Exogenous demand shocks: $\varepsilon_{i,t}(n) \perp \eta_t(n), \mu_t(n), \nu_t(n)$
  (2) No spillover effects
  (3) Homogenous demand elasticity: $\zeta^P_{i,t}(n) = \zeta^P(n)$ and $\zeta^X_{i,t}(n) = \zeta^X(n)$
  (4) Homogenous supply elasticity: $\lambda^F_t(n) = \lambda^F(n)$ and $\lambda^X_t(n) = \lambda^X(n)$

Identification

- Define three weights: $S_{i,t}(n) = \frac{Q_{i,t-1}(n)}{\sum_i Q_{i,t-1}(n)}$, $E_i(n)$, and $S_{i,t}(n) - E_i(n)$
- The aggregate demand functions are

$$
\begin{aligned}
S_{i,t}(n): \quad & \widetilde{\Delta q_t(n)} = -\zeta^P(n) R_t(n) + \zeta^X(n)\Delta x_t(n) + \widetilde{\gamma(n)}\eta_t(n) + \widetilde{\varepsilon_t(n)} && (13)\\
E_i(n): \quad & \overline{\Delta q_t(n)} = -\zeta^P(n) R_t(n) + \zeta^X(n)\Delta x_t(n) + \overline{\gamma(n)}\eta_t(n) + \overline{\varepsilon_t(n)} && (14)\\
S_{i,t}(n) - E_i(n): \quad & \widehat{\Delta q_t(n)} = \widehat{\gamma(n)}\eta_t(n) + \widehat{\varepsilon_t(n)}. && (15)
\end{aligned}
$$

- The demand shock is $D_t(n) = \widetilde{\varepsilon_t(n)}$, but unidentifiable.
  - $z_t(n) \overset{\text{def}}{=} \widehat{\varepsilon_t(n)}$ is identified!
  - $z_t(n)$ is called the granular instrumental variable (GIV). (Gabaix and Koijen, 2024)

- $\Delta Q_t^F(n) = \widetilde{\Delta q_t(n)}$

Identification

Proposition 2

The equilibrium effects of investor flows are identified from regressions

$$\Delta Q_t^F(n) = M^F(n) z_t(n) + \xi_t(n) \tag{16}$$

$$\Delta x_t(n) = M^X(n) z_t(n) + v_t(n) \tag{17}$$

where

$$M^F(n) = \lambda^F(n)[\zeta^P(n) + \lambda^F(n) - \zeta^X(n)\lambda^X(n)]^{-1} \tag{18}$$

$$M^X(n) = \lambda^X(n)[\zeta^P(n) + \lambda^F(n) - \zeta^X(n)\lambda^X(n)]^{-1} \tag{19}$$

Theory

Identification

Estimation Procedure

- Aggregate institutional holdings to nine: brokers, hedge funds, long term investors, private banking, small active, large active, small passive, large passive, and households.
- Compute the weights $S_{i,t}(n)$ and $E_i(n)$: $S_{i,t}(n) = \frac{Q_{i,t-1}(n)}{\sum_i Q_{i,t-1}(n)}$ and $E_i(n) = \frac{1/\sigma_i^2(n)}{\sum_i 1/\sigma_i^2(n)}$
- Follow Gabaix and Koijen (2024) to construct $z_t(n)$
  - $\eta_t = (\text{GDP Growth}_t, \eta_{1t}(n), \eta_{2t}(n))$
  - $(\eta_{1t}(n), \eta_{2t}(n))$ by PCA
- Run the two regressions

$$\Delta Q_t^F(n) = M^F z_t(n) + \alpha^F(n) + \gamma^F(n)\eta_t(n) + \xi_t(n) \tag{20}$$

$$\Delta x_t(n) = M^X z_t(n) + \alpha^X(n) + \gamma^X(n)\eta_t(n) + \upsilon_t(n) \tag{21}$$

GIV $z_t(n)$ Validity

- Main results are stable for GIVs constructed by different factors
- The GIVs are unrelated to firm characteristics in previous quarters
- The GIVs should capture the *hypothetical* demand shocks.
  (1) Demand shocks from mutual fund flows positively predict $z_t(n)$.
  Method Result
  (2) Demand shocks by dividend reinvestment positively predict $z_t(n)$.
  Method Result
  (3) $z_t(n)$ captures both hypothetical demand shocks at the same time.
  Result

