Exploited by Complexity

Pengjie Gao, Allen Hu, Peter Kelly, Cameron Peng, and Ning Zhu

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Motivation

- More than a trillion dollars of structured financial products have been sold to households over the last decade or so
- Motives for issuing structured financial products
  - traditional: risk-sharing (Allen et al. 1994; Duffie and Rahi 1995)
  - recent: exploit naive investors via *complexity* (Bordalo et al. 2016)
- Growing evidence for the exploitation-based view
  - salient headline rates, with risks shrouded (Célérier and Vallée 2017)
  - low or negative returns (Henderson and Pearson 2011; Vokata 2018)
- **This paper**
  1. heterogeneous effects on investment performance
  2. redistributional consequences

Intuition

- Example of the hotel industry (Gabaix and Laibson 2006)
  - stay cost: basic room rate + various add-ons (e.g., parking)
    - hotels lower basic room rates by upcharging add-ons
  - **asymmetry**:
    - *naive*: pay for over-priced add-ons
    - *sophisticated*: avoid them and take advantage of the cheap rate
  - a cross-subsidization

- Analogy for complex financial products
  - a new product with an upside and a downside is introduced
    - downside: e.g., crash risk
  - issuers make the upside salient and shroud the downside
    - only the sophisticates know about the downside
  - crash risk goes up: smart ones get out and naive ones suffer
    - a similar cross-subsidization

Empirical Strategy

- **Challenges**
  1. many structured products are sold directly by brokers to households
     - brokers misguide their clients into dominated products (Egan 2019)
     - hard to disentangle the effect of product design from broker activities
  2. detailed transaction data of structured products are lacking
     - even harder to make comparisons with *simple* products
  3. complex products may also have other features
     - difficult to isolate the effect of complexity

- **Strategy**
  1. **setting**: exchange-traded structured funds in China
     - leveraged funds with *time-varying* leverage and *hidden* clauses
     - exchange-traded setting: little space for aggressive sales tactics
  2. **data**: all exchange-traded products for 3M retail investors
     - compare structured funds against non-structured funds such as ETFs
  3. **event study**: 2015 market crash triggered a *hidden* feature
     - for 52 funds, their value would shrink by half over a two-day window
     - differential responses to quantify the effect of complexity

Preview of Results

1. Performance asymmetry
   - on average, an investor broke even from 2014 to 2015
   - **asymmetry**:
     - the largest 1% gained 500 million; the remaining 99% lost 500 million
     - similar transfers from the naive to the sophisticated
   - **population**: a total wealth transfer of 8 to 20 billion RMB
2. Comparison with simple ETFs
   - little evidence of any ETFs-induced wealth transfer
   - the scaling effect of leverage cannot explain the difference

Preview of Results, cont'd

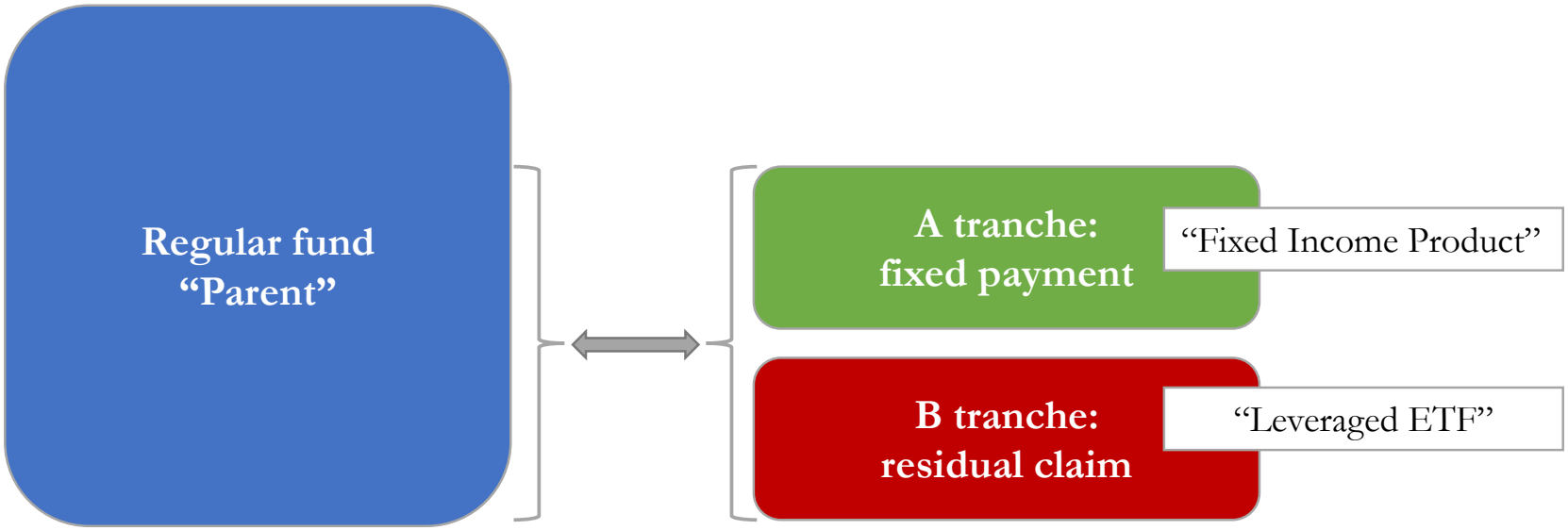
❸ Direct evidence (on the effects of complexity)

