

CHILE

Efstathios (Stathi) Avdis
(University of Alberta)

Sergei Glebkin
(INSEAD)

AFA 2024

CHILE

- We propose a new asymmetric-information asset pricing framework
- It allows for general and heterogeneous utilities, heterogeneous information, and general payoff distributions

CHILE

- We propose a new asymmetric-information asset pricing framework
- It allows for general and heterogeneous utilities, heterogeneous information, and general payoff distributions
- We consider a **L**arge **E**conomy (=continuum of agents)

CHILE

- We propose a new asymmetric-information asset pricing framework
- It allows for general and heterogeneous utilities, heterogeneous information, and general payoff distributions
- We consider a **L**arge **E**conomy (=continuum of agents)
- With **H**eterogeneous **I**nformation

CHILE

- We propose a new asymmetric-information asset pricing framework
- It allows for general and heterogeneous utilities, heterogeneous information, and general payoff distributions
- We consider a **L**arge **E**conomy (=continuum of agents)
- With **H**eterogeneous **I**nformation
- We model information as a diffusion process, across agents.
Diffusions have **C**ontinuous paths
 - ▶ \Rightarrow **C**ontinuous **H**eterogeneous **I**nformation information structure

CHILE

- We propose a new asymmetric-information asset pricing framework
- It allows for general and heterogeneous utilities, heterogeneous information, and general payoff distributions
- We consider a **L**arge **E**conomy (=continuum of agents)
- With **H**eterogeneous **I**nformation
- We model information as a diffusion process, across agents.
Diffusions have **C**ontinuous paths
 - ▶ \Rightarrow **C**ontinuous **H**eterogeneous **I**nformation information structure
- **C**ontinuous **H**eterogeneous **I**nformation + **L**arge **E**conomy = **CHILE**

Question

How does **wealth inequality** affect **market quality**?

Question

How does wealth inequality affect market quality?

- wealth inequality = unequal size distribution of market participants
- size = AUM for institutional investors; wealth for individual investors
- market quality = liquidity, information efficiency and trading volume

Question

How does **wealth inequality** affect **market quality**?

- **wealth inequality** = unequal size distribution of market participants
- size = AUM for institutional investors; wealth for individual investors
- **market quality** = liquidity, information efficiency and trading volume
- Changes in **wealth inequality** represent:
 - ▶ At low frequency: Long-term changes in size distribution due to institutionalization, increasing concentration of asset management industry, and widening wealth inequality

Question

How does **wealth inequality** affect **market quality**?

- **wealth inequality** = unequal size distribution of market participants
- size = AUM for institutional investors; wealth for individual investors
- **market quality** = liquidity, information efficiency and trading volume
- Changes in **wealth inequality** represent:
 - ▶ At low frequency: Long-term changes in size distribution due to institutionalization, increasing concentration of asset management industry, and widening wealth inequality
 - ▶ At high frequency: Size distribution changes due to different kinds of traders (whales vs small fry) present at different times

Question

How does **wealth inequality** affect **market quality**?

CHILE is uniquely suited, as one needs a model with

- Wealth effects
- Heterogeneity
- Asymmetric information

The model

- time $\in \{1, 2\}$
- Risk-free asset, $R_f = 1$.
- Risky asset pays off $\text{Payoff}(v)$, $v \sim N(0, \tau_v^{-1})$
- Continuum of traders $a \in [0, 1)$
 - ▶ Trader a lives in $[a, a + da)$
 - ▶ Observes signal $ds(a) = v \cdot da + \frac{1}{\sqrt{t(a)}} dB$, precision $= t(a) \cdot da$

The model

- time $\in \{1, 2\}$
- Risk-free asset, $R_f = 1$.
- Risky asset pays off $\text{Payoff}(v)$, $v \sim N(0, \tau_v^{-1})$
- Continuum of traders $a \in [0, 1)$
 - ▶ Trader a lives in $[a, a + da)$
 - ▶ Observes signal $ds(a) = v \cdot da + \frac{1}{\sqrt{t(a)}} dB$, precision $= t(a) \cdot da$
- Trader a takes prices as given; being small, ignores his impact on:
 - ▶ price level and
 - ▶ info content of prices
- Maximizes $E[u(W_0(a) + x(\cdot)(R - 1); a)|P]$

