Investor horizon and information choice: Do long-term investors matter for price informativeness?

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Abstract

I document the distinct and time-varying roles of long-term and short-term investors in improving stock market informational efficiency. Long-term investors' contribution to price informativeness increases over time—especially after 2004 and among firms with low information quality—whereas short-term investors' contribution declines. Using the Volcker Rule as an exogenous shock to long-term investors' exits, I show that the post-implementation exit of long-term investors with significant ownership stakes (greater than 5%) is associated with a reduction in price informativeness. I construct a heterogeneous agent model to shed light on the mechanism by which long-term investors allocate relatively more resources to future asset fundamental value, and short-term investors allocate relatively more resources to current demand signal. The share of long-term investors is positively associated with the price informativeness.

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1 Introduction

Institutional investors are considered sophisticated investors and have been playing an increasingly important role in shaping asset prices and market efficiency. With the advancement of financial technology, the trading strategies have shifted from traditional pure fundamental trading to a mix of fundamental and demand-based trading (Farboodi and Veldkamp (2020). The average trading horizons have decreased from three years to less than one year over the past 40 years (Heugh and Fox (2018)). Investors with different investment horizons tend to emphasize different trading strategies (Binsbergen et al. (2024). Specifically, long-term investors continue to rely primarily on traditional fundamental trading strategies, whereas short-term investors increasingly employ quantitative or demand-based trading strategies. This study investigates the differential effects of long-term and short-term investors on price informativeness over the past four decades, in the context of evolving trading strategies.

Price informativeness—a key dimension of stock market efficiency—measures the extent to which stock prices reflect fundamental information. Recent shifts in institutional trading have attracted considerable attention for their implications on market efficiency. On average, the price of stocks with high institutional ownership contains more information about future earnings than stocks with low institutional ownership(Bai et al. (2016)). However, aggregate institutional ownership does not fully explain the time-series variation across firms of different sizes. Although total institutional ownership has increased across all firms, the evolution of price informativeness differs markedly by firm size: it has risen for large firms but declined for small firms(Farboodi et al. (2022)). These patterns imply heterogeneity among investors in their contribution to firms' price informativeness over time. This study examines the differentiated roles of long-term and short-term investors on price informativeness over time and documents that long-term investors play an increasingly important role in improving price informativeness over the past four decades. Specifically, long-term investors' effect on price informativeness is larger than that of short-term investors' post 2004, when quantitative trading strategies started to gain prominence. I provide micro-level evidence that long-term investors contribute to improving the stock market efficiency through fundamental research, therefore, incorporating fundamental information into the stock price.

This study documents the growing importance of long-term investors in enhancing the informational efficiency of the stock market. On average, a higher share of long-term investors is associated with greater price informativeness. Moreover, the impact of long-term investors on price informativeness has strengthened over the past four decades. Cross-sectionally, this effect varies across stocks with different information environments. In particular, it is strongest for firms with low information quality—specifically, small-cap stocks—highlighting the growing role of long-term investors in generating and incorporating fundamental information into stock prices. I use the Volcker Rule as an exogenous shock on long-term investor share, and I find that following the implementation of the Volcker Rule, firms that experience the exit of long-term investors holding significant stakes ($> 5\%$) exhibit reduced price informativeness over the next three years.

Built on the information choice model of Farboodi and Veldkamp (2020), I construct a heterogeneous agent model to consider when investors have different investment horizons, specifically, long-term investors trade infrequently and short-term investors trade frequently (Duffie (2010)), how they allocate the information resources in terms of acquiring asset fundamental signal and acquiring asset demand signal, and how agents' information choices contribute to the price informativeness. The model predicts that long-term investors invest relatively more in future fundamental signals than short-term investors do, and short-term investors invest relatively more in current noisy demand signals than long-term investors do. The price informativeness increases with the share of long-term investors. This model sheds light on the mechanism by which the information production role of long-term investors through fundamental research became especially important after 2004, when short-term investors increasingly engaged in demand-driven trading.

This study contributes to the information role of institutional investors on stock market efficiency. The price informativeness has increased over the past thirty years for S&P 500 firms (Bai et al. (2016)), but decreased for non-S&P 500 firms, and the differentiated trend between S&P 500 firms and non-S&P 500 firms mainly comes from the size composition effects, where investors shift attention from small firms to large firms over time(Farboodi et al. (2022)). Kacperczyk et al. (2024) study the distributional effects of asset ownership on price informativeness in a general equilibrium model. They show that the price informativeness is non-monotonic in the oligopolists' aggregate size, decreasing in the sector's concentration and in the size of the passive sector. Sammon (2021) studies how passive ownership affects the incorporation of information into stock prices and documents that the rise in passive ownership over the last 30 years has caused the amount of information incorporated into prices ahead of earnings announcements to decline by one-fourth of its whole-sample mean. Xiong et al. (2025) supplements empirical evidence that institutional concentration is negatively associated with price informativeness because active investors reallocate their attention across different assets and trade more cautiously when active ownership becomes more concentrated. Unlike Xiong et al. (2025), which focuses on institutional concentration, this study highlights the growing role of long-term investors in enhancing price informativeness through active fundamental information production, particularly as some market participants' trading strategies evolve from purely fundamental-based to a combination of fundamental- and demand-based approaches.

This study contributes to the stock market efficiency implications of technology advancements. Farboodi and Veldkamp (2020) document that an unbiased technological change can explain a market-wide shift in data collection and trading strategies shift from fundamental trading to demand-based trading, and the price informativeness increases when the trading strategies shift from fundamental trading to a mix of fundamental and demand trading because average investors become more informed when investors extract demand-based information. Weller (2017) documents that algorithm trading that improves price efficiency with respect to existing information deters information acquisition and diminishes price efficiency with respect to acquirable information. Investors with different horizons are unevenly affected by technology-induced shifts in trading strategies. Li and Yu (2021) document that the link between corporate bond credit spreads and secondary market illiquidity in the cross section has grown stronger since 2005 as short-term investors increase trading activities in the secondary market, amplifying the effect of secondary market frictions on prices. My findings—that long-term investors' role in enhancing stock market efficiency increases over time, while the contribution of short-term investors declines—are consistent in spirit with the investor-composition–driven credit market frictions documented in Li and Yu (2021).

This study contributes to the literature on learning in financial markets by examining how long-term and short-term investors contribute differently to price informativeness when investors learn about both fundamental signals and noisy demand signals. Fundamental uncertainty and noisy demand both move stock prices. Investors become informed either by acquiring information about the fundamental asset or by acquiring information about the noisy demand. With only fundamental uncertainty of risky assets, fundamental information is a strategic substitute (Grossman and Stiglitz (1980)). The existence of two information sources, fundamental uncertainty and noisy demand, can lead to information acquisition being complementary (Ganguli and Yang (2009), Manzano and Vives (2011)). I combine investors' infrequent trading behavior (Duffie (2010),Chien et al. (2012),Biais et al. (1999)) with investors' information choices (Farboodi and Veldkamp (2020)) and examine how investors' information resources are allocated between fundamental signals and demand signals, and how the signal allocation consequently determines the price informativeness.

Finally, this study highlights the importance of investor heterogeneity, specifically in terms of investment horizons. Yan and Zhang (2007) show that the positive relation between institutional ownership and future stock returns documented in Gompers and Metrick (2001) is driven by short-term institutions. Furthermore, short-term institutions' trading forecasts future returns, and long-term investors do not predict short-term and long-term returns. The finding that short-term investors had a greater impact on stock market efficiency before 2004 is consistent with evidence that short-term investors were more informed than long-term investors, as documented in Yan and Zhang (2007), whose sample period ends in 2003. Investor horizon has been studied in other contexts. For example, Duffie (2010) studies the asset price dynamics caused by the slow movement of investment capital to trading opportunities and documents that the pattern of price responses to supply or demand shocks typically involves a sharp reaction to the shock and a subsequent and more extended reversal. Chien et al. (2012) examines whether the failure of unsophisticated investors to rebalance their portfolios can help to explain the countercyclical volatility of aggregate risk compensation in financial markets. Binsbergen et al. (2024) examines horizon-specific investment ideas, where short-term ideas are less scalable while holdings of low-turnover funds add value only over longer horizons. This study examines the differentiated roles of long-term investors and short-term investors in stock market efficiency as trading strategies evolve.

2 Theoretical framework and predictions

Fundamental uncertainty and noisy demand both move stock prices. Investors become informed either by acquiring information about the fundamental asset or by acquiring information about the noisy demand. With only fundamental uncertainty of risky assets, fundamental information is a strategic substitute (Grossman and Stiglitz (1980)). The existence of two information sources, fundamental uncertainty and noisy demand, can lead to information acquisition being complementary (Ganguli and Yang (2009), Manzano and Vives (2011)).

The price informativeness is affected by both the fundamental information acquisition and the noisy demand information acquisition. I present a model that builds on Farboodi and Veldkamp (2020) while introducing heterogeneous agents with different investment horizons. Specifically, long-term investors trade infrequently and short-term investors trade infrequently (Duffie (2010),Chien et al. (2012)). Following the setting in Farboodi and Veldkamp (2020), I illustrate how investors' trading horizons affect agents' information choices and, consequently, the price informativeness. This section provides a summary of the theoretical framework and develops the model predictions. Detailed model descriptions are in Appendix A.

The model is a three-period dynamic model featuring one risky asset and one risk-free asset, two types of investors, short-term (ST) and long-term (LT), a unit mass of noise traders, and three types of information choice: noise traders' current demand signal precision at $t = 0$, future fundamental information precision at $t = 1$, and future fundamental information precision at $t = 2$. Current demand signals at $t = 0$ help investors extract the fundamental information from price and determine the expected value of the risky asset; future fundamental signals at $t = 1$ and future fundamental signals at $t = 2$ help investors determine the future payoffs of the risky asset. The portfolio choices and information choices made by short-term and long-term investors are summarized in the following table:

	Time	0	1	2
	Price	p_0	p_1	
Portfolio choice	ST	Trade (q_{i0}^{ST})	Liquidate($-q_{i0}^{ST}$) Trade (q_{i1}^{ST})	Liquidate ($-q_{i1}^{ST}$)
	LT	Trade (q_{i0}^{ST})	Hold	Liquidate ($-q_{i0}^{LT}$)
Information choice	ST	$\Omega_{xi00}^{ST}, \Omega_{fi01}^{ST}, \Omega_{fi02}^{ST}$	$\Omega_{xi11}^{ST}, \Omega_{fi12}^{ST}$	
	LT	$\Omega_{xi00}^{LT}, \Omega_{fi01}^{LT}, \Omega_{fi02}^{LT}$		
Demand shock	noise trader	x_0	x_1	
Dividend signal		y_0	y_1	y_2

Future fundamental signals at $t = 1$ and at $t = 2$ are both valuable because long-term investors only trade at $t = 0$; therefore, long-term investors would like to incorporate the future information at $t = 1$ and at $t = 2$ while making the portfolio choice at $t = 0$. Short-term and long-term investors both live for three periods. Short-term investors make frequent portfolio choices at periods $t = 0$ and $t = 1$. Long-term investors make infrequent portfolio choices, only at $t = 0$. Both short-term and long-term investors have the same flexibility in allocating information choices across periods. But because long-term investors do not trade at $t = 1$, it is not optimal for them to allocate information resources at $t = 1$. Therefore, long-term investors will only make information choices at $t = 0$. The primary outcome variables include the information choices by short-term and long-term investors, and the price informativeness.

2.1 Prediction on information choices and price informativeness

I derive the theoretical prediction on information choices and price informativeness.

1. Prediction on information choices
   - Long-term investors allocate relatively more resources to future-period fundamental signals precision than short-term investors do (Panel A in Figure 7).
   - Short-term investors allocate relatively more resources to current demand signal precision than long-term investors do(Panel B in Figure 7).
2. Prediction on price informativeness
   - Future period price informativeness increases with the share of long-term investors (Figure 8).

3 Data and methodology

3.1 Data

The first is the Thomson Reuters Institutional Holdings (13F). Form 13F provides position-level disclosure of all institutional investment managers with more than 100 million in assets under management with relevant long US holdings. The second is the CRSP stock price and Compustat accounting data. Analyst coverage is from I/B/E/S. Evidence of institutional investors' information acquisition activity is obtained by matching the log file from the SEC's Electronic Data Gathering, Analysis, and Retrieval (EDGAR) system and the IP addresses from the American Registry for Internet Numbers (ARIN).

3.1.1 Measure of long-term and short-term investors

Long-term and short-term institutions are classified as per the institutional horizon categorization in Bushee (2001):

- **Short-term:**
  - **Transient (TRA)**: Transient institutions are characterized as having high portfolio turnover and highly diversified portfolio holdings.
- **Long-term:**
  - **Quasi-indexers (QXI)**: Quasi-indexers are characterized by low turnover, but they tend to have diversified holdings, consistent with a passive, buy-and-hold strategy of investing portfolio funds in a broad set of firms.
  - **Dedicated (DED)**: Dedicated institutions are characterized by large average investments in portfolio firms and extremely low turnover, consistent with a "relationship investing" role and a commitment to provide long-term patient capital.