- rely on the trigger of a hidden feature: **leverage reset**
  - high leverage $\rightarrow$ large premium
  - *too* high $\rightarrow$ resets to one
  - after reset, premium disappears, and fund value shrinks by half
- many investors completely ignored these events
  - differential responses: 25% to 45% of the total wealth transfer
  - poor, naive investors were left holding the funds when resets hit
- issuers were aware of the risk but chose to shroud it in prospectuses

❹ Entry decisions (if time permits)

- participants: extrapolators entered after positive market returns
- attracted by the high "headline" returns, but ignored the risks shrouded by complex features (Bordalo et al. 2016)

Structured Funds: AB Funds



Parent Fund
- Created/redeemed at the broker
- **Not** traded on the exchange
- Pay the net-asset-value (NAV)
- Can be split into A and B shares

A and B Funds
- **Cannot** be created or redeemed
- Traded on the exchange
- Pay market prices, which can deviate from NAV
- Can be merged into parent shares

- All shares are normalized to a per-share NAV of one

Feature I: Time-Varying Leverage

- B funds $\rightarrow$ leveraged closed-end funds
  - however, two additional features that make them more *complex*
- **Example**:
  - with NAV of 200 USD, 100 shares of A and 100 shares of B
  - A tranche annual dividend rate $= 8\%$

Feature I: Time-Varying Leverage

Time	NAV_P	NAV_A	NAV_B	Leverage (NAV_B/NAV_A)
Month 3	1.1	1.02	1.18	0.86
Month 6	1.3	1.04	1.56	0.66
Month 9	0.8	1.06	0.54	1.96
Month 12	0.65	1.08	0.22	4.91

- when the underlying assets go up (down) in value, leverage goes down (up)

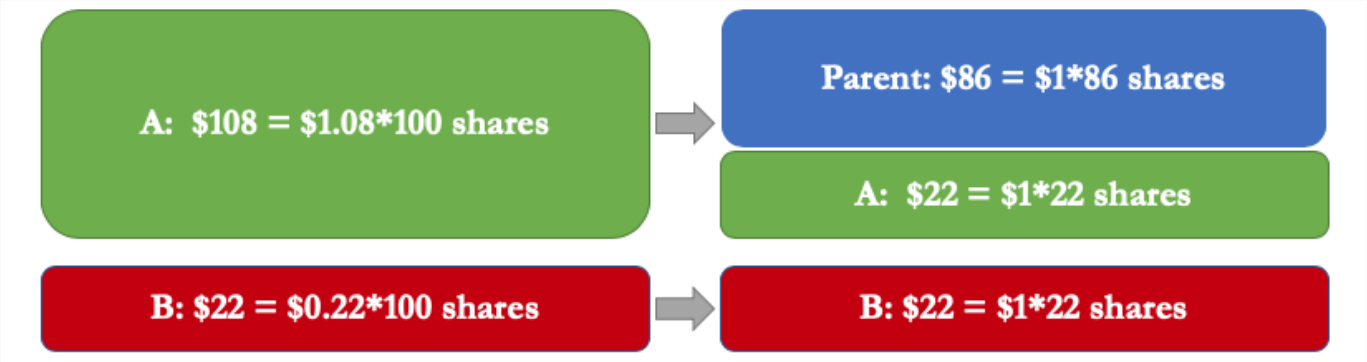
Feature II: Restructuring Clause

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- In theory, A is not risk-free
  - if the parent drops by more than 50%, it eats into the A tranche
- To ensure that A is risk-free
  - if the per-share NAV of B drops below 0.25, funds are restructured
  - NAVs are reset to one for A, B, and the Parent