Long-term Issuance

$$\sum_{\tau=0}^{8} \Delta Q^F_{t+\tau}(n) = M^F z_t(n) + \alpha^F(n) + \gamma^F(n)\eta_t(n) + \xi_t(n) \tag{22}$$

Long-term Growth of Real Investment

$$\sum_{\tau=0}^{8} \Delta \frac{I_{t+\tau}}{K_{t+\tau-1}}(n) = M^X z_t(n) + \alpha^X(n) + \gamma^X(n)\eta_t(n) + \upsilon_t(n) \tag{23}$$

	(1)	(2)	(3)
$z_t(n)$	0.184***	0.188***	0.188***
	(0.057)	(0.058)	(0.058)
Obs.	38172	38172	38172
R^2	0.461	0.463	0.463
Firm FEs	Yes	Yes	Yes
Firm×GDP Growth	Yes	Yes	Yes
Firm×η_1		Yes	Yes
Firm×η_2			Yes

Heterogeneity Analysis

- Investor Inflows vs. Outflows
  - Almost zero net buybacks for outflows
    Financing
  - Dis-investment is 50% for outflows of investment for inflows
    Investment

- Economic Expansions vs. Recessions
  - Net issuance is 56% during recessions of that during expansions
    Financing
  - Investment responses are 50% during recessions of that during expansions
    Investment

The Effect of Investor Preferences

How much the feedback effect diminishes the direct effect:

$$\Delta^X = \frac{(\boldsymbol{\zeta}_t^P + \boldsymbol{\Lambda}_t^F - \boldsymbol{\zeta}_t^X \boldsymbol{\Lambda}_t^X)^{-1}}{(\boldsymbol{\zeta}_t^P + \boldsymbol{\Lambda}_t^F)^{-1}} - 1. \tag{24}$$

(1) $(\zeta_t^P + \mathbf{\Lambda}_t^F - \zeta_t^X \mathbf{\Lambda}_t^X)^{-1}$: identify by $R_t(n)$ on $z_t(n)$

(2) $\mathbf{\Lambda}_t^F$: identify by $\mathbb{E}\left[z_t(n)[\Delta Q_t^F(n) - \lambda^F(n) R_t(n)]\right] = 0$

(3) ζ_t^P: identify by instruments in DSAP such as investment mandate of institutions

The Effect of Investor Preferences

The price impact of investor flows is

$$\mathrm{diag}(P_t)^{-1}\Delta P_t = (\boldsymbol{\zeta}_t^P + \boldsymbol{\Lambda}_t^F - \boldsymbol{\zeta}_t^X \boldsymbol{\Lambda}_t^X)^{-1} \Delta D_t \tag{25}$$

(1) $(\boldsymbol{\zeta}_t^P + \boldsymbol{\Lambda}_t^F - \boldsymbol{\zeta}_t^X \boldsymbol{\Lambda}_t^X)^{-1} = 0.266$

(2) $\boldsymbol{\Lambda}_t^F = 0.236/0.266 = 0.887$

The Effect of Investor Preferences

Reverse Question: Firm's Role in the Stock Market

The price impact of investor flows

$$\mathrm{diag}(P_t)^{-1}\Delta P_t = (\boldsymbol{\zeta}_t^P + \boldsymbol{\Lambda}_t^F - \boldsymbol{\zeta}_t^X \boldsymbol{\Lambda}_t^X)^{-1}\Delta D_t \tag{26}$$

The price impact without fundamental responses ($\boldsymbol{\Lambda}_t^X = 0$)

$$\mathrm{diag}(P_t)^{-1}\Delta P_t = (\boldsymbol{\zeta}_t^P + \boldsymbol{\Lambda}_t^F)^{-1}\Delta D_t \tag{27}$$

The price impact without firm responses ($\boldsymbol{\Lambda}_t^F = \boldsymbol{\Lambda}_t^X = 0$)

$$\mathrm{diag}(P_t)^{-1}\Delta P_t = (\boldsymbol{\zeta}_t^P)^{-1}\Delta D_t \tag{28}$$

Reverse Question: Firm's Role in the Stock Market

Benchmark price impact is 0.266.