Table 1 summarizes the stock characteristics preferred by short-term transilient investors, long-term quasi-index investors, and long-term dedicated investors. On average, the short-term transient investors hold around 14% S&P 500 stocks, and 12% non-S&P 500 stocks. The long-term dedicated investors hold around 12% S&P 500 stocks, and 10% non-S&P 500 stocks. The long-term quasi-indexed investors hold around 40% S&P 500 stocks, and 20% non-S&P 500 stocks. Quasi-index institutional investors have the most different stock preferences on S&P 500 and non-S&P 500 stocks. Long-term dedicated investors tend to prefer stocks with smaller market capitalization. Short-term transient investors and long-term quasi-indexer investors prefer stocks with similar characteristics. Long-term quasi-indexer investors have the highest share for both S&P 500 and non-S&P 500 stocks.

A pure passive index fund is considered long-term but plays a less important role in terms of information production. I follow Appel et al. (2016) to identify pure passive funds from the mutual fund name and to exclude the pure index fund positions from the TR13F institutional investors' holdings, where the mutual fund information is obtained from the Mutual Fund S12 holdings database.

To provide evidence on the information production role of long-term investors, I map the financial institutions' IP addresses with the log files from the SEC's Electronic Data Gathering, Analysis, and Retrieval (EDGAR) system and track the footprint of institutional investors. The financial institutions' IP addresses are identified through the American Registry for Internet Numbers (ARIN). ARIN[1] is a nonprofit, member-based organization that administers IP addresses in support of the operation and growth of the Internet.

[1] https://www.arin.net/

3.1.2 Measure of price informativeness

The primary measure of price informativeness is based on Bai et al. (2016), which is estimated with the following cross-sectional regression:

$$\frac{E_{i,t+h}}{A_{i,t}} = a_{t,h} + b_{t,h} * log(\frac{M_{i,t}}{A_{i,t}}) + c_{t,h} * (\frac{E_{i,t}}{A_{i,t}}) + d^s_{t,h} * I^s_{i,t} + \epsilon_{i,t,h} \tag{1}$$

Bai et al. (2016) run the cross-sectional regression every year. The price informativeness is estimated at the market level, where the market-level forecast price efficiency in year t at prediction horizon h is calculated as follows:

$$b_{t,h} * \sigma_t(log(M_{i,t}/A_{i,t}))$$

3.2 Empirical methodology

The price informativeness measure estimated in Bai et al. (2016) is at the market level. To study the heterogeneous investors' role in affecting cross-sectional firms' price informativeness, I instead estimate the pooled regression using firm-level data at the annual frequency. This pooled regression methodology aligns with Xiong et al. (2025), which studies the role of institutional ownership concentration on price informativeness, and Farboodi et al. (2022), which studies the size composition effect on price informativeness. The regression model is as follows:

$$\begin{aligned}\frac{E_{i,t+h}}{A_{i,t}} = a_h &+ b1_h * \log\left(\frac{M_{i,t}}{A_{i,t}}\right) + b2^{ST}_h * shareST_{i,t} + b2^{LT}_h * shareLT_{i,t} \\ &+ b3^{ST}_h * \log\left(\frac{M_{i,t}}{A_{i,t}}\right) * shareST_{i,t} + b3^{LT}_h * \log\left(\frac{M_{i,t}}{A_{i,t}}\right) * shareLT_{i,t} \\ &+ c_h * \left(\frac{E_{i,t}}{A_{i,t}}\right) + d_h * X_{i,t} + e_h * FE_{i,t} + \epsilon_{i,t,h}\end{aligned} \tag{2}$$

where i is a firm index, t is a time index. $E_{i,t+h}$ is firm i's earnings at year $t+h$, where $h = 1$ year, 3 year, 5 year. $A_{i,t}$ is firm i's total asset at time t, $M_{i,t}$ is the firm i's market value at time t. $shareST_{i,t}$ is the share of short-term investor of firm i at time t. $shareLT_{i,t}$ is the share of long-term investor of firm i at time t. $X_{i,t}$ stands for firm controls. $FE_{i,t}$ stands for firm and year fixed effects.

Price informativeness is measured as the standardized coefficient of $log(\frac{M_{i,t}}{A_{i,t}})$:

$$(b1_h + b2_h^{ST} * shareST_{it} + b2_h^{LT} * shareLT_{it}) * \sigma(log(M_{i,t}/A_{i,t})) \tag{3}$$

Following Yan and Zhang (2007), firm controls include firm age, dividend yield, book-to-market ratio, price, turnover, idiosyncratic volatility, and an S&P 500 indicator. Firm age is calculated as the number of years since the first return appears in CRSP. Dividend yield is calculated as the cash dividend divided by the share price. Stock turnover is the average stock quarterly turnover by institutional investors. Stock idiosyncratic volatility is measured as the standard deviation of the residuals from the Fama–French three-factor model estimated using the past 12 months of monthly returns. S&P 500 indicator is a dummy variable for S&P 500 index membership.

4 Main results

4.1 Institutional investors and price informativeness

On average, a higher long-term institutional investor ownership is associated with higher price informativeness (Table 4); short-term institutional investor ownership predicts future earnings, but is only statistically significantly associated with one-year price informativeness.

Long-term share and short-term share present the differentiated effects on price informativeness over time. Table 5 shows that the differentiated positive effect from long-term share mainly comes from the post-2004 period. Before 2004, the short-term share has larger effect on price informativeness than the long-term share did. I run the regression every ten years and plot the regression coefficients for long-term share and short-term share to illustrate the time series heterogeneity of the role of long-term and short-term share on price informativeness. Figure 2 shows that the long-term share presents an increasing trend from 1980 to 2023, while the short-term share presents a decreasing trend from 1980 to 2023. In the post-2004 period, long-term shareholders contribute more positively to price informativeness than short-term shareholders.

Cross-sectionally, the effect of long-term and short-term shares on price informativeness varies with firm size. Specifically, the effect of long-term investors on price informativeness is most salient for small-sized firms (Table 6). The cross-sectional heterogeneity effect of long-term and short-term shares on price informativeness aligns with Farboodi et al. (2022).

5 Information diffusion surrounding earnings announcements

This section studies the information diffusion surrounding earnings announcements to shed light on the information production role of long-term investors. Following Yan and Zhang (2007), I first rank stocks based on their long-term share and short-term share, and form five quintile portfolios, respectively. Then I study the information incorporated in the stock price before and during earnings announcements (Biais et al. (1999), Boguth et al. (2025)). Specifically, I estimate unbiased regressions for portfolios formed by sorting stocks independently into quintiles based on their short-term and long-term share rankings.

$$Ret^q_{i[-30,10]} = \alpha^q_t + \beta^q_t Ret^q_{i[-30,t]} + \epsilon_{i,t}, \tag{4}$$

where $Ret^q_{i[t_1,t_2]}$ is accumulative daily abnormal returns of stock i in portfolio q between time period $[t_1, t_2]$. The R^2_t estimated from the above regression indicates how much the cumulative abnormal returns in the sub-period $[-30, t]$ can explain the cumulative abnormal returns in the period $[-30, 10]$, where $t = 0$ represents the announcement date for stock i. This regression is estimated within each portfolio q.

For each portfolio at each quarter, I calculate the information content reflected in the stock price prior to earnings announcement dates. I compare the information content reflected in the stock price before and after earnings announcement dates.

Figure 3 shows the R-square for portfolio quintiles formed based on the long-term share. It indicates that the portfolio with the highest long-term share has more information incorporated into the price before earnings announcements. From the top quintile portfolio with the highest long-term share to the bottom quintile portfolio with the lowest long-term share, the information content incorporated into the price before earnings announcements decreases monotonically. Figure 4 compares the information content incorporated in the price surrounding the earnings announcement dates for the portfolio with the highest long-term share and the portfolio with the highest short-term share. The portfolio with the highest long-term share has more information incorporated in price before the earnings announcement, while the portfolio with the highest short-term share has more information incorporated in price during the earnings announcement. This suggests the information production role of long-term investors, where long-term investors acquire fundamental information, and this information is reflected in price before earnings announcements. The portfolio with the lowest long-term share and the portfolio with the lowest short-term share have similar patterns in the information incorporation surrounding earnings announcements. These consistently suggest that long-term share is positively associated with the information content incorporated in stock prices surrounding earnings announcement dates. This also suggests that long-term investors play a role in bringing future fundamentals forward so that current prices reflect more future earnings news (Warfield and Wild (1992), Collins et al. (1994), Lundholm and Myers (2002)).

6 Robustness tests

This section provides robustness tests to establish the information production roles of long-term investors. Specifically, to address the concern of the pure passive investors, I rule out the pure index holdings from long-term investors (Section 6.1). To differentiate the effect of long-term share and total institutional share, I control for the total institutional share and examine the additional predictability of long-term percentage on price informativeness (Section 6.2).

6.1 Ruling out index holdings from long-term investors

A portion of asset managers has become passive. Some passive investors purely track the index. These purely index-tracking positions are expected to play a less important role in terms of information production. To rule out the effect of passive investing, I deduct index-related mutual fund positions from TR13F holdings. Pure passive share may affect the price informativeness by inducing the active investors to trade more to exploit the information (Xiong et al. (2025)). I rule out the pure passive share to substantiate the information production role of long-term investors on price informativeness.

I follow Appel et al. (2016) to rule out pure passive share. Specifically, I flag a fund as passively managed if its fund name includes a string that identifies it as an index fund or if the CRSP Mutual Fund Database classifies the fund as an index fund[2]. The mutual fund holdings data is from 2002 to 2023. I firstly construct an institution-stock level classification of active-passive stock ownership. That is, for each institutional investor's holding in stock i, I split the institutional investor's position into passive and active ownership. I cal-

[2]The strings used to identify index funds are: Index, Idx, Indx, Ind_(where _ indicates a space), Russell, S & P, S and P, S&P, SandP, SP, DOW, Dow, DJ, MSCI, Bloomberg, KBW, NASDAQ, NYSE, STOXX, FTSE, Wilshire, Morningstar, 100, 400, 500, 600, 900, 1000, 1500, 2000, and 5000.

culate the long-term passive share and long-term active share. I study the effect on price informativeness for long-term active share and long-term passive share, respectively.

The role of long-term active share and long-term passive shar on price informativeness is tested with the following regression:

$$
\begin{aligned}
\frac{E_{i,t+h}}{A_{i,t}} = a_h + b1_h * \log\left(\frac{M_{i,t}}{A_{i,t}}\right) + b2_h^{ST} * shareST_{i,t} + b2_h^{LT\,A,P} * shareLT_{i,t}^{A,P} \\
+ b3_h^{ST} * \log\left(\frac{M_{i,t}}{A_{i,t}}\right) * shareST_{i,t} + b3_h^{LT\,A,P} * \log\left(\frac{M_{i,t}}{A_{i,t}}\right) * shareLT_{i,t}^{A,P} \\
+ c_h * \left(\frac{E_{i,t}}{A_{i,t}}\right) + d_h * X_{i,t} + e_h * FE_{i,t} + \epsilon_{i,t,h}
\end{aligned}
\tag{5}
$$

where $shareLT_{i,t}^{A,P}$ represent the active long-term share, and the passive long-term share, respectively. $shareST_{i,t}$ represents the total short-term share. I do not separately consider active and passive short-term shares in the regression because the short-term passive share is close to zero (Table 9).

Table 9 summarizes the passive and active long-term and short-term shares. For the long-term investors, the mean passive share is 2.1%, the mean active share is 37.6%. For the short-term investors, the mean passive share is close to zero, the mean active share is 23%. Overall, the passive share categorized based on the mutual fund name is relatively small compared to the active share for both short-term shares and long-term shares. Table 10 shows that the information role of active long-term share is positively associated with price informativeness. I note that the passive long-term share is also positively associated with price informativeness, and the marginal effect of the passive long-term share is larger than the marginal effect of the active long-term share. This may be due to the fact that the passive share, as defined in Appel et al. (2016), is relatively small. The positive role of passive long-term shares on price informativeness seems to align with the mechanism that short-term investors can trade more actively with a large share of passive long-term investors (Xiong et al. (2025), Haddad and Muir (2025)).

6.2 Differentiating long-term shares from total institutional shares

To differentiate the effect of long-term shares and total institutional shares on price informativeness, I control for the total institutional shares and examine whether the long-term share percentage has additional predictability on price informativeness.

$$\begin{aligned}\frac{E_{i,t+h}}{A_{i,t}} = a_h + b1_h * \log\left(\frac{M_{i,t}}{A_{i,t}}\right) + b2_h^{Tot} * totinstshare_{i,t} + b2_h^{LT} * instshareLTpct_{i,t} \\ + b3_h^{Tot} * \log\left(\frac{M_{i,t}}{A_{i,t}}\right) * totinstshare_{i,t} + b3_h^{LT} * \log\left(\frac{M_{i,t}}{A_{i,t}}\right) * instshareLTpct_{i,t} \\ + c_h * \left(\frac{E_{i,t}}{A_{i,t}}\right) + d_h * X_{i,t} + e_h * FE_{i,t} + \epsilon_{i,t,h}\end{aligned} \tag{6}$$

where $instshareLTpct_{i,t}$ denotes the percentage of long-term institutional share relative to total institutional share.

Table 8 indicates that the long-term ownership provides incremental predictive power for the information content of prices on future earnings in small-sized firms. And the predictability power is slightly larger for the small-sized firms without analyst coverage. Xiong et al. (2025) document that institutional concentration of active ownership is negatively associated with price informativeness. I control for the stock-level institutional concentration, and the regression results in Table 7 indicate that long-term share still plays a more important role than short-term share in the post-2004 period after controlling for the stock-level institutional concentration.