- **Example**

Time	NAV_P	NAV_A	NAV_B	Leverage
Month 12	0.65	1.08	**0.22**	4.91



Popularity of B Funds

- In 2015, the Chinese stock market had a dramatic bubble and crash episode
  - rose 100% in six months and crashed

- B funds became exceedingly popular in the run-up
  - traded by 10% of the active investor population
  - market size comparable to ETFs

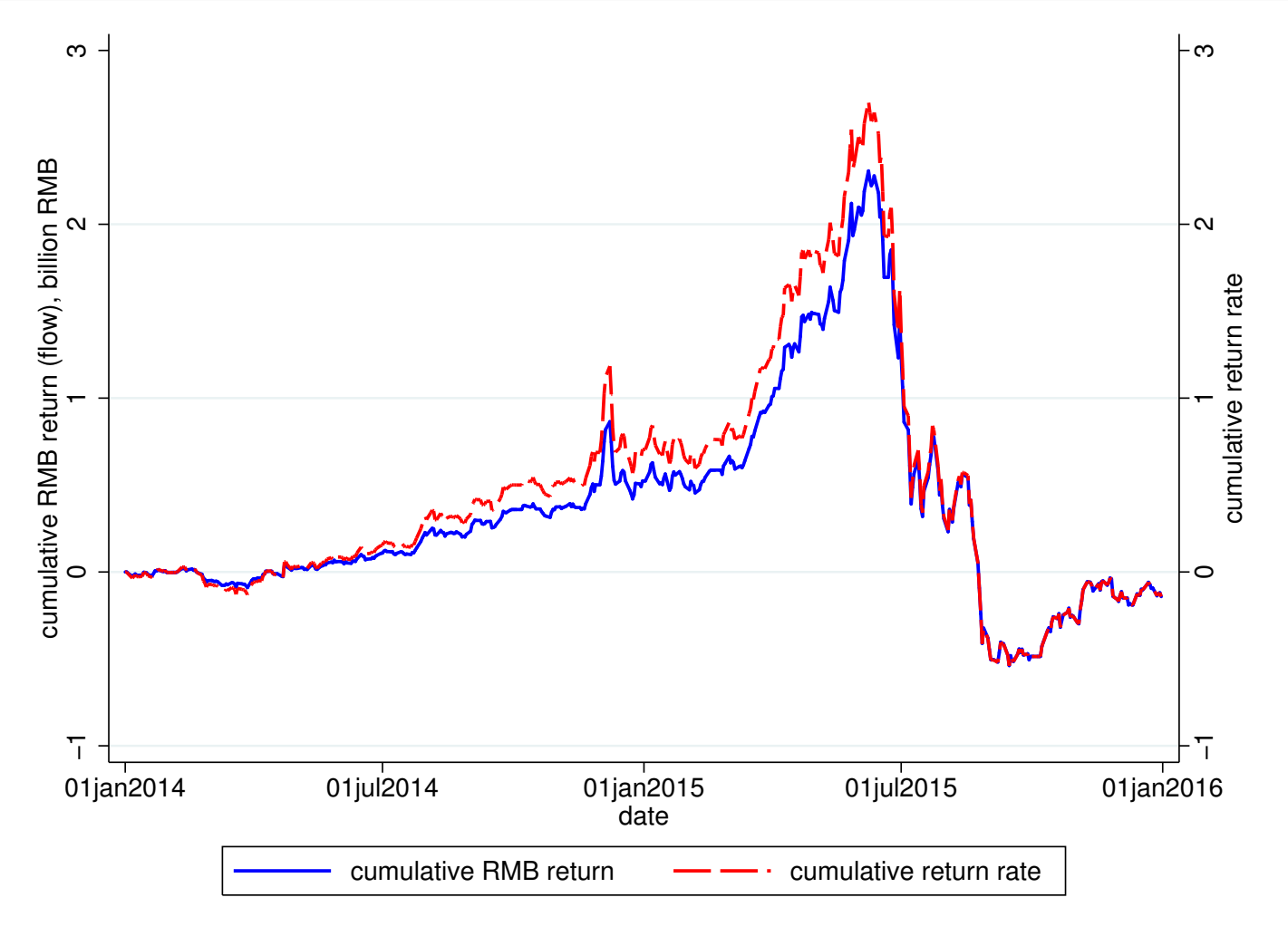
- **Popularity**: embedded leverage
  - Chinese retail investors were (are) leverage-constrained
    - e.g., minimum 500K for a margin account
  - B funds filled this gap