Conclusion

- This paper develops a demand-supply framework to study the multipliers of investor flows
  - The multipliers depend on both demand and supply side elasticities
  - The multipliers can be decomposed as direct and feedback effects
- The multipliers can be identified using GIV
  - 1% investor flow leads to .24% share issuance and 0.19% growth of real investment
  - The effect to outflows and during recessions is half of that inflows and economic expansions
  - The direct effect is mostly diminished by the feedback effect
- The framework also provides a novel tool to evaluate how a firm shapes financial markets
  - Share supply reduces the price impact of investor flows by 80%
  - Firm's investment reduces the price impact by additional 10%

GIV $z_t(n)$ Validity: Mutual Fund Flows

- The *hypothetical* demand shocks are defined as Lou (2012).
  - Keep only $\frac{F_{i,t}}{TNA_{i,t-1}} \geqslant 5\%$ mutual fund flows
  - Firm level demand shock is

$$MFFlow_t(n) = \sum_{i=1}^{I} Q_{i,t-1}(n) \frac{F_{i,t}}{TNA_{i,t-1}} \tag{29}$$

Back

GIV $z_t(n)$ Validity: Mutual Fund Flows

$$z_t(n) = \beta MFFlow_t(n) + FEs + \epsilon_t(n) \tag{30}$$

Back

GIV $z_t(n)$ Validity: Dividend Reinvestment

- The *hypothetical* demand shocks are defined as Schmickler and Tremacoldi-Rossi (2023).
  - Investor flow to n due to dividend reinvestment is $\Delta q_{i,t}(n) = \frac{\sum_{m \neq n} Div_{i,t}(m)}{AUM_{i,t-1}}$
  - Firm level demand shock is

$$DivxFlow_t(n) = \frac{\sum_{i=1}^{I} Q_{i,t-1}(n) \Delta q_{i,t}(n)}{Q_{t-1}^{F}(n)} \tag{31}$$

Back

GIV $z_t(n)$ Validity: Dividend Reinvestment

$$z_t(n) = \beta DivxFlow_t(n) + FEs + \epsilon_t(n) \tag{32}$$

	(1)	(2)	(3)
DivxFlow	9.007***	16.002***	16.002***
	(1.464)	(1.904)	(2.124)
Obs.	399635	399635	399635
R^2	0.004	0.012	0.012
Quarter FEs		Yes	Yes
Quarter Clustering	Yes	Yes	Yes
Firm Clustering			Yes
Obs.	399635	399635	399635
R^2	0.0041	0.0117	0.0117

Back

GIV $z_t(n)$ Validity: Mutual Fund Flows vs Dividend Reinvestment

$$z_t(n) = \beta_1 MFFlow_t(n) + \beta_2 DivxFlow_t(n) + FEs + \epsilon_t(n) \tag{33}$$

Back

Share Issuance: Inflows versus Outflows

For 1% investor flows,

- 0.85% net issuance to inflows
- 0.01% net buyback in outflows

$\Rightarrow$ All effects from inflows

Back

Real Investment: Inflows versus Outflows

For 1% investor flows,

- 0.30% investment growth to inflows
- 0.15% dis-investment growth in outflows

$\Rightarrow$ 50% of the effect

Back

Share Issuance during Economic Recessions

For 1% investor flows,

- 0.25% share issuance in expansions
- 0.14% share issuance in recessions

$\Rightarrow$ 56% of the effect in recessions

Back

Real Investment during Economic Recessions

	(1)	(2)	(3)
$z_t(n)$	0.187***	0.183***	0.183***
	(0.044)	(0.045)	(0.045)
Recession	-0.300***	-0.297***	-0.297***
	(0.096)	(0.095)	(0.095)
$z_t(n) \times$Recession	-0.093*	-0.095*	-0.095*
	(0.047)	(0.050)	(0.050)
Obs.	38172	38172	38172
R^2	0.123	0.131	0.131
Firm FEs	Yes	Yes	Yes
Firm$\times\eta_1$		Yes	Yes
Firm$\times\eta_2$			Yes

For 1% investor flows,

- 0.18% investment growth in expansions
- 0.09% investment growth in recessions

$\Rightarrow$ 50% of the effect in recessions

Back

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