7 Identification - long-term investors' exits

Long-term investors and short-term investors may self-select to invest in firms whose prices are more predictive of future earnings. To provide causal evidence on the information production roles of long-term investors, I use the Vocker rule as an exogenous shock and study how the long-term investors' exits affect stocks' informational efficiency.

The Volcker Rule [3] prohibits banking entities from engaging in proprietary trading. The Volcker Rule also prohibits banking entities from owning and sponsoring hedge funds and private equity funds, referred to as ”covered funds”. On April 1, 2014, the Volcker Rule became effective, requiring that banks with at least $50 billion in trading assets report some quantitative metrics starting in July 2014. By July 21, 2015, large banks were required to be fully compliant with the Volcker Rule. During the conformance period, banks had to make good faith efforts to conform to the new rules. Hence, at least some effects of the Volcker Rule are expected to become evident starting in April 2014 (Bao et al. (2017)). Figure 6 is the long-term share for treatment and control firms, pre and post the implementation of the Volcker Rule. The long-term ownership trends for the treatment and control firms are similar, except during the Volcker Rule implementation period, when the long-term ownership share of treatment firms declined more sharply than that of control firms. This justifies the first-stage parallel trend of the long-term share for treatment and control firms.

Long-term investors who exited in 2014 and 2015 are considered treated investors. Firms are considered treated if the firm is held by treated long-term investors and the ownership is greater than 5% in the exit year. Firms are considered as control firms if the firms are not held by treated long-term investors for three years (inc.) before the long-term investors' exits, and the firms operate at least five years before and after the treatment year, to ensure that there are enough data points as control firms.

[3]https://www.federalreserve.gov/supervisionreg/volcker-rule.htm

7.1 The price informativeness surrounding the Volcker Rule

I apply the following regression methodology to test the effect of long-term investors' exits on price informativeness.

$$
\begin{aligned}
\frac{E_{i,t+h}}{A_{i,t}} &= a_h + b1_h * \log\left(\frac{M_{i,t}}{A_{i,t}}\right) + b2_h * treat_{i,t} + b3_h * post_{i,t} \\
&\quad + b4_h * \log\left(\frac{M_{i,t}}{A_{i,t}}\right) * treat_{i,t} + b5_{t,h} * \log\left(\frac{M_{i,t}}{A_{i,t}}\right) * post_{i,t} \\
&\quad + b6_h * \log\left(\frac{M_{i,t}}{A_{i,t}}\right) * treat_{i,t} * post_{i,t} + c_h * \left(\frac{E_{i,t}}{A_{i,t}}\right) + d_h * FE_{i,t} + \epsilon_{i,t,h}
\end{aligned} \tag{7}
$$

where $post_{i,t}$ is equal to one if the year is at the treatment year or post-treatment year. This regression is run with the sample three years before and after the treatment year, $h = 1, 3,$ and 5 years. Coefficient $b6_{t,h}$ captures the treatment effect of long-term investors' exits on price informativeness.

Table 11 reports the effect of long-term investors' exits on price informativeness. Price informativeness declines for firms that long-term investors exit following the implementation of the Volcker Rule. The effect is the strongest for price informativeness measured over the longest horizons.

7.2 The jump ratio surrounding the Volcker Rule

The price informativeness defined in the main specification (Bai et al. (2016)) measures the price informativeness over a long horizon. The investor composition rebalances over time, and the effect may weaken over the long term. To examine information acquisition over short horizons, I follow Weller (2017) to study the information content in stock prices surrounding earnings announcements.

The absolute cumulative abnormal return is a standard measure of the incorporation of information into prices (Fama et al. (1969)). Weller (2017) uses the price jump ratio as a measure of information acquisition, where the price jump ratio is defined as the ratio of post-announcement price variation to total variation before the earnings announcement. Following Weller (2017), for each stock i at quarterly earnings announcement t, the jump ratio for control and treated firms in the time window of $T-21$ to $T+2$ is measured as the ratio of the announcement response divided by the total variation in the pre- and post-announcement period:

$$jump_{it}^{21} = \frac{CAR_{it}^{(T-1,T+2)}}{CAR_{it}^{(T-21,T+2})} \tag{8}$$

Cumulative abnormal returns are net of Fama and French (1992) three-factor implied returns over the same interval, where $T-1$ captures pre-announcement variation and $T+2$ captures post-announcement drift. The normalized measure accounts for differences in the expected magnitude of abnormal returns among stocks and over time.

The price jump ratio quantifies the share of information acquired and incorporated into prices pre-announcement. If acquirable return information is proportional to the total realized return, this ratio directly measures the fraction of acquirable information incorporated into prices before its public disclosure. Informed trading (information acquisition before earnings announcement) has a common implication of smooth convergence of prices to post-announcement values before information is publicly revealed. Higher values of the price jump ratio represent less information in prices relative to the post-announcement information set.

Table 12 shows that the jump ratio increases for treated firms post the Volcker Rule implementation. Following Weller (2017), I also assess the effect of long-term investor exits on information acquisition intensity, after controlling for firm characteristics that matter for firms' information environment. The significance and magnitude still hold after controlling for firm characteristics. Following Weller (2017), the firm characteristics include stock price, stock volume, stock market cap, and an analyst coverage dummy indicating whether the stock is covered by an analyst.

8 Mechanism

This section provides micro-level evidence on long-term investors' information production. Following Chen et al. (2020), I use the EDGAR log file to identify long-term investors' footprints to shed light on long-term and short-term investors' information acquisition activity.

I map institutional investors' digital footprints to their holdings to document the extent to which long-term and short-term investors rely on fundamental information sources, and to examine how institutional information exploitation varies across firms of different sizes. In this section, the organization and IP link mapping file is from the American Registry for Internet Numbers (ARIN). EDGAR log file data for July 1, 2017, to May 18, 2020 is no longer available. Therefore, the EDGAR log file used in this section is from January 2003 to December 2016. In addition, the filing behavior post-2014 seems to be very different from the filing behavior before 2014, specifically, there are substantially more queries post-2014 compared to previous years. To have a consistent comparison across years, I focus on the EDGAR log files from January 2003 to December 2013. The data cleaning steps follow Ryans (2017)[4]. The SEC filings include firms' fundamentals filings [5]. For each day, I retain only one unique record for each institution–firm query. This helps mitigate concerns about distinguishing machine-generated queries from human-generated ones.

The analysis of long-term and short-term investors' information-acquisition activity, using SEC log files, is organized into two parts. First, I examine the total information-acquisition activity of long-term and short-term investors across firms of varying sizes.

[4]The data filtering steps include: keep records with $code = 200$ (successful delivery of requested document by the EDGAR server); keep records with $idx = 0$ - remove index observations, as index pages provide the viewer a link to a filing, not the filing itself; keep records with $crawler = 0$ (remove identified web crawlers).

[5]10-K, 10-K/A, 10-K405, 10-K405/A, 10-Q, 10-Q/A, 8-K, 8-K/A.

Figure 5 shows that the information acquisition activity through SEC filings by long-term investor accounts for above 80% of the total downloads, suggesting that long-term investors' focus on fundamentals. Downloads by long-term and short-term investors over time also suggest that long-term investors began to account for a larger share of fundamental research consumption after 2004. However, the relatively short pre-2004 window—only two years—limits the strength of inferences about fundamental research consumption before 2004.

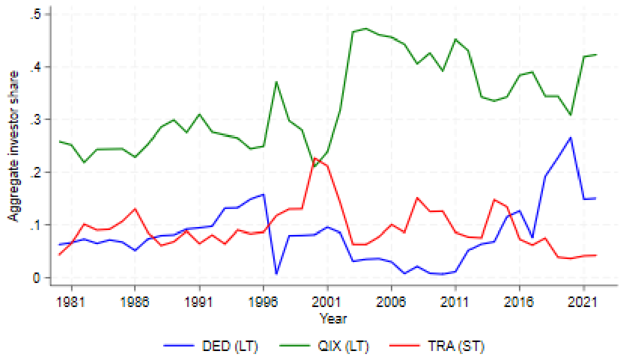
9 Conclusion

This study provides empirical evidence that long-term and short-term investors play distinct roles in improving price informativeness over time. Specifically, long-term investors become increasingly more important in improving price informativeness, especially post 2004 when demand-based trading strategies began to gain prominence. The diverging patterns of long-term and short-term investors on price informativeness suggest the increasingly important active information production roles of long-term investors as a portion of market participants shift towards demand-based information extraction trading strategies.

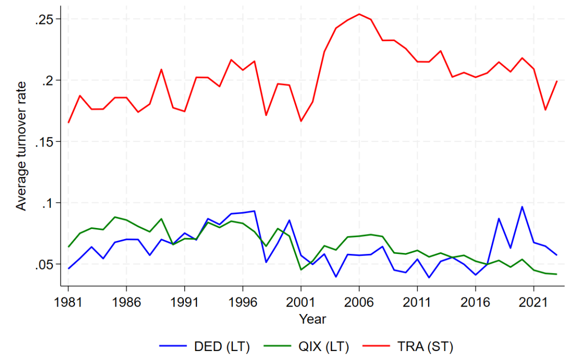
The theoretical model illustrates that long-term investors, who trade less frequently than short-term investors, allocate relatively more resources to future fundamental value signal precision than short-term investors do, and short-term investors allocate relatively more resources to demand signal precision than long-term investors do. The price informativeness increases with the share of long-term investors.

Figure 1: Aggregate investor share and turnover rate

This figure presents the aggregate investor share and aggregate turnover rate from 1980 to 2023 for three types of institutional investors defined in Bushee (2001): dedicated (DED), quasi-indexer (QIX), and transilient (TRA).



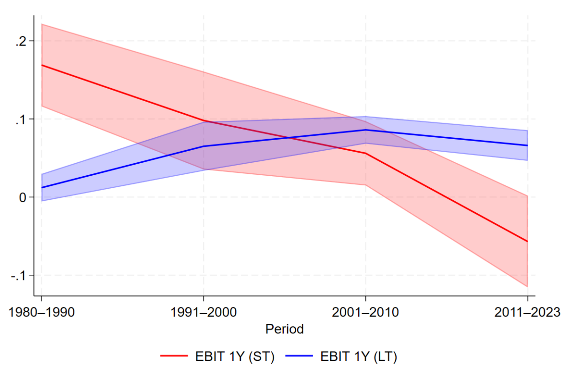
Panel A: Aggregate investor share



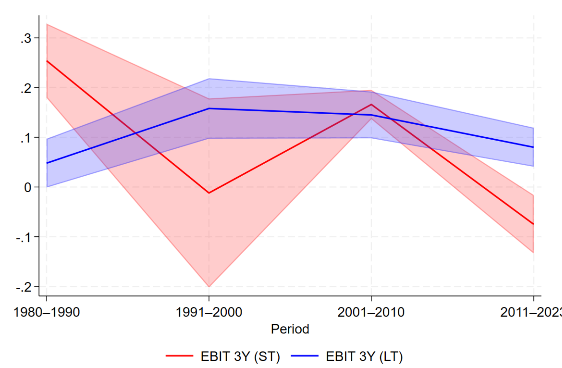
Panel B: Aggregate turnover rate

Figure 2: Long-term share and short-term share on price informativeness by period

This figure presents the regression coefficients for long-term share and short-term share by period, for one-year earnings and three-year earnings. The coefficients are estimated using non-overlapping 10-year windows.



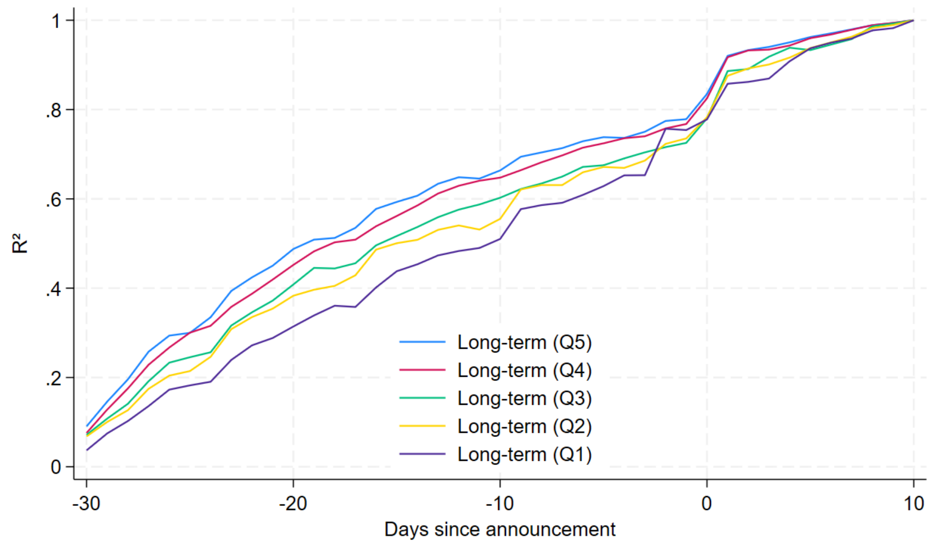
Panel A: LT and ST share on price informativeness - EBIT 1Y



Panel B: LT and ST share on price informativeness - EBIT 3Y

Figure 3: Earnings announcement information incorporation for long-term portfolios

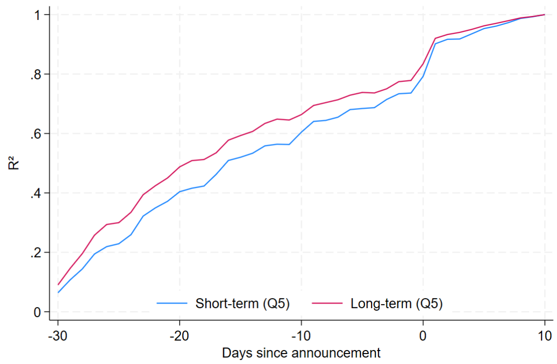
This figure shows the R-square for quintile portfolios formed based on the long-term share over a [-30,+10] window around earnings announcement dates. Q5 is the top quintile portfolio with the highest long-term share. Q1 is the bottom quintile portfolio with the lowest long-term share.