- B funds were trading at a large **premium**
  - exceeded 100% in some cases
  - variation mostly explained by leverage (in both TS and CS)

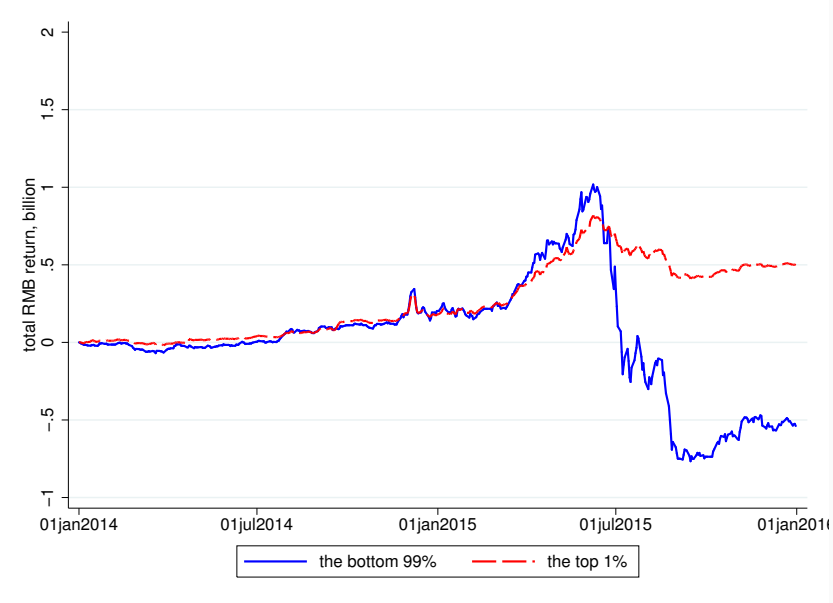
Data

- **Transaction data**: from a large national brokerage firm in China
  - wide geographic coverage
  - all exchange-listed securities
    - stocks, ETFs, and structured funds
  - 5% of the entire Chinese investor population
- **Survey data**: survey responses when opening an account
  - self-reported wealth and sophistication
  - control variables such as risk attitudes and investment horizons