The model

- time $\in \{1, 2\}$
- Risk-free asset, $R_f = 1$.
- Risky asset pays off $\text{Payoff}(v)$, $v \sim N(0, \tau_v^{-1})$
- Continuum of traders $a \in [0, 1)$
 - ▶ Trader a lives in $[a, a + da)$
 - ▶ Observes signal $ds(a) = v \cdot da + \frac{1}{\sqrt{t(a)}} dB$, precision $= t(a) \cdot da$
- Trader a takes prices as given; being small, ignores his impact on:
 - ▶ price level and
 - ▶ info content of prices
- Maximizes $E[u(W_0(a) + x(\cdot)(R - 1); a) | P]$
- **Rich heterogeneity:** $\{W_0(a), t(a), u(\cdot, a)\}$, arbitrary functions of $a \in [0, 1)$. General utilities.

The model

- time $\in \{1, 2\}$
- Risk-free asset, $R_f = 1$.
- Risky asset pays off $\text{Payoff}(v)$, $v \sim N(0, \tau_v^{-1})$
- Continuum of traders $a \in [0, 1)$
 - ▶ Trader a lives in $[a, a + da)$
 - ▶ Observes signal $ds(a) = v \cdot da + \frac{1}{\sqrt{t(a)}} dB$, precision $= t(a) \cdot da$
- Trader a takes prices as given; being small, ignores his impact on:
 - ▶ price level and
 - ▶ info content of prices
- Maximizes $E[u(W_0(a) + x(\cdot)(R - 1); a) | P]$
- **Rich heterogeneity:** $\{W_0(a), t(a), u(\cdot, a)\}$, arbitrary functions of $a \in [0, 1)$. General utilities.
- Tractable equilibrium with closed-form solutions in the most general case

How does inequality affect market quality?

Inequality is a double-edged sword:

- **Wealth inequality** is bad for **information efficiency** but is good for **liquidity and volume**:

making sufficiently rich richer and sufficiently poor poorer makes prices less informative, but increases liquidity and volume

How does inequality affect market quality?

Inequality is a double-edged sword:

- **Wealth inequality** is bad for **information efficiency** but is good for **liquidity and volume**:
making sufficiently rich richer and sufficiently poor poorer makes prices less informative, but increases liquidity and volume
- **Information inequality** is bad for **information efficiency** but is good for **liquidity and volume**:
making sufficiently rich more informed and sufficiently poor less informed makes prices less informative, but increases liquidity and volume

How does inequality affect market quality?

Inequality is a double-edged sword:

- **Wealth inequality** is bad for **information efficiency** but is good for **liquidity and volume**:
making sufficiently rich richer and sufficiently poor poorer makes prices less informative, but increases liquidity and volume
- **Information inequality** is bad for **information efficiency** but is good for **liquidity and volume**:
making sufficiently rich more informed and sufficiently poor less informed makes prices less informative, but increases liquidity and volume
- **With endogenous information**, the rich acquire more info than the poor.
Wealth inequality \implies information inequality.
The effect of wealth on market quality is reinforced.

Equilibrium

Theorem. There exists a unique equilibrium, in which

$$dX(a) = \beta(a, P) \underbrace{ds(a)}_{v da + dB(a)/\sqrt{t(a)}} + \delta(a, P) da,$$

$$\beta(a, P) \propto \frac{t(a)}{\rho(a)}.$$

Price is info equivalent to signal s_p

$$s_p = v + \int_0^1 \omega(a) \frac{dB(a)}{\sqrt{t(a)}}, \text{ with } \omega(a) = \frac{\beta(a, P)}{\int_0^1 \beta(a, P) da}.$$

- Trader a 's demand $dX(a)$ is linear in $ds(a)$
- $\beta(a) \propto t(a)/\rho(a)$, as in standard models, like Hellwig (1980). **However:**
- **Wealth effects:** absolute risk tolerance $1/\rho(a)$ depends on wealth. With DARA, wealthier traders are more risk-tolerant.
- **Signal noise does not wash out.** Aggregate signal s_p depends on $\omega(a)$.