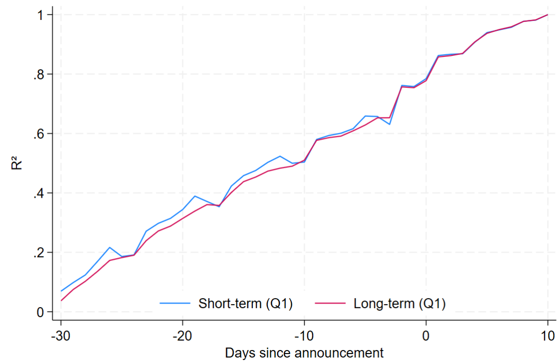
R-square for portfolio quintiles formed on long-term share

Figure 4: Earnings announcement information incorporation for long-term and short-term portfolio quintiles (top quintile and bottom quintile)

This figure shows the R-square for portfolio quintiles formed based on the long-term share and the short-term share over a [-30,+10] window around earnings announcement dates. Panel A compares the R-square for the top portfolio quintile (Q5) formed based on the long-term share and short-term share, respectively; Panel B compares the R-square for the bottom portfolio quintile (Q1) formed based on the long-term share and short-term share, respectively.



Panel A: R-square for portfolios formed based on long-term share and short-term share - Q5



Panel B: R-square for portfolios formed based on long-term share and short-term share - Q1

Figure 5: Information acquisition activity by long-term and short-term investors

This figure aggregates the information acquisition activity (total SEC log file downloads adjusted by the investor share) for long-term and short-term investors from 2003 to 2013. LT (small) refers to long-term investors' information acquisition activity for small-sized firms; ST (small) refers to short-term investors' information acquisition activity for small-sized firms; LT (large) refers to long-term investors' information acquisition activity for large-sized firms; ST (large) refers to short-term investors' information acquisition activity for large-sized firms.

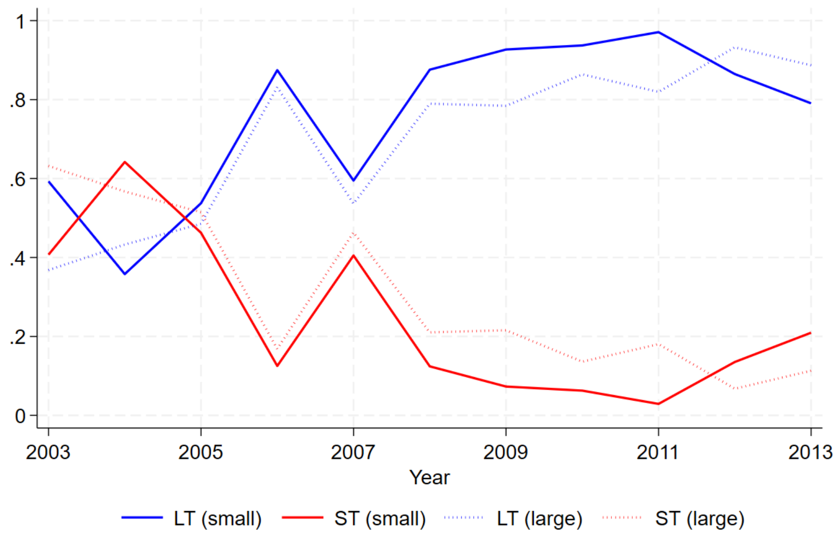
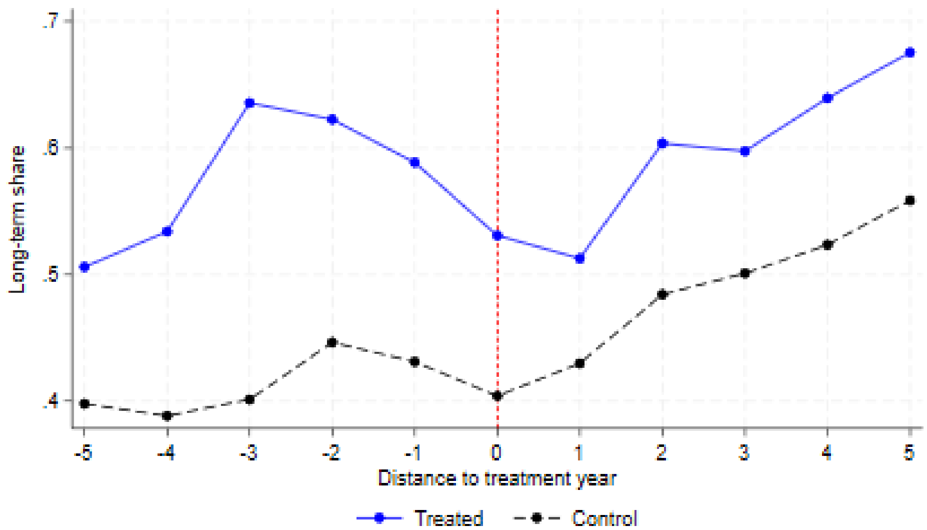


Figure 6: Long-term investor share surrounding the Volcker Rule implementation

This figure shows the long-term share for treated firms and control firms five years before and after the Volcker Rule implementation. Event year $t = 0$ refers to the time periods when the Volcker Rule was implemented. Treated firms are firms that have an institutional ownership of over 5% by exited long-term investors. Control firms are firms that were not held by exited long-term investors and also operated five years before and after the Volcker Rule implementation year.



Long-term share surrounding the Volcker Rule

Table 1: Stock characteristics preferences by different types of investors

This table summarizes the stock characteristics preferences for three types of institutional investors: Transient investors (TRA), Quasi-index investors (QIX), and Dedicated investors (DED) as defined in Bushee (2001). For each investor type, I compute stock characteristics—including the share of institutional ownership, market capitalization, and total assets—using the subsample of stocks in which that investor type holds a positive ownership stake. For example, among S&P 500 firms with positive ownership by transient investors, the average transient ownership share is 14.3%, the mean market capitalization is $17,248 million, and the mean total assets are $33,325 million.

	TRA													
	SP500							non-SP500						
	mean	sd	p10	p25	p50	p75	p90	mean	sd	p10	p25	p50	p75	p90
percentage of stock shares	0.143	0.094	0.044	0.073	0.121	0.191	0.275	0.115	0.120	0.004	0.021	0.078	0.172	0.281
market cap	17,248	54,681	820	2,185	6,253	15,225	36,897	715	2,190	15	44	164	613	1,780
total asset	33,325	123,426	1,115	2,623	7,376	21,805	56,521	1,341	8,119	13	44	191	828	2,624

	QIX													
	SP500							non-SP500						
	mean	sd	p10	p25	p50	p75	p90	mean	sd	p10	p25	p50	p75	p90
percentage of stock shares	0.401	0.162	0.206	0.285	0.389	0.513	0.623	0.198	0.213	0.008	0.037	0.130	0.301	0.507
market cap	20,750	58,510	763	2,069	6,514	17,958	45,450	646	2,203	11	32	119	482	1,576
total asset	37,958	150,701	1,088	2,678	7,632	24,259	66,125	1,233	6,833	11	36	162	739	2,487

	DED													
	SP500							non-SP500						
	mean	sd	p10	p25	p50	p75	p90	mean	sd	p10	p25	p50	p75	p90
percentage of stock shares	0.122	0.102	0.021	0.047	0.095	0.168	0.269	0.095	0.107	0.004	0.019	0.061	0.134	0.230
market cap	6,555	20,855	372	803	1,895	4,783	12,498	245	917	7	18	54	175	521
total asset	17,549	99,669	583	1,215	2,806	9,472	32,062	572	2,765	8	21	72	282	1,029

Table 2: Summary statistics

This table presents mean, p10, p25, median, p75, p90, and standard deviation of variables in the main regression. EBIT 1Y, EBIT 3Y, and EBIT 5Y are the scaled one-year, three-year, and five-year earnings by total assets. instshareST, instshareLT are the short-term and long-term institutional investor share. instshareDED, instshareQIX are the long-term dedicated and long-term quasi-indexer share. The data sample is from 1980 to 2023.

Variable	Mean	sd	p10	p25	Median	p75	p90
EBIT 1Y	0.036	0.239	- 0.164	0.001	0.068	0.142	0.233
EBIT 3Y	0.084	0.337	- 0.130	0.012	0.091	0.204	0.366
EBIT 5Y	0.154	0.474	- 0.112	0.022	0.123	0.286	0.552
log(mktcap/at)	- 0.411	1.313	- 2.094	- 1.145	- 0.320	0.428	1.151
instshareST	0.085	0.100	0	0.007	0.051	0.128	0.222
instshareLT	0.275	0.247	0.006	0.059	0.214	0.450	0.645
instshareDED	0.066	0.098	0	0	0.026	0.098	0.194
instshareQIX	0.209	0.207	0.004	0.035	0.144	0.335	0.524
ebit/at	0.014	0.224	- 0.176	0	0.057	0.116	0.182

Table 3: Correlation matrix

This table presents the correlation matrix for the variables used in the main specification.

Variable	EBIT 1Y	EBIT 3Y	EBIT 5Y	log(mktcap/at)	instshareST	instshareLT	instshareDED	instshareQIX	ebit/at
EBIT 1Y	1.000								
EBIT 3Y	0.736	1.000							
EBIT 5Y	0.604	0.720	1.000						
log(mktcap/at)	-0.033	-0.038	-0.014	1.000					
instshareST	0.124	0.106	0.101	0.168	1.000				
instshareLT	0.195	0.146	0.118	0.082	0.438	1.000			
instshareDED	0.077	0.068	0.065	0.014	0.116	0.438	1.000		
instshareQIX	0.184	0.134	0.104	0.085	0.437	0.925	0.063	1.000	
ebit/at	0.845	0.655	0.551	-0.067	0.105	0.214	0.085	0.202	1.000

Table 4: Long-term share on price informativeness - all

This table summarizes the relation between long-term and short-term investor share and price informativeness across all firms. The sample period is from 1980 to 2023. EBIT 1Y, EBIT 3Y, and EBIT 5Y refer to the one-year, three-year, and five-year earnings before interest and tax, respectively. InstshareST and instshareLT represent the share of short-term investors and the share of long-term investors. Other firm controls include firm age, dividend price yield, book-to-market ratio, stock turnover, stock idiosyncratic risk, and the SP500 indicator. Standard errors are reported in brackets. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1) EBIT 1Y	(2) EBIT 3Y	(3) EBIT 5Y
log(mktcap/at)	-0.009	-0.018*	0.007
	[0.007]	[0.009]	[0.010]
instshareST	0.170***	0.134***	0.090
	[0.027]	[0.041]	[0.055]
instshareLT	0.015	-0.049**	-0.151***
	[0.009]	[0.021]	[0.035]
log(mktcap/at)*instshareST	0.038*	0.004	0.036
	[0.021]	[0.041]	[0.043]
log(mktcap/at)*instshareLT	0.043***	0.056***	0.023
	[0.010]	[0.020]	[0.024]
ebit/at	0.605***	0.493***	0.480***
	[0.017]	[0.028]	[0.039]
Adj. R-sq	0.787	0.615	0.542
Within R-sq	0.340	0.083	0.044
Observations	135293	109809	90594
Other firm controls	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes

Table 5: Long-term share on price informativeness - before/after 2004

This table summarizes the effect of long-term share and short-term share on price informativeness for the sample before/after 2004. The sample is divided by 2004 because the demand-based trading strategies started to become popular after 2004. Other firm controls include firm age, dividend price yield, book-to-market ratio, stock turnover, stock idiosyncratic risk, and the SP500 indicator. Standard errors are reported in brackets. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	Before 2004			After 2004		
	(1) EBIT 1Y	(2) EBIT 3Y	(3) EBIT 5Y	(4) EBIT 1Y	(5) EBIT 3Y	(6) EBIT 5Y
log(mktcap/at)	-0.005	-0.016	0.011	-0.025***	-0.043***	-0.032**
	[0.009]	[0.010]	[0.011]	[0.008]	[0.009]	[0.014]
instshareST	0.139***	0.019	-0.113*	0.166***	0.173***	0.194***
	[0.029]	[0.041]	[0.059]	[0.021]	[0.040]	[0.058]
instshareLT	0.015	-0.117***	-0.268***	0.023**	0.012	-0.013
	[0.013]	[0.028]	[0.038]	[0.009]	[0.017]	[0.032]
log(mktcap/at)*instshareST	0.082***	0.021	0.045	-0.021	-0.043	-0.030
	[0.014]	[0.047]	[0.038]	[0.027]	[0.037]	[0.038]
log(mktcap/at)*instshareLT	0.064***	0.068**	0.013	0.059***	0.071***	0.059**
	[0.014]	[0.025]	[0.027]	[0.010]	[0.016]	[0.020]
ebit/at	0.546***	0.349***	0.309***	0.545***	0.464***	0.481***
	[0.027]	[0.032]	[0.039]	[0.022]	[0.039]	[0.064]
Adj. R-sq	0.745	0.573	0.533	0.839	0.725	0.677
Within R-sq	0.276	0.042	0.026	0.307	0.093	0.050
Observations	81838	69053	58913	53080	40419	31436
Other firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 6: Long-term share on price informativeness - by firm size