Overview: B Returns



B Returns by Account Size

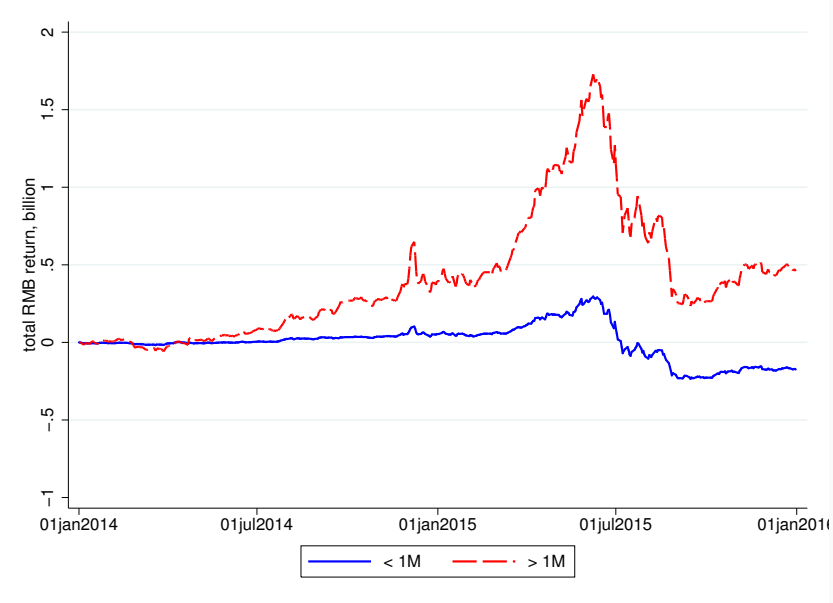


(a) RMB return

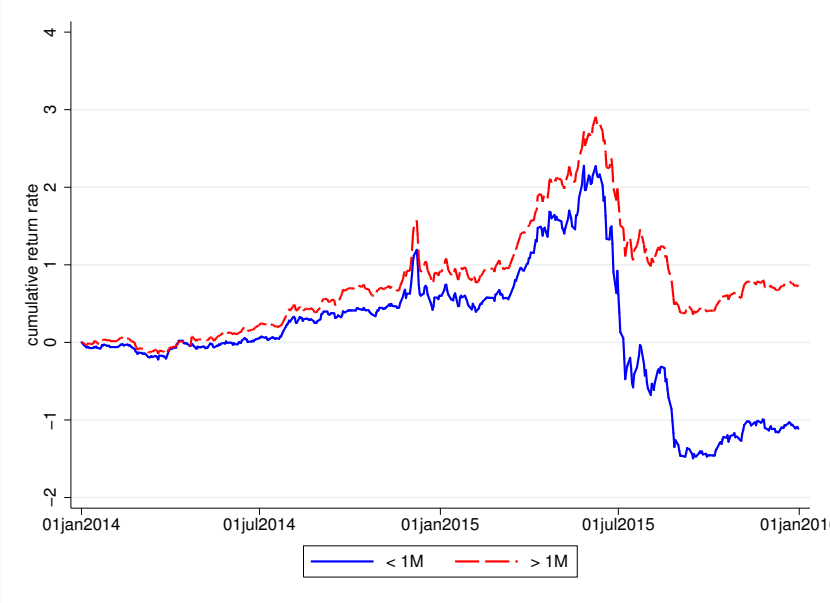


(b) Return rate ($\frac{\text{RMB Return}}{\text{Avg Balance}}$)

B Returns by Self-Reported Wealth

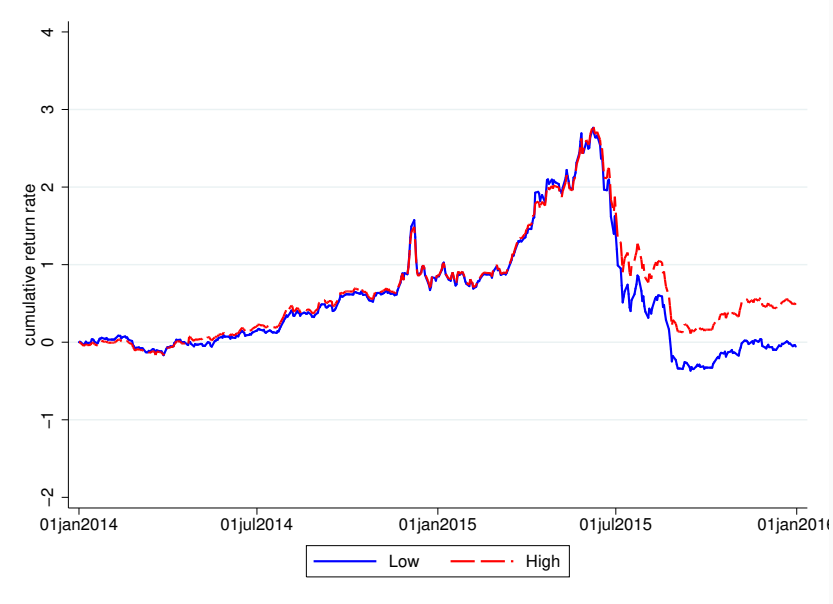


(a) RMB return

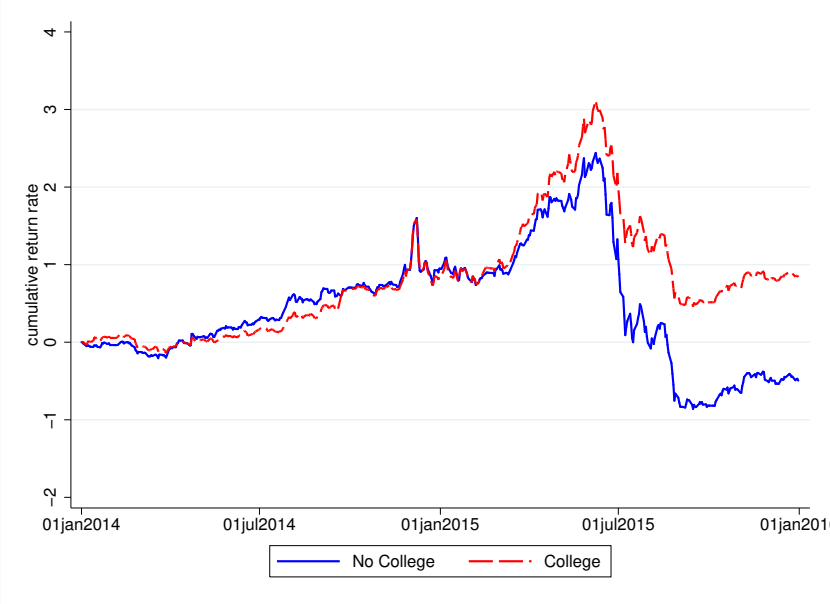


(b) Return rate ($\frac{\text{RMB Return}}{\text{Avg Balance}}$)