Ideal information aggregation in CHILE

Price is info equivalent to signal s_p

$$s_p = v + \int_0^1 \omega(a) \frac{dB(a)}{\sqrt{t(a)}}, \text{ with } \omega(a) = \frac{\beta(a)}{\int_0^1 \beta(a) da}.$$

Price reflects a weighted average of signals $ds(a)$ with weights $\omega(a)$.

Is there an “ideal” weighting scheme $w(a)$ that maximizes price informativeness?

Ideal information aggregation in CHILE

Is there an “ideal” weighting scheme $w(a)$ that maximizes price informativeness?

Lemma. The best way to aggregate signals is with weights $w^*(a) \propto t(a)$.

Intuition

- Signals of better quality should get higher weight
- Why is $w^*(a) \propto t(a)$?
 - ▶ Because when $w^*(a) \propto t(a)$, $\tau_p = \int_0^1 t(a) da$, which cannot be exceeded.
(Price cannot reflect more info than what is collectively contained in all signals)

Key inefficiency

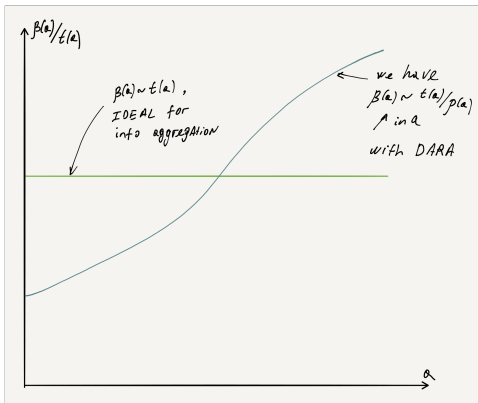
Let's index traders according to their wealth. Then, $W_0(a) \uparrow$ in a .

- Want: $\beta(a)/t(a) = \text{const}$
- We have: $\beta(a)/t(a) = 1/\rho(a)$
 - ▶ $1/\rho(a) \uparrow$ in a with DARA

Key inefficiency

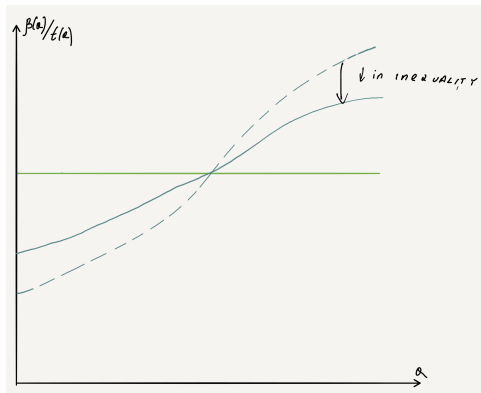
Let's index traders according to their wealth. Then, $W_0(a) \uparrow$ in a .

- Want: $\beta(a)/t(a) = \text{const}$
- We have: $\beta(a)/t(a) = 1/\rho(a)$
 - ▶ $1/\rho(a) \uparrow$ in a with DARA
- **Prices outweigh signals of large investors**



Key mechanism

- Prices overweigh signals of large investors
- Reducing inequality makes large traders smaller and small traders larger
- Weighting scheme is pulled closer to the ideal, improving price informativeness



Wealth inequality and information efficiency

Changes in inequality correspond to changes in $W_0(a)$

Need to be able to do comparative statics with respect to a function

Wealth inequality and information efficiency

Changes in inequality correspond to changes in $W_0(a)$

Need to be able to do comparative statics with respect to a function

Definition. Gateaux derivative $\mathcal{I}'[W_0^\Delta(a)]$ in the direction $W_0^\Delta(a)$ is

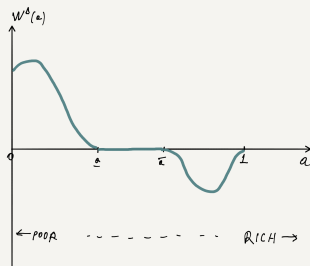
$$\mathcal{I}'[W_0^\Delta(a)] = \lim_{\epsilon \rightarrow 0} \frac{\mathcal{I}(W_0(a) + \epsilon W_0^\Delta(a)) - \mathcal{I}(W_0(a))}{\epsilon}$$

Which directions $W_0^\Delta(a)$ correspond to a reduction in inequality?