This table summarizes the relation between long-term and short-term investor share and price informativeness for small-sized, medium-sized, and large-sized firms. Other firm controls include firm age, dividend price yield, book-to-market ratio, stock turnover, stock idiosyncratic risk, and the SP500 indicator. Standard errors are reported in brackets. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	Small			Medium			Large		
	(1) EBIT1 all	(2) EBIT3 all	(3) EBIT5 all	(1) EBIT1 all	(2) EBIT3 all	(3) EBIT5 all	(1) EBIT1 all	(2) EBIT3 all	(3) EBIT5 all
log(mktcap/at)	-0.029***	-0.053***	-0.063***	-0.001	-0.036***	-0.028*	0.024*	0.050**	0.128***
	[0.006]	[0.009]	[0.015]	[0.007]	[0.011]	[0.016]	[0.012]	[0.020]	[0.021]
instshareST	0.131***	0.056	0.070	0.179***	0.105***	0.081	0.137***	0.204***	0.204***
	[0.031]	[0.061]	[0.102]	[0.020]	[0.033]	[0.051]	[0.021]	[0.032]	[0.041]
instshareLT	0.023	-0.017	-0.000	0.000	-0.111***	-0.171***	-0.006	-0.042***	-0.094***
	[0.016]	[0.033]	[0.068]	[0.011]	[0.020]	[0.033]	[0.005]	[0.013]	[0.025]
log(mktcap/at)*inshareST	0.028	0.021	0.049	0.077***	0.123***	0.177***	0.036***	-0.005	-0.010
	[0.021]	[0.044]	[0.075]	[0.015]	[0.030]	[0.043]	[0.013]	[0.038]	[0.048]
log(mktcap/at)*inshareLT	0.045***	0.059**	0.105**	0.026**	0.070***	0.110***	0.020	0.028	-0.044
	[0.011]	[0.024]	[0.040]	[0.010]	[0.021]	[0.029]	[0.014]	[0.024]	[0.028]
ebit/at	0.516***	0.423***	0.428***	0.626***	0.501***	0.434***	0.670***	0.521***	0.407***
	[0.014]	[0.031]	[0.047]	[0.021]	[0.033]	[0.050]	[0.042]	[0.069]	[0.065]
Adj. R-sq	0.787	0.668	0.622	0.771	0.614	0.566	0.744	0.528	0.479
Within R-sq	0.281	0.084	0.040	0.326	0.085	0.038	0.397	0.117	0.095
Observations	34881	25589	19481	45128	36765	30135	50151	43631	38172
Other firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 7: Total institutional share and price informativeness - before/after 2004

This table separates the effect of total institutional ownership and long-term share on price informativeness for the subsamples before 2004 and after 2004. Totinstshare is the total institutional share. instshareLTpct is the percentage of the long-term share over the total institutional share. instshareHHI measures the stock-level concentration. instsharePassive measures the total passive share for each stock. Other firm controls include firm age, dividend price yield, book-to-market ratio, stock turnover, stock idiosyncratic risk, and the SP500 indicator. Standard errors are reported in brackets. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	Before 2004			After 2004		
	(1)	(2)	(3)	(4)	(5)	(6)
	EBIT 1Y	EBIT 3Y	EBIT 5Y	EBIT 1Y	EBIT 3Y	EBIT 5Y
log(mktcap/at)	0.008	-0.011	0.042**	-0.054***	-0.082***	-0.058**
	[0.017]	[0.023]	[0.019]	[0.011]	[0.015]	[0.023]
instshareLTpct	-0.053***	-0.031**	-0.056***	-0.028***	-0.020	-0.035
	[0.006]	[0.012]	[0.014]	[0.007]	[0.014]	[0.026]
totinstshare	0.057***	-0.081***	-0.201***	0.009	-0.050***	-0.078***
	[0.014]	[0.022]	[0.040]	[0.007]	[0.016]	[0.023]
log(mktcap/at)*instshareLTpct	-0.002	0.014	-0.013	0.031***	0.036***	0.010
	[0.010]	[0.023]	[0.018]	[0.007]	[0.012]	[0.018]
log(mktcap/at)*totinstshare	0.061***	0.039*	0.005	0.064***	0.097***	0.101***
	[0.009]	[0.021]	[0.025]	[0.008]	[0.014]	[0.019]
log(mktcap/at)*instshareHHI	-0.030**	-0.037**	-0.054*	-0.024**	-0.047***	-0.072**
	[0.012]	[0.015]	[0.026]	[0.009]	[0.013]	[0.027]
log(mktcap/at)*instsharePassive	-1.204**	-0.566	-3.911***	0.055	-0.213	-0.183
	[0.444]	[0.689]	[0.946]	[0.070]	[0.171]	[0.306]
ebit/at	0.526***	0.338***	0.296***	0.548***	0.456***	0.444***
	[0.025]	[0.030]	[0.040]	[0.020]	[0.040]	[0.064]
instshareHHI	0.012	0.030	0.098***	-0.015	-0.029	-0.025
	[0.009]	[0.019]	[0.029]	[0.011]	[0.023]	[0.035]
instsharePassive	-2.652***	-2.776**	-5.061***	0.179***	1.480***	1.902***
	[0.787]	[1.251]	[1.683]	[0.042]	[0.464]	[0.510]
Adj. R-sq	0.743	0.573	0.542	0.840	0.723	0.669
Within R-sq	0.264	0.040	0.026	0.319	0.101	0.052
Observations	77152	65270	55855	56286	43112	33718
Other firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 8: Total institutional share and price informativeness (small size)

This table separates the effect of total institutional ownership and long-term share on price informativeness for the subsample of small firms. instshareLTpct is the percentage of the long-term share over the total institutional share. Totinstshare is the total institutional share. Columns (1)–(3) report regressions estimated within small-sized firms, while Columns (4)–(6) report regressions estimated within small-sized firms without analyst coverage. Other firm controls include firm age, dividend price yield, book-to-market ratio, stock turnover, stock idiosyncratic risk, and the SP500 indicator. Standard errors are reported in brackets. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	Small size			Small size (without analyst coverage)		
	(1) EBIT 1Y	(2) EBIT 3Y	(3) EBIT 5Y	(4) EBIT 1Y	(5) EBIT 3Y	(6) EBIT 5Y
log(mktcap/at)	-0.044***	-0.074***	-0.080***	-0.045***	-0.085***	-0.080***
	[0.007]	[0.011]	[0.020]	[0.007]	[0.013]	[0.025]
instshareLTpct	-0.016***	0.010	-0.010	-0.009	0.022	-0.008
	[0.006]	[0.011]	[0.024]	[0.006]	[0.014]	[0.026]
totinstshare	0.047***	0.009	0.013	0.030*	0.023	-0.012
	[0.013]	[0.027]	[0.056]	[0.016]	[0.043]	[0.072]
log(mktcap/at)*instshareLTpct	0.020***	0.029**	0.024	0.027***	0.040***	0.027
	[0.005]	[0.012]	[0.018]	[0.006]	[0.013]	[0.021]
log(mktcap/at)*totinstshare	0.038***	0.052**	0.084**	0.019*	0.047*	0.043
	[0.009]	[0.020]	[0.035]	[0.010]	[0.024]	[0.044]
ebit/at	0.516***	0.421***	0.428***	0.508***	0.402***	0.389***
	[0.014]	[0.031]	[0.048]	[0.016]	[0.033]	[0.049]
Adj. R-sq	0.787	0.668	0.622	0.790	0.670	0.629
Within R-sq	0.282	0.085	0.040	0.275	0.083	0.035
Observations	34881	25589	19481	24085	18594	14605
Other firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 9: Long-term and short-term share statistics (passive and active)

This table summarizes the mean, standard deviation, and percentiles for passive and active institutional shares for long-term and short-term investors, respectively. The passive share is defined based on the mutual fund naming convention (Appel et al. (2016)). inst_share_ST_passive and inst_share_ST_active refer to short-term passive and short-term active institutional shares. inst_share_LT_passive and inst_share_LT_active refer to long-term passive and long-term active institutional shares.

Inst share	mean	sd	p10	p25	p50	p75	p90
inst_share_ST_passive	0.000	0.001	0.000	0.000	0.000	0.000	0.001
inst_share_ST_active	0.230	0.212	0.010	0.067	0.180	0.340	0.515
inst_share_LT_passive	0.021	0.032	0.000	0.003	0.015	0.032	0.055
inst_share_LT_active	0.376	0.257	0.032	0.144	0.380	0.584	0.709

Table 10: Ruling out pure passive investor holdings

This table summarizes the effect of long-term and short-term passive and active share on price informativeness. The passive is defined based on the mutual fund name (Appel et al. (2016)). The active is the difference between TR13F holdings and passive holdings for long-term and short-term investors, respectively. The data sample is from 2002 to 2023 because mutual fund holdings data is only available from 2002. instshareST represents the total short-term share. In columns (1)–(3), instshareLT represents the total long-term share. In columns (4)–(6), instshareLT represents the active long-term share. In columns (7)–(9), instshareLT represents the passive long-term share. In all regressions, instshareST denotes total short-term institutional ownership, without distinguishing between passive and active shares. Other firm controls include firm age, dividend price yield, book-to-market ratio, stock turnover, stock idiosyncratic risk, and the SP500 indicator. Standard errors are reported in brackets. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	All (2002 - 2023)			Active			Passive		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(3)
	EBIT 1Y	EBIT 3Y	EBIT 5Y	EBIT 1Y	EBIT 3Y	EBIT 5Y	EBIT 1Y	EBIT 3Y	EBIT 5Y
log(mktcap/at)	-0.021***	-0.036***	-0.032**	-0.020**	-0.035***	-0.031**	-0.021***	-0.038***	-0.039***
	[0.007]	[0.010]	[0.011]	[0.007]	[0.010]	[0.011]	[0.006]	[0.008]	[0.011]
instshareST	0.145***	0.170***	0.206***	0.144***	0.169***	0.205***	0.123***	0.142***	0.181***
	[0.026]	[0.041]	[0.049]	[0.026]	[0.040]	[0.048]	[0.024]	[0.036]	[0.051]
instshareLT	0.026***	0.005	-0.036	0.027**	0.003	-0.038	0.282***	0.657	0.279
	[0.009]	[0.019]	[0.030]	[0.010]	[0.019]	[0.030]	[0.032]	[0.420]	[0.589]
log(mktcap/at)*instshareST	0.001	0.019	0.038	0.000	0.019	0.040	0.065***	0.089**	0.099**
	[0.027]	[0.045]	[0.049]	[0.025]	[0.045]	[0.048]	[0.021]	[0.037]	[0.039]
log(mktcap/at)*instshareLT	0.053***	0.050**	0.036	0.053***	0.050**	0.033	0.541***	0.589**	0.796***
	[0.010]	[0.020]	[0.023]	[0.011]	[0.020]	[0.023]	[0.059]	[0.222]	[0.266]
ebit/at	0.550***	0.457***	0.458***	0.550***	0.458***	0.459***	0.552***	0.456***	0.453***
	[0.018]	[0.039]	[0.057]	[0.018]	[0.039]	[0.058]	[0.017]	[0.039]	[0.057]
Adj. R-sq	0.833	0.712	0.652	0.833	0.712	0.652	0.833	0.712	0.652
Within R-sq	0.324	0.092	0.047	0.324	0.092	0.047	0.322	0.092	0.047
Observations	63601	49472	38924	63601	49472	38924	63601	49472	38924
Other firm controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 11: Price informativeness post the Volcker Rule

This table summarizes the effect of long-term investors' exits on price informativeness post the Volcker Rule. Treat is an indicator equal to one if a firm is held by exited long-term investors at more than 5% during the Volcker Rule implementation period. Post is a variable that equals one if the year is during or after the implementation period of the Volcker Rule. Control firms are firms that are not held by the exited long-term investors and also continue to operate at least 5 years after the implementation year of the Volcker Rule. Standard errors are reported in brackets. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1) EBIT 1Y	(2) EBIT 3Y	(3) EBIT 5Y
log(mktcap/at)	0.017***	-0.023***	-0.028***
	[0.004]	[0.007]	[0.010]
treat	0.007	-0.007	-0.007
	[0.007]	[0.008]	[0.004]
post	-0.007***	0.006	0.017***
	[0.002]	[0.004]	[0.006]
log(mktcap/at)*treat	0.028	0.029**	0.050***
	[0.019]	[0.014]	[0.016]
log(mktcap/at)*post	0.001	0.005	0.013**
	[0.002]	[0.003]	[0.006]
log(mktcap/at)*treat*post	-0.033*	-0.054**	-0.084**
	[0.018]	[0.023]	[0.041]
ebit/at	0.419***	0.322***	0.415***
	[0.027]	[0.045]	[0.063]
Adj. R-sq	0.850	0.762	0.721
Observations	33105	31586	29369
Firm FE	No	No	No

Table 12: Jump ratio post the Volcker rule

This table summarizes the jump ratio post the Volcker Rule. Regression (1) does not include stock control characteristics. Regression (2) includes stock control characteristics. Treat is a variable that equals one if a firm is held by exited long-term investors more than 5% in the implementation period of the Volcker Rule. Post is a variable that equals one if the year is during or after the implementation period of the Volcker Rule. Control firms are firms that are not held by the exited long-term investors and also continue to operate at least 5 years after the implementation year of the Volcker Rule. Standard errors are reported in brackets. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

	(1) Jump ratio	(2) Jump ratio with firm control
treat	-0.173*	-0.195**
	[0.093]	[0.094]
post	0.024**	0.038***
	[0.010]	[0.011]
treat*post	0.404**	0.389**
	[0.191]	[0.190]
mktcap		-0.000
		[0.000]
with analyst coverage		0.046***
		[0.015]
price		-0.000***
		[0.000]
Avg trading volume		-0.000***
		[0.000]
Adj. R-sq	0.001	0.005
Observations	14514	11805
Firm FE	No	No

A The Model

The model builds on Farboodi and Veldkamp (2020) and studies how agents' investment horizon affects their information choice between acquiring assets' fundamental value and acquiring noise traders' demand, and consequently, contributes to the price informativeness. The model extends the concept of infrequent trading to the stock market efficiency(Duffie (2010),Chien et al. (2012)).