B Return Rates by Sophistication



(a) Self-reported financial literacy



(b) Education

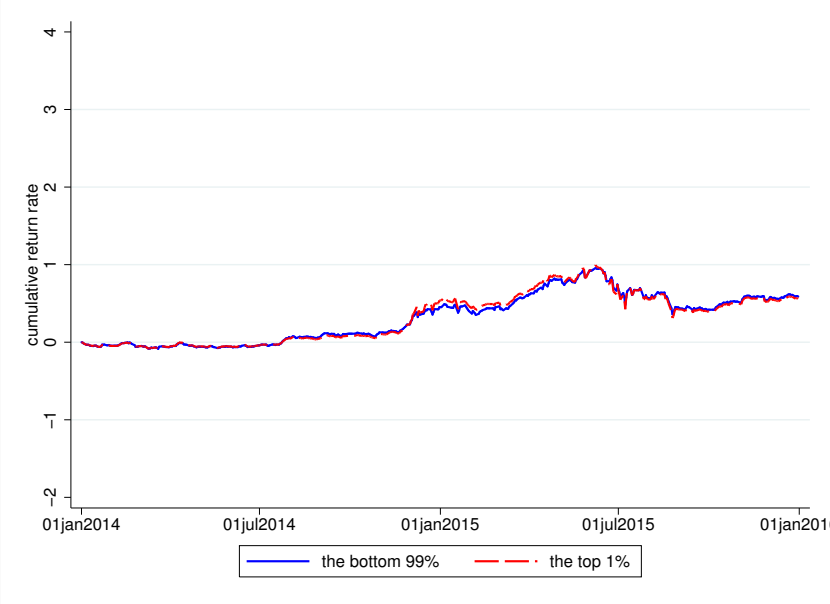
ETFs as Simple Products

- Ex-ante, it is perhaps not surprising that rich and sophisticated investors do better
- Our goal is to show that adding *complexity* to simple products widens the return gap
  - **complexity tax**: subsidizes the rich (sophisticated) and taxes the poor (naive)
- A natural benchmark *without* complexity: simple ETFs
  - virtually hold the same underlying assets
  - both are exchange-traded with ample liquidity
  - market size is also similar around the bubble

