Belief Polarization, Information Bias, and Financial Markets
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Abstract

This paper studies how belief polarization affects financial markets. I develop an equilibrium model with two groups of investors whose polarized views are driven by biased private signals. Investors trade competitively in the market based on public information revealed by the equilibrium asset price and private information accumulated through word-of-mouth communication. Investors’ unconscious biases lead to belief divergence and generate excess volatility and trading volume. The information-sharing process amplifies these effects. The public asset price does not fully eliminate investors’ unconscious biases.

Motivation

Why are people’s views polarized? One possible explanation: unconscious bias (Hirshleifer, 2020; Akcay and Hirshleifer, 2021) in information possibly from trading volume. The information-sharing process amplifies these effects. The information accumulated through word-of-mouth communication. Investors’ unconscious biases lead to belief divergence and generate excess volatility and trading volume. The information-sharing process amplifies these effects. The public asset price does not fully eliminate investors’ unconscious biases.

Theoretical Model

Standard CARA-normal competitive market with dynamic NREE.
- OLG framework: $s$ from generation $t-1$ trades at date $t$, consumes at date $t+1$.
- Two groups: $g \in \{A, B\}$ has a continuum of investors with risk-aversion $\frac{1}{\gamma}$.
- K risky assets: pay dividends $D_i = q_i / \epsilon_i$, $U_t \sim N(0, \tau^{-1})$ is a common factor.
- Private signal: At date $t$, $i \in g$ receives biased noisy signals about $D_{t+1}$:
  \[ S_i^t = \eta(t_{i,t} + \delta_i) + \epsilon_{i,t} \in N(0, \tau^{-1}) \]
  Unconscious bias $\delta_i$ is unobservable, and investors are unaware of it.
- Public signal: At date $t$, $i$ observes equilibrium market prices $P_t$.
- i’s distorted beliefs about $\lambda$: private information:
  \[ S_i^t = D_{t+1} + \epsilon_{i,t} \]  
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An Intentional Interpretation for Unconscious Biases

Unconscious bias $\delta_i$ is the endogenous result of information percolation process (Duffie et al., 2009) with echo chambers.
- From $t-1$ to $t$: Investors randomly meet and share endogenous signals about $U_{t+1}$:
  \[ Z_{i,t} = U_{t+1} + \eta_i \sim N(0, \tau^{-1}) \]
- Meetings: take place continuously at Poisson arrival times with intensity $\lambda$.
- Echo Chambers: governed by “tolerance-to-listen” parameter $\beta_i > 0$.

\[ \begin{array}{c|c}
\text{Meeting} & \text{Statement} \\
\hline
\text{in } A & \text{accept signal} \Rightarrow \text{awareness } = \delta_i, \beta_i > 0 \\
\text{in } B & \text{reject signal} \Rightarrow \text{awareness } = \delta_i, \beta_i > 0
\end{array} \]

If $\beta_i \rightarrow \infty$, $i \in g$ has open mind and is not restricted by echo chambers. If $\beta_i \rightarrow 0$, $i \in g$ has a “silo” mentality and does not accept less extreme views.

- Polarization case: information percolation + echo chambers.
- Benchmark case: no echo chamber channel by letting $\beta_i, \delta_i \rightarrow \infty$.
- $\delta_i$ is defined as the group distortion comparing the two cases.
- An simulated example: $\beta_i = 10,000$, number of investors $= 100,000$, $\tau = 0.01$.

Main finding: Communication of investors amplifies belief polarization while market price helps to reduce belief polarization.

Result 1: Distorted Learning and Equilibrium

At trading date $t$, i learns about $D_{t+1}$ under Gaussian updating. The misinterpretation of information distorts investor $i$’s learning process.
- Conditional variance is not affected by the unconscious bias: $\operatorname{Var}[D_{t+1}^2] = \eta^2(t_{i,t} + \delta_i + 1) + \tau^{-1}$
- Conditional expectation is affected by the unconscious bias: $E[D_{t+1}^2] = \operatorname{Var}[D_{t+1}]^2(t_{i,t} + \delta_i + 1) + \operatorname{Var}[\delta_i] + \operatorname{Var}[D_{t+1}]^2 + \operatorname{Var}[\delta_i]$

The true equilibrium asset pricing function is given by

\[ P_t = D_{t+1} + \frac{1}{2} \delta_i + \delta_i \eta \frac{\tau}{\gamma} X_t \]

Main finding: Unconscious biases have an equilibrium aggregate effect!

Result 2: Belief Polarization

Definition: Belief polarization $P_t$ is measured as the distance between the average beliefs of the two groups about the future dividends $D_{t+1}$:

\[ P_t = \int_{-\infty}^{\infty} \mathbb{E}[D_{t+1}|\mathcal{F}_t] \, dt - \int_{-\infty}^{\infty} \mathbb{E}[D_{t+1}|\mathcal{F}_t] \, dt \]

\[ = \int_{-\infty}^{\infty} \mathbb{E}[D_{t+1}|\mathcal{F}_t] \, dt \int_{-\infty}^{\infty} \mathbb{E}[D_{t+1}|\mathcal{F}_t] \, dt \]

\[ \frac{\partial}{\partial \delta_i} = \frac{\int_{-\infty}^{\infty} \mathbb{E}[D_{t+1}|\mathcal{F}_t] \, dt}{\int_{-\infty}^{\infty} \mathbb{E}[D_{t+1}|\mathcal{F}_t] \, dt} \]

\[ \text{Belief polarization exists only when there are biases.} \]

- The larger absolute values of $|\delta_i|$, the larger the belief polarization.
- Take one risky asset as an example:

Main finding: Belief polarization percolates with echo chambers, after the election, the Republican-affiliated group $\mathcal{P}$ will take more equity shares than the Democratic-affiliated group $\mathcal{R}$ at $t = 1$.

\[ \int_{-\infty}^{\infty} \mathbb{V}(x) \, dx - \int_{-\infty}^{\infty} \mathbb{V}(x) \, dx \]

If the partisanship bias $\delta$ is significant or investors meet at high intensity, the Democratic-affiliated group $\mathcal{P}$ rebalances into the safe asset while the Republican-affiliated group $\mathcal{R}$ increases the equity holding (Meeusen et al., 2020). These effects are attenuated if information percolates without echo chambers.

References