A.1 Model setup

The model is a three-period dynamic model featuring one risk-free asset, one risky asset, two types of investors, three types of information choices (fundamental signal at $t = 1$, demand signal at $t = 1$, and fundamental signal at $t = 2$), and a unit mass of noise traders.

Risky asset:

There is a single tradable, risky asset. Its supply is one unit per capita. A risk-free asset is in zero net supply, and the risk-free rate is r. The risky asset is a claim to a stream of dividend payments d_0, d_1, d_2:

$$d_{t+1} = \mu + G(d_t - \mu) + y_{t+1} \tag{9}$$

where:

$$y_{t+1} = \rho y_t + v_{t+1}, v_{t+1} \sim N(0, \tau_0^{-1}) \tag{10}$$

v_{t+1} is i.i.d. The dividends y_{t+1} are realized at the end of period $t + 1$.

Investors:

There are two types of investors in the market: short-term investors (ST) and long-term investors (LT). The mass of short-term investors is m. The mass of long-term investors is $1 - m$. Both types of investors live for three periods. The only difference between short-term and long-term investors is that long-term investors trade infrequently, only at

$t = 0$, while short-term investors trade frequently, at $t = 0$ and $t = 1$. Short-term and long-term investors have the same flexibility in allocating information resources across periods. But because long-term investors do not trade at $t = 1$, they will not choose to allocate information resources at $t = 1$. At $t = 0$, long-term investors acquire information for the current demand signal, information for the future fundamental signals at $t = 1$ and $t = 2$.

The agents' portfolio choice and information choice over three periods are summarized in the following table:

	Time	0	1	2
	Price	p_0	p_1	
Portfolio choice	ST	Trade (q_{i0}^{ST})	Liquidate($-q_{i0}^{ST}$) Trade (q_{i1}^{ST})	Liquidate ($-q_{i1}^{ST}$)
	LT	Trade (q_{i0}^{ST})	Hold	Liquidate ($-q_{i0}^{LT}$)
Information choice	ST	$\Omega_{xi00}^{ST}, \Omega_{fi01}^{ST}, \Omega_{fi02}^{ST}$	$\Omega_{xi11}^{ST}, \Omega_{fi12}^{ST}$	
	LT	$\Omega_{xi00}^{LT}, \Omega_{fi01}^{LT}, \Omega_{fi02}^{LT}$		
Demand shock	noise trader	x_0	x_1	
Dividend signal			y_1	y_2

Market-clearing conditions for the risky asset are:

- At $t = 0$:

$$m * q_{i0}^{ST} + (1 - m) * q_{i0}^{LT} - x_0 = 1 \tag{11}$$

- At $t = 1$:

$$m * q_{i1}^{ST} + (1 - m) * q_{i0}^{LT} - x_1 = 1 \tag{12}$$

Utility:

Both short-term and long-term investors are endowed with initial wealth W_0, and have a constant absolute risk aversion utility over the terminal wealth:

$$U_{i0}^{ST,LT} = -\beta E_0[e^{-\lambda(W_{i2}^{ST,LT})}] \tag{13}$$

Budget constraints:

Short-term investors' wealth is defined per period:

At $t = 1$:

$$W_{i1}^{ST} = r(W_0 - q_{i0}^{ST} p_0) + q_{i0}^{ST}(p_1 + d_1) \tag{14}$$

At $t = 2$:

$$W_{i2}^{ST} = r(W_{i1}^{ST} - q_{i1}^{ST} p_1) + q_{i1}^{ST} d_2 \tag{15}$$

Substituting W_{i1}^{ST} into the terminal wealth equation:

$$W_{i2}^{ST} = r^2 W_0 + q_{i0}^{ST} r(d_1 + p_1 - rp_0) + q_{i1}^{ST}(d_2 - rp_1) \tag{16}$$

Long-term investors make investment decisions at $t = 0$. The budget constraint is defined over three periods:

$$W_{i2}^{LT} = r^2(W_0 - q_{i0}^{LT} p_0) + q_{i0}^{LT}(d_1 r + d_2) \tag{17}$$

Demand shocks:

The economy is populated by a unit measure of noise traders at $t = 0$ and $t = 1$. These traders trade for non-informational reasons. Noise traders live for one period. Each noise trader sells x_0, x_1 shares of the asset at $t = 0, t = 1$, respectively, where $x_0, x_1 \sim N(0, \tau_x^{-1})$ are i.i.d. and are independent of other shocks in the model. The noise traders' demand is not revealed to the market participants over periods. This setup avoids price and long-term investors' demand from becoming fully revealed at $t = 1$. There are no noise traders at $t = 2$. Agents at $t = 2$ liquidate the position and collect dividends.

Information sets:

The information sets are defined recursively: The first is the variables that are known to agent i at the start of period 0. This information set is $\{y_0, d_0\} \equiv I_0^-$. This is what investors know when they choose which signals to acquire at the start of period 0. The information set at the end of period 0 is $\{I_0^-, \eta_{xi00}, \eta_{fi01}, \eta_{fi02}, p_0\} \equiv I_{i0}$. This includes the three signals that investors choose to observe and the information contained in the equilibrium prices. Specifically:

- At the start of period 0: $\{y_0, d_0\} \equiv I_0^-$
- At the end of period 0: $\{I_0^-, \eta_{xi00}^{ST}, \eta_{fi01}^{ST}, \eta_{fi02}^{ST}, p_0\} \equiv I_{i0}^{ST}$, $\{I_0^-, \eta_{xi00}^{LT}, \eta_{fi01}^{LT}, \eta_{fi02}^{LT}, p_0\} \equiv I_{i0}^{LT}$
- At the start of period 1: $\{I_0^{ST}, y_1, d_1\} \equiv I_1^{ST-}$, $\{I_0^{LT}, y_1, d_1\} \equiv I_1^{LT-}$
- At the end of period 1: $\{I_1^{ST-}, \eta_{xi11}^{ST}, \eta_{fi12}^{ST}, p_1\} \equiv I_{i1}^{ST}$, $\{I_1^{LT-}, p_1\} \equiv I_{i1}^{LT}$

The dividend innovations y_0, y_1, y_2 are revealed to market participants at the end of each period. The noise trader demands, x_0, x_1, do not reveal to market participants throughout the time periods. This prohibits the long-term investors' demand, and fundamental information y_2 becomes fully revealed at the end of $t = 1$.

Information choice:

Investors choose how much information to acquire or process about the next two periods' dividend innovation y_1, y_2, and also about the current-period noisy demand shocks x_0, x_1. Short-term investors and long-term investors have the same flexibility in making information choices. But because long-term investors make infrequent portfolio choices at $t = 0$; therefore, infrequent information choices at $t = 0$. The information choices for long-term investors made at $t = 0$ are across three periods, and long-term investors incorporate all the information that is valuable for the portfolio choice decision at $t = 0$.

The next two periods' fundamental signals can be acquired with different precision. The demand signal is i.i.d., and investors can only acquire the current-period demand signal. The fundamental signal and the demand signal innovations are defined in the following.

Long-term investors' information choices at $t = 0$ are defined as:

$$\eta_{xi00}^{LT} = x_0 + \epsilon_{xi00}^{LT}, \text{where } \epsilon_{xi00}^{LT} \sim N(0, (\Omega_{xi00}^{LT})^{-1}) \tag{18}$$

$$\eta^{LT}_{fi01} = y_1 + \epsilon^{LT}_{fi01}, \text{where } \epsilon^{LT}_{fi01} \sim N(0, (\Omega^{LT}_{fi01})^{-1}) \tag{19}$$

$$\eta^{LT}_{fi02} = y_2 + \epsilon^{LT}_{fi02}, \text{where } \epsilon^{LT}_{fi02} \sim N(0, (\Omega^{LT}_{fi02})^{-1}) \tag{20}$$

Short-term investors' information choices at $t = 0$ are defined as:

$$\eta^{ST}_{xi00} = x_0 + \epsilon^{ST}_{xi00}, \text{where } \epsilon^{ST}_{xi00} \sim N(0, (\Omega^{ST}_{xi00})^{-1}) \tag{21}$$

$$\eta^{ST}_{fi01} = y_1 + \epsilon^{ST}_{fi01}, \text{where } \epsilon^{ST}_{fi01} \sim N(0, (\Omega^{ST}_{fi01})^{-1}) \tag{22}$$

$$\eta^{ST}_{fi02} = y_2 + \epsilon^{ST}_{fi02}, \text{where } \epsilon^{ST}_{fi02} \sim N(0, (\Omega^{ST}_{fi02})^{-1}) \tag{23}$$

Short-term investors' information choices at $t = 1$ are defined as:

$$\eta^{ST}_{xi11} = x_1 + \epsilon^{ST}_{xi11}, \text{where } \epsilon^{ST}_{xi11} \sim N(0, (\Omega^{ST}_{xi11})^{-1}) \tag{24}$$

$$\eta^{ST}_{fi12} = y_2 + \epsilon^{ST}_{fi12}, \text{where } \epsilon^{ST}_{fi12} \sim N(0, (\Omega^{ST}_{fi12})^{-1}) \tag{25}$$

A.2 Equilibrium

The equilibrium is a sequence of short-term and long-term investors' information choices, portfolio choices, and prices such that agents' optimal demands are equal to the supply of the risky assets.

Information choice optimization:

Similar to Farboodi and Veldkamp (2020), the total information processing constraints K are constant for both short-term investors and long-term investors.

$$K_0 + K_1 = K \tag{26}$$

where K_0 and K_1 are the total information processing constraints at $t = 0$ and $t = 1$. Short-term investors choose the information choices to maximize the two-period utility over the terminal wealth:

At $t = 1$:

$$V_1(W_{i1}|I_{i1}^{ST-}) = \max_{\Omega_{xi11}^{ST}, \Omega_{fi12}^{ST}} E_1[U(W_{i2}^{ST})|I_{i1}^{ST-})] \tag{27}$$

s.t.

$$(\Omega_{fi12}^{ST})^2 + X_x(\Omega_{xi11}^{ST})^2 \leq K_1 \tag{28}$$

At $t = 0$:

$$\max_{\Omega_{xi00}^{ST}, \Omega_{fi01}^{ST}, \Omega_{fi02}^{ST}} E_0[V_1(W_{i1}|I_{i1}^{ST-})|I_{i0}^{ST-}] \tag{29}$$

s.t.

$$(\Omega_{fi01}^{ST})^2 + X_x(\Omega_{xi00}^{ST})^2 + X_f(\Omega_{fi02}^{ST})^2 \leq K_0 \tag{30}$$

where

$$K_0 + K_1 \leq K \tag{31}$$

Long-term investors choose the information choices to maximize utility over terminal wealth:

$$\max_{\Omega_{xi00}^{LT}, \Omega_{fi01}^{LT}, \Omega_{fi02}^{LT}} E_0[U(W_{i2}^{LT}|I_{i0}^{LT-})] \tag{32}$$

s.t. a one-period information processing constraint at $t = 0$:

$$(\Omega_{fi01}^{LT})^2 + X_x(\Omega_{xi00}^{LT})^2 + X_f(\Omega_{fi02}^{LT})^2 \leq K \tag{33}$$

Here, X_x, X_f are the relative processing costs for the demand signal at $t = 1$, and the fundamental signal at $t = 2$, compared to the processing cost of the fundamental signal at $t = 1$.