Comparing Return Rates by Account Size

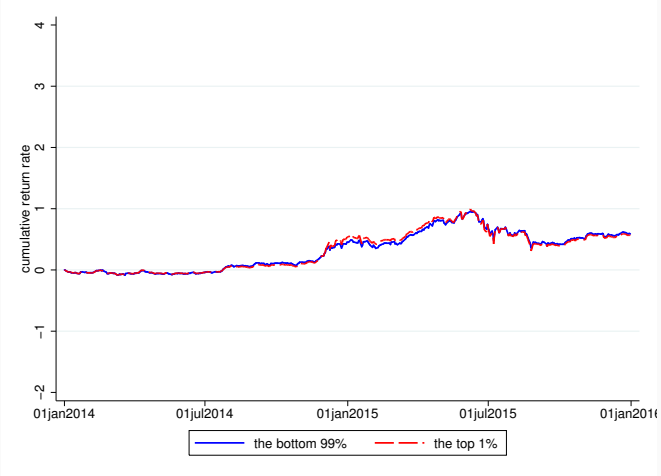


(a) B return rates

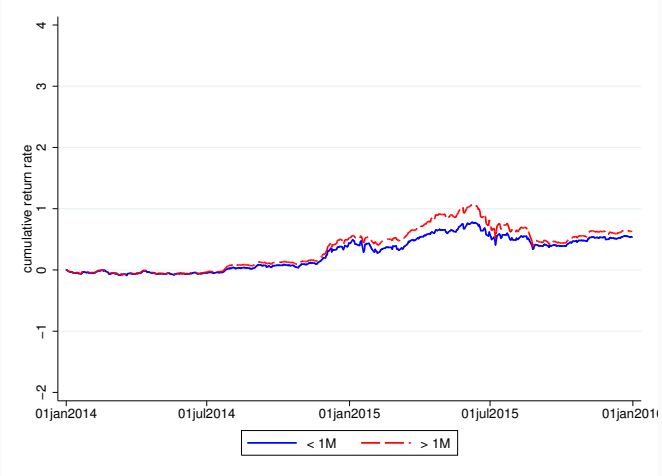


(b) ETF return rates

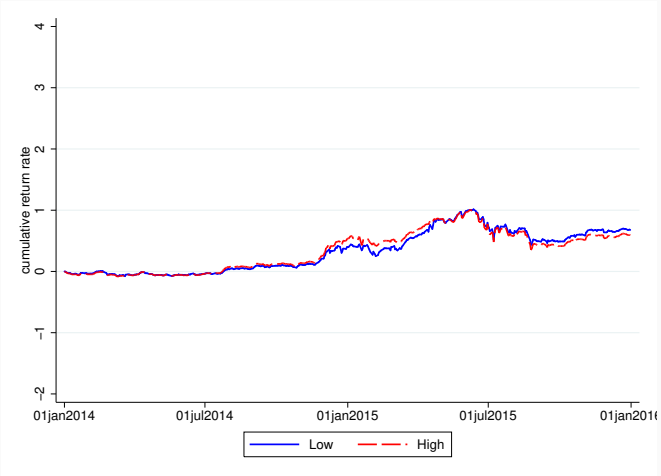
ETF Return Rates by Investor Groups



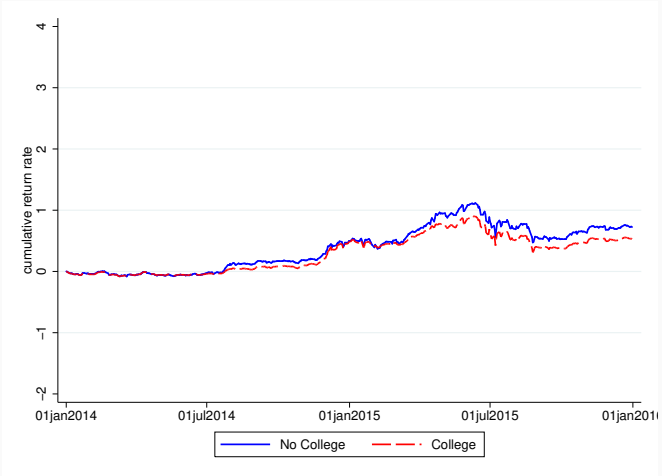
(a) Size



(b) Wealth



(c) Literacy



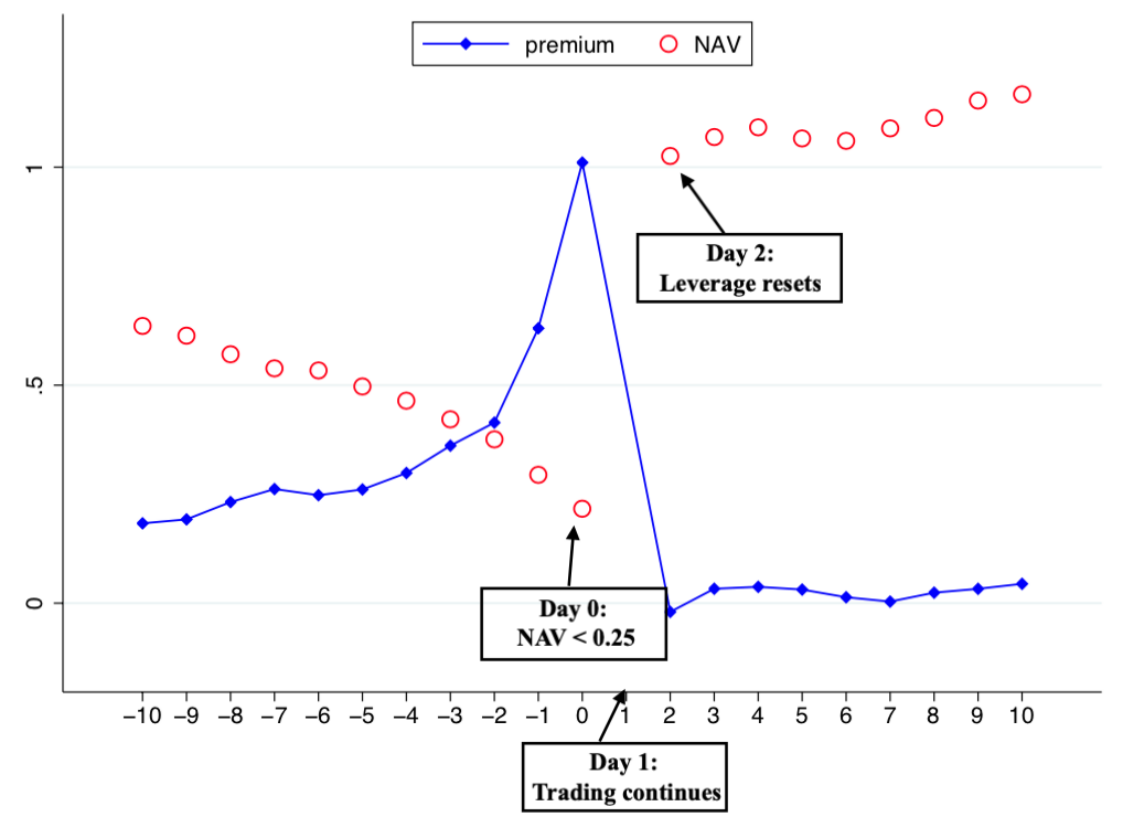
(d) Education

Summary of Findings

- A sharp contrast between B funds and ETFs
  - cannot be explained by the scaling effect of leverage