Robin Hood and Gateaux

Assume $W_0(a) \uparrow$ in a (WLOG)

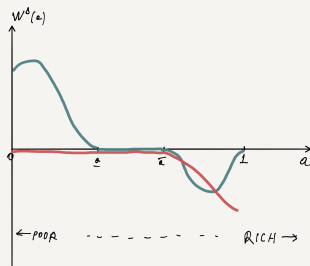
Definition. Robin Hood variation is a direction $W_0^\Delta(a) \neq 0$ such that wealth of poor increases ($W_0^\Delta(a) \geq 0$ for $a < \underline{a}$) and wealth of rich decreases ($W_0^\Delta(a) \leq 0$ for $a > \bar{a}$).



Robin Hood and Gateaux

Assume $W_0(a) \uparrow$ in a (WLOG)

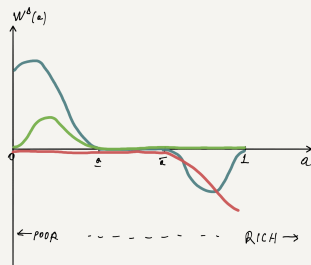
Definition. Robin Hood variation is a direction $W_0^\Delta(a) \neq 0$ such that wealth of poor increases ($W_0^\Delta(a) \geq 0$ for $a < \underline{a}$) and wealth of rich decreases ($W_0^\Delta(a) \leq 0$ for $a > \bar{a}$).



Robin Hood and Gateaux

Assume $W_0(a) \uparrow$ in a (WLOG)

Definition. Robin Hood variation is a direction $W_0^\Delta(a) \neq 0$ such that wealth of poor increases ($W_0^\Delta(a) \geq 0$ for $a < \underline{a}$) and wealth of rich decreases ($W_0^\Delta(a) \leq 0$ for $a > \bar{a}$).

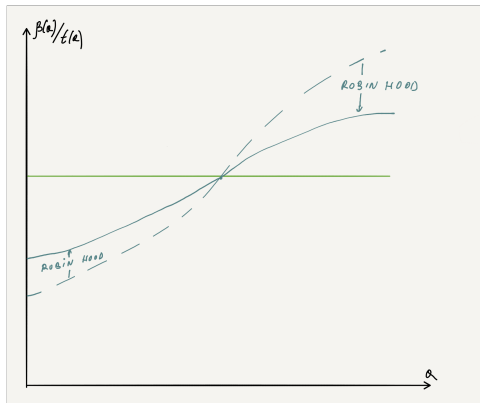


How does wealth inequality affect information efficiency?

Proposition. Assume DARA utility, exogenous precisions.

Making sufficiently rich less rich and sufficiently poor less poor makes prices more informative:

For any Robin Hood variation with low enough \underline{a} and high enough \bar{a} , $\mathcal{I}' > 0$.



How does wealth inequality affect market quality?

Inequality is a double-edged sword:

- **Wealth inequality** is bad for **information efficiency** but is good for **liquidity and volume**:

making sufficiently rich richer and sufficiently poor poorer makes prices less informative, but increases liquidity and volume

Why is inequality bad for liquidity and volume?

Mechanism: widening wealth inequality hurts information efficiency \implies

- adverse selection \downarrow ($\implies \mathcal{L} \uparrow$)
- makes traders' expectations less aligned (as they put less weight on the common information contained in the price) ($\implies \mathcal{V} \uparrow$)

Conclusion

- A new heterogeneous information asset pricing framework
- Tractable. General utilities. Rich heterogeneity. Closed-form solutions
- Allows to analyse how wealth inequality affects market quality
- Active follow-ups:
 - ▶ Non-competitive equilibrium (Kyle) in CHILE
 - ▶ Discriminatory price auction/ static limit order book
 - ▶ Continuous-time CHILE
 - ▶ Multi-asset CHILE
 - ▶ ...