Portfolio choice optimization:

At $t = 1$, short-term investors maximize over one period:

$$\max_{q_{i1}^{ST}} E_1[q_{i1}^{ST}(d_2 - rp_1)|I_{i1}^{ST}] - \frac{\lambda}{2}Var_1[q_{i1}^{ST}(d_2 - rp_1)|I_{i1}^{ST}] \tag{34}$$

s.t. budget constraint:

$$W_{i2}^{ST} = r(W_{i1}^{ST} - q_{i1}^{ST}p_1) + q_{i1}^{ST}d_2 \tag{35}$$

Plugging the optimal demand q_{i1}^{ST*} into the value function at $t = 1$ yields a simple exponential-affine form:

$$V_1(W_1|I_{i1}^{ST}) = E_1[-\text{exp}(-\lambda[rW_{i1}^{ST} + q_{i1}^{ST*}(d_2 - rp_1)] \tag{36}$$

At $t = 0$, short-term investors maximize utility over one period.

$$\max_{q_{i0}^{ST}} E_0[V_1(W_1|I_{i1}^{ST})] = \max_{q_{i0}^{ST}} E_0[E_1[-\text{exp}(-\lambda[rW_{i1}^{ST} + q_{i1}^{ST*}(d_2 - rp_1)]] \tag{37}$$

s.t. budget constraint:

$$W_{i1}^{ST} = r(W_0 - q_{i0}^{ST}p_0) + q_{i0}^{ST}(p_1 + d_1) \tag{38}$$

At $t = 0$, long-term investors maximize utility over a two-period window:

$$\max_{q_{i0}^{LT}} U_0^{LT} = \max_{q_{i0}^{LT}}(E_0[q_{i0}^{LT}(rd_1 + d_2 - r^2p_0)|I_{i0}^{LT}] - \frac{\lambda}{2}Var_0[q_{i0}^{LT}(rd_1 + d_2 - r^2p_0)|I_{i0}^{LT})] \tag{39}$$

s.t. budget constraint:

$$W_{i2}^{LT} = r^2(W_0 - q_{i0}^{LT}p_0) + q_{i0}^{LT}(d_1r + d_2) \tag{40}$$

Optimal demand:

The short-term investors' optimal demand at $t = 1$ is:

$$q_{i1}^{ST*} = \frac{E_1[d_2|I_{i1}^{ST}] - rp_1}{\lambda Var_1[d_2|I_{i1}^{ST}]} \tag{41}$$

The short-term investors' optimal demand at $t = 0$ is:

$$q_{i0}^{ST*} = \frac{E_0[p_1 + d_1|I_{i0}^{ST}] - rp_0}{\lambda Var_0[p_1 + d_1|I_{i0}^{ST}]} \tag{42}$$

The short-term investors' optimal demand at $t = 0$ is equal to the myopic demand because the continuation value $V_1(W_{i1}^{ST}|I_{i1}^{ST})$ does not depend on the state variable d_1.

The long-term investors' optimal demand at $t = 0$ is:

$$q_{i0}^{LT*} = \frac{E_0[rd_1 + d_2|I_{i0}^{LT}] - r^2 p_0}{\lambda Var_0[rd_1 + d_2|I_{i0}^{LT}]} \tag{43}$$

Equilibrium:

An equilibrium is a sequence of short-term investors' information choices $\Omega_{xi00}^{ST}, \Omega_{fi01}^{ST}, \Omega_{fi02}^{ST}$ (at $t = 0$), $\Omega_{xi11}^{ST}, \Omega_{fi12}^{ST}$ (at $t = 1$) and long-term investors' information choices $\Omega_{xi00}^{LT}, \Omega_{fi01}^{LT}, \Omega_{fi02}^{LT}$ (at $t = 0$), prices p_0, p_1, and portfolio choices $q_{i0}^{ST}, q_{i1}^{ST}, q_{i0}^{LT}$, such that:

1. Short-term investors choose signal precisions Ω_{xi00}^{ST}, Ω_{fi01}^{ST}, and Ω_{fi02}^{ST} at $t = 0$, Ω_{xi11}^{ST}, Ω_{fi12}^{ST} at $t = 1$ to maximize utility, taking the choices of other agents as given. This choice is subject to the information technology constraint, and $\Omega_{xi00}^{ST} \geq 0$, $\Omega_{fi01}^{ST} \geq 0$, $\Omega_{fi02}^{ST} \geq 0$, $\Omega_{fi12}^{ST} \geq 0$, $\Omega_{xi11}^{ST} \geq 0$.

2. Long-term investors choose signal precisions $\Omega_{xi00}^{LT}, \Omega_{fi01}^{LT},$ and Ω_{fi02}^{LT} at $t = 0$ to maximize utility, taking the choices of other agents as given. This choice is subject to the information technology constraint, and $\Omega_{xi00}^{LT} \geq 0$, $\Omega_{fi01}^{LT} \geq 0$, $\Omega_{fi02}^{LT} \geq 0$.

3. At $t = 0$, short-term investors use Bayes' law to combine prior information I_0^- with signals η_{xi00}^{ST},η_{fi01}^{ST}, η_{fi02}^{ST} and p_0 in I_0^{ST}, and to update beliefs. At $t = 1$, short-term

investors use Bayes' law to combine prior information I_1^- with signals η_{xi11}^{ST}, η_{fi12}^{ST} and p_1 in I_1^{ST}, and to update beliefs. At $t = 0$, long-term investors use Bayes' law to combine prior information I_0^- with signals η_{xi00}^{LT}, η_{fi01}^{LT}, η_{fi02}^{LT}, and p_0 in I_0^{LT}, and to update beliefs.

4. At $t = 0$, short-term investors choose their risky asset investment q_{i0}^{ST} to maximize the utility, taking the asset price and the actions of other agents as given, subject to the budget constraint. At $t = 1$, short-term investors choose their risky asset investment q_{i1}^{ST} to maximize the utility, taking the asset price and the actions of other agents as given, subject to the budget constraint. At $t = 0$, long-term investors choose risky asset investments q_{i0}^{LT} to maximize the utility, taking the asset price and the actions of other agents as given, subject to the budget constraint.

5. At each date t, the risky asset price equates demand, minus demand shocks (sales), and one unit of supply. The measure of short-term investors is m, the measure of long-term investors is $1 - m$. The market-clearing condition at $t = 0$ and $t = 1$ are:

$$mq_{i0}^{ST} + (1 - m)q_{i0}^{LT} - x_0 = 1 \tag{44}$$

$$mq_{i1}^{ST} + (1 - m)q_{i0}^{LT} - x_1 = 1 \tag{45}$$

A.3 Solving the model

A.3.1 Solving price function

At $t = 0$, the price function is a linear combination of current dividend $d_0 - \mu$, the dividend innovation y_1 at $t = 1$, the dividend innovation y_2 at $t = 2$, and the noise trader supply x_0 at $t = 0$:

$$p_0 = A_0 + B_0(d_0 - \mu) + C_0 y_1 + D_0 x_0 + E_0 y_2 \tag{46}$$

At $t = 1$, the price function is a linear combination of current dividend $d_1 - \mu$, the dividend innovation y_2 at $t = 2$, and the noise trader supply x_1 at $t = 1$:

$$p_1 = A_1 + B_1(d_1 - \mu) + C_1 y_2 + D_1 x_1 \tag{47}$$

Risky asset market clearing condition at $t = 0$ satisfies:

$$m\frac{E_0[p_1 + d_1 | I_{i0}^{ST}] - rp_0}{\lambda Var_0[p_1 + d_1 | I_{i0}^{ST}]} + (1-m)\frac{E_0[rd_1 + d_2 | I_{i0}^{LT}] - r^2 p_0}{\lambda Var_0[rd_1 + d_2 | I_{i0}^{LT}]} = 1 + x_0 \tag{48}$$

Matching the coefficients of x_0, y_1, y_2, the price function at $t = 0$ is solved as per the following:

$$\begin{aligned} A_0 = & \frac{mVar_0^{LT}[A_1 + \mu + (1+B_1)\rho y_0 + C_1\rho^2 y_0]}{rmVar_0^{LT} + (1-m)r^2 Var_0^{ST}} \\ & + \frac{(1-m)Var_0^{ST}[(1+r)\mu + (r+G)\rho y_0 + \rho^2 y_0]}{rmVar_0^{LT} + (1-m)r^2 Var_0^{ST}} \\ & - \frac{\lambda Var_0^{ST} Var_0^{LT}}{rmVar_0^{LT} + (1-m)r^2 Var_0^{ST}} \\ & - (C_0 + \rho E_0)\rho y_0 \end{aligned} \tag{49}$$

$$B_0 = \frac{m(B_1 G + G)Var_0^{LT} + (1-m)(rG + G^2)Var_0^{ST}}{rmVar_0^{LT} + (1-m)r^2 Var_0^{ST}} = \frac{G^2 + rG}{r^2} \tag{50}$$

$$\begin{aligned} C_0 + \rho E_0 = & \frac{m[1 + B_1 + C_1\rho]\frac{\Omega_{pi0}^{ST} + \Omega_{fi01}^{ST}}{\tau_0 + \Omega_{pi0}^{ST} + \Omega_{fi01}^{ST}} + C_1\frac{\Omega_{pi0}^{ST} + \rho\Omega_{fi02}^{ST}}{\tau_0 + \Omega_{pi0}^{ST} + \Omega_{fi02}^{ST}}}{[mrVar_0^{LT} + (1-m)r^2 Var_0^{ST}]} * Var_0^{LT} \\ & + \frac{(1-m)[(r + G + \rho)\frac{\Omega_{pi0}^{LT} + \Omega_{fi01}^{LT}}{\tau_0 + \Omega_{pi0}^{LT} + \Omega_{fi01}^{LT}} + \frac{\Omega_{pi0}^{LT} + \rho\Omega_{fi02}^{LT}}{\tau_0 + \Omega_{pi0}^{LT} + \Omega_{fi02}^{LT}}}{[mrVar_0^{LT} + (1-m)r^2 Var_0^{ST}]} * Var_0^{ST} \end{aligned} \tag{51}$$

$$\begin{aligned} E_0 = & \frac{m[1 + B_1 + C_1\rho]\frac{\Omega_{pi0}^{ST} * \frac{E_0}{C_0 + \rho E_0}}{\tau_0 + \Omega_{pi0}^{ST} + \Omega_{fi01}^{ST}} + C_1\frac{\Omega_{pi0}^{ST} * \frac{E_0}{C_0 + \rho E_0} + \Omega_{fi02}^{ST}}{\tau_0 + \Omega_{pi0}^{ST} + \Omega_{fi02}^{ST}}}{[mrVar_0^{LT} + (1-m)r^2 Var_0^{ST}]} * Var_0^{LT} \\ & + \frac{(1-m)[r + G + \rho]\frac{\Omega_{pi0}^{LT} * \frac{E_0}{C_0 + \rho E_0}}{\tau_0 + \Omega_{pi0}^{LT} + \Omega_{fi01}^{LT}} + \frac{\Omega_{pi0}^{LT} * \frac{E_0}{C_0 + \rho E_0} + \Omega_{fi02}^{LT}}{\tau_0 + \Omega_{pi0}^{LT} + \Omega_{fi02}^{LT}}}{[mrVar_0^{LT} + (1-m)r^2 Var_0^{ST}]} * Var_0^{ST} \end{aligned} \tag{52}$$

$$D_0 = \frac{m[(1+B_1+C_1\rho)\frac{\Omega^{ST}_{pi0}*\frac{\tau_x}{\tau_x+\Omega^{ST}_{xi00}}}{\tau_0+\Omega^{ST}_{pi0}+\Omega^{ST}_{fi01}} + C_1\frac{\Omega^{ST}_{pi0}*\frac{D_0}{C_0+\rho E_0}*\frac{\tau_x}{\tau_x+\Omega^{ST}_{xi00}}}{\tau_0+\Omega^{ST}_{pi0}+\Omega^{ST}_{fi02}}]}{[mrVar^{LT}_0+(1-m)r^2Var^{ST}_0]} * Var^{LT}_0$$
$$+ \frac{(1-m)[(r+G+\rho)\frac{\Omega^{LT}_{pi0}*\frac{\tau_x}{\tau_x+\Omega^{LT}_{xi00}}}{\tau_0+\Omega^{LT}_{pi0}+\Omega^{LT}_{fi01}} + \frac{\Omega^{LT}_{pi0}*\frac{D_0}{C_0+\rho E_0}*\frac{\tau_x}{\tau_x+\Omega^{LT}_{xi00}}}{\tau_0+\Omega^{LT}_{pi0}+\Omega^{LT}_{fi02}}]}{[mrVar^{LT}_0+(1-m)r^2Var^{ST}_0]} * Var^{ST}_0$$
$$- \frac{\lambda Var^{ST}_0 Var^{LT}_0}{[mrVar^{LT}_0+(1-m)r^2Var^{ST}_0]} \tag{53}$$

where

$$\Omega^{ST}_{pi0} = (\frac{C_0+\rho E_0}{D_0})^2(\tau_x+\Omega^{ST}_{xi00}) \tag{54}$$

$$\Omega^{LT}_{pi0} = (\frac{C_0+\rho E_0}{D_0})^2(\tau_x+\Omega^{LT}_{xi00}) \tag{55}$$

Risky asset market clearing condition at $t=1$ satisfies:

$$m\frac{E[d_2|I^{ST}_{i1}]-rp_1}{\lambda Var_1[d_2|I^{ST}_{i1}]} + (1-m)\frac{E_0[rd_1+d_2|I^{LT}_{i0}]-r^2p_0}{\lambda Var_0[rd_1+d_2|I^{LT}_{i0}]} = 1+x_1 \tag{56}$$

Or:

$$m\frac{E[d_2|I^{ST}_{i1}]-rp_1}{\lambda Var_1[d_2|I^{ST}_{i1}]} = 1+x_1-(1-m)q^{LT}_{i0} \tag{57}$$

Matching the coefficients of x_1, y_2, the price function at $t=1$ is solved as per the following:

$$A_1 = \frac{m[\mu+\rho y_1]-\lambda[1-(1-m)q^{LT}_{i0}]Var_1[v_2|I^{ST}_{i1}]}{rm} - C_1\rho y_1$$
$$+ \frac{1}{r}\frac{(\Omega^{ST}_{fi1}+\Omega^{ST}_{fi2})\rho y_1 + \tilde{\Omega}^{ST}_{pi0}(y_1+\frac{D_0}{C_0+\rho E_0}\frac{\tau_x}{\tau_x+\Omega_{xi0}}x_1)}{\tau_0+\Omega^{ST}_{fi02}+\Omega^{ST}_{fi12}+\tilde{\Omega}^{ST}_{pi0}+\Omega^{ST}_{pi1}} \tag{58}$$

$$B_1 = \frac{G}{r} \tag{59}$$

$$C_1 = \frac{1}{r}[\frac{\Omega^{ST}_{fi02}+\Omega^{ST}_{fi12}+\tilde{\Omega}^{ST}_{pi0}\frac{E_0}{C_0+\rho E_0}+\Omega^{ST}_{pi1}}{\tau_0+\Omega^{ST}_{fi02}+\Omega^{ST}_{fi12}+\tilde{\Omega}^{ST}_{pi0}+\Omega^{ST}_{pi1}}] \tag{60}$$

$$D_1 = \frac{1}{r}[\frac{\Omega^{ST}_{pi1}*(D_1/C_1)*\frac{\tau_x}{\tau_x+\Omega^{ST}_{xi11}}}{\tau_0+\Omega^{ST}_{fi02}+\Omega^{ST}_{fi12}+\tilde{\Omega}^{ST}_{pi0}+\Omega^{ST}_{pi1}}] - \frac{\lambda}{rm}\frac{1}{\tau_0+\Omega^{ST}_{fi02}+\Omega^{ST}_{fi12}+\tilde{\Omega}^{ST}_{pi0}+\Omega^{ST}_{pi1}} \tag{61}$$

The ex-post price precision $\tilde{\Omega}_{pi0}^{ST}$ is different from the ex-ante price precision Ω_{pi0}^{ST} because short-term investors update their beliefs on the dividend signal y_2 in p_0 at $t = 1$ when the dividend signal y_1 is revealed to the market participants. The ex-post price precision $\tilde{\Omega}_{pi0}^{ST}$ is calculated as the following.

$$\tilde{\Omega}_{pi0}^{ST} = (E_0/D_0)^2(\tau_x + \Omega_{xi00}^{ST}) \tag{62}$$

And the price precision at $t = 1$ is:

$$\Omega_{pi1}^{ST} = (C_1/D_1)^2(\tau_x + \Omega_{xi11}^{ST}) \tag{63}$$

A.3.2 Solving optimal information choice

Short-term investors' information choices are determined over two periods via backward induction, where short-term investors minimize the total payoff variance over two periods. The utility maximization with CARA utility is equivalent to the minimization of the payoff variance.

At $t = 1$, short-term investors minimize the variance of payoff at $t = 2$:

$$\min Var_1^{ST}(\Omega_{xi11}^{ST}, \Omega_{fi12}^{ST}) \equiv Var_1[d_2|I_{i1}^{ST}] = Var_1[y_2|I_{i1}^{ST}] = Var_1[v_2|I_{i1}^{ST}] \tag{64}$$

s.t.

$$(\Omega_{fi12}^{ST})^2 + X_x(\Omega_{xi11}^{ST})^2 \leq K_1 \tag{65}$$

At $t = 0$, short-term investors minimize the variance of the payoff at $t = 1$:

$$\begin{aligned}\min Var_0^{ST}(\Omega_{fi01}^{ST}, \Omega_{xi00}^{ST}, \Omega_{fi02}^{ST}) \equiv Var_0[p_1 + d_1 | I_{i0}^{ST}] = (1 + B_1 + C_1\rho)^2 Var_0[v_1 | I_{i0}^{ST}] \\ + C_1^2 Var_0[v_2 | I_{i0}^{ST}] \\ + 2(1 + B_1 + C_1\rho) C_1 Cov_0[v_1, v_2 | I_{i0}^{ST}]) \\ + D_1^2 \tau_x^{-1}\end{aligned} \tag{66}$$

s.t.

$$(\Omega_{fi01}^{ST})^2 + X_x(\Omega_{xi00}^{ST})^2 + X_f(\Omega_{fi02}^{ST})^2 \leq K_0 \tag{67}$$

where the total information resource budget constraint is:

$$K_0 + K_1 \leq K$$

The short-term investors' optimization at $t = 1$ is similar to the one-period model optimization in Farboodi and Veldkamp (2020), where

$$Var_1[v_2 | I_{i1}^{ST}] = (\tau_0 + \tilde{\Omega}_{pi0}^{ST} + \Omega_{pi1}^{ST} + \Omega_{fi02}^{ST} + \Omega_{fi12}^{ST})^{-1} \tag{68}$$

$$\tilde{\Omega}_{pi0}^{ST} = (E_0/D_0)^2(\tau_x + \Omega_{xi00}^{ST}) \tag{69}$$

$$\Omega_{pi1}^{ST} = (C_1/D_1)^2(\tau_x + \Omega_{xi11}^{ST}) \tag{70}$$

The first order condition yields the following optimal information choice:

$$\Omega_{xi11}^{ST} = \frac{1}{X_x}(C_1/D_1)^2 \Omega_{fi12}^{ST} \tag{71}$$

Long-term investors' information choice optimization is determined by the following variance minimization problem.

$$\begin{aligned}
&\min Var_0^{LT}(\Omega_{fi01}^{LT}, \Omega_{xi00}^{LT}, \Omega_{fi02}^{LT}) \equiv Var_0[rd_1 + d_2|I_{i0}^{LT}] \\
&= (r+G+\rho)^2 Var_0[v_1|I_{i0}^{LT}] \\
&+ Var_0[v_2|I_{i0}^{LT}] \\
&+ 2(r+G+\rho)Cov_0[v_1, v_2|I_{i0}^{LT}]
\end{aligned} \tag{72}$$

s.t.

$$(\Omega_{fi01}^{LT})^2 + X_x(\Omega_{xi00}^{LT})^2 + X_f(\Omega_{fi02}^{LT})^2 \leq K \tag{73}$$

For both types of investors, the conditional variance $Var_0[v_1|\eta_{pi0}, \eta_{fi0}, \eta_{fi1}]$, $Var_0[v_2|\eta_{pi0}, \eta_{fi1}]$, and $Cov_0[v_1, v_2|\eta_{pi0}, \eta_{fi0}, \eta_{fi1}]$ are determined by the Bayesian updating and are calculated as:

$$Var_0[v_1|\eta_{pi0}, \eta_{fi0}, \eta_{fi1}] = \frac{\tau_0 + \frac{1}{d_0^2}(\tau_x + \Omega_{xi01})e_0^2 + \Omega_{fi02}}{\tau_0^2 + \tau_0[\frac{1}{d_0^2}(\tau_x + \Omega_{xi01})(1+e_0^2) + \Omega_{fi01} + \Omega_{fi02}(1+\rho^2)] + \Omega_{fi01}\Omega_{fi02}(1-e_0\rho)^2 + \Omega_{fi01}(\frac{1}{d_0^2}(\tau_x + \Omega_{xi01})e_0^2 + \Omega_{fi02})} \tag{74}$$

$$Var_0[v_2|\eta_{pi0}, \eta_{fi1}] = \frac{\tau_0 + \frac{1}{d_0^2}(\tau_x + \Omega_{xi01}) + \Omega_{fi01} + \Omega_{fi02}\rho^2}{\tau_0^2 + \tau_0[\frac{1}{d_0^2}(\tau_x + \Omega_{xi01})(1+e_0^2) + \Omega_{fi01} + \Omega_{fi02}(1+\rho^2)] + \Omega_{fi01}\Omega_{fi02}(1-e_0\rho)^2 + \Omega_{fi01}(\frac{1}{d_0^2}(\tau_x + \Omega_{xi01})e_0^2 + \Omega_{fi02})} \tag{75}$$

$$Cov_0[v_1, v_2|\eta_{pi0}, \eta_{fi0}, \eta_{fi1}] = \frac{-(\frac{1}{d_0^2}(\tau_x + \Omega_{xi01})e_0 + \Omega_{fi02}\rho)}{\tau_0^2 + \tau_0[\frac{1}{d_0^2}(\tau_x + \Omega_{xi01})(1+e_0^2) + \Omega_{fi01} + \Omega_{fi02}(1+\rho^2)] + \Omega_{fi01}\Omega_{fi02}(1-e_0\rho)^2 + \Omega_{fi01}(\frac{1}{d_0^2}(\tau_x + \Omega_{xi01})e_0^2 + \Omega_{fi02}} \tag{76}$$

where

$$e_0 = \frac{E_0}{C_0 + \rho E_0} \tag{77}$$

$$d_0 = \frac{D_0}{C_0 + \rho E_0} \tag{78}$$

The optimal information choices at $t = 0$ are determined by first-order conditions. I haven't found closed-form solutions for the optimal information choice at $t = 0$. And the optimal information choices are solved numerically via a fixed-point approach.

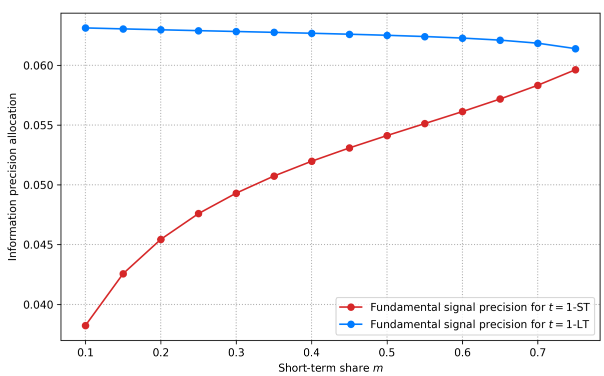
A.4 Model prediction

The model generates the information choice predictions and the price informativeness predictions.

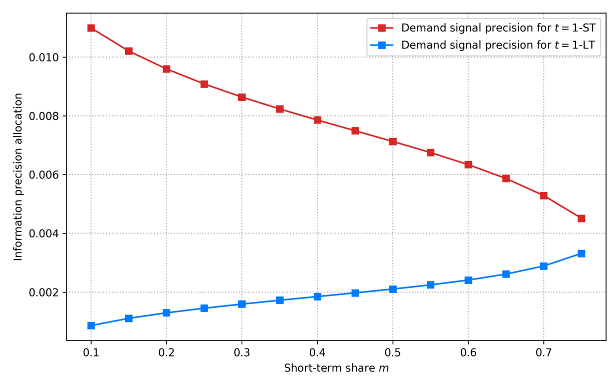
Prediction on information choice

- Long-term investors allocate more resources to future fundamental signal precision.
- Short-term investors allocate more resources to current demand signal precision.

Figure 7: Information choice prediction by long-term investors and short-term investors



Panel A: Information choice vs short-term share m (Ω_{fi01})

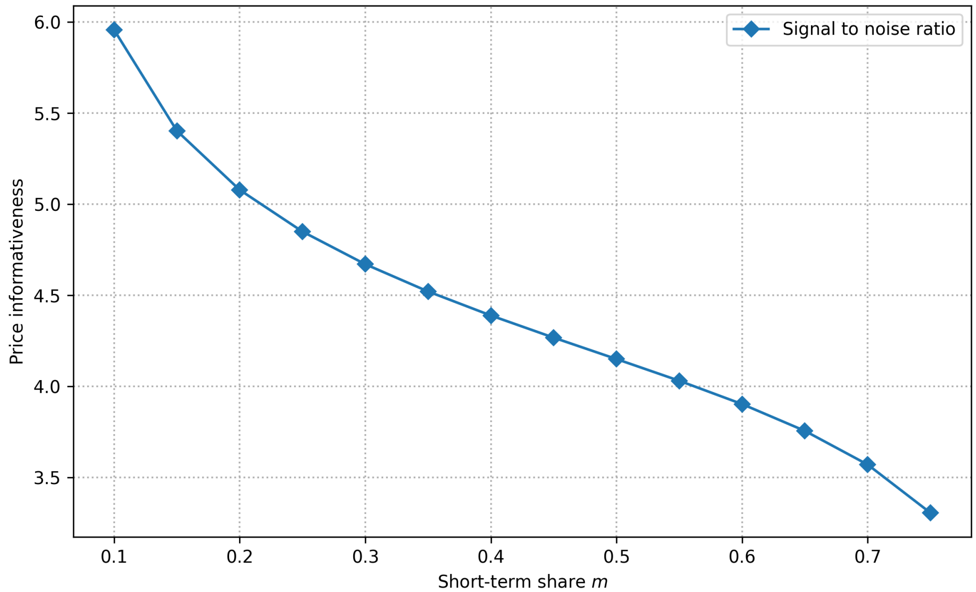


Panel B: Information choice vs short-term share m (Ω_{xi00})

Prediction on price informativeness

- As the share of long-term investors increases, the price becomes more informative about the fundamentals.

Figure 8: Price informativeness and short-term share m



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