  - average leverage was around 1:1
- However, the effects of leverage may go beyond scaling
  - e.g., leverage could exacerbate behavioral biases (Heimer and Simsek 2019; Heimer and Imas 2020)
  - a more ideal comparison: B funds vs. leveraged ETFs (with a constant leverage)
    - non-existent in the Chinese market
- How do we isolate the effects of complexity from leverage?
  - *Feature II*: **leverage resets** during restructuring events

Overview of Restructuring Events

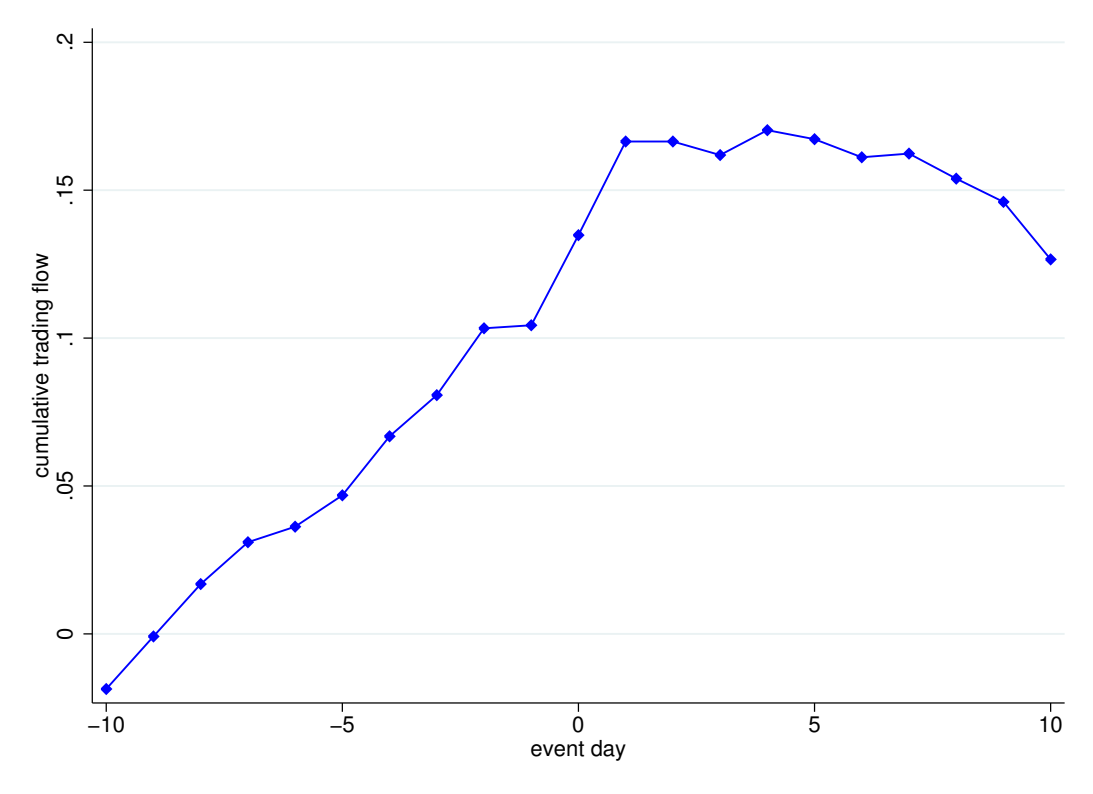
- **2015 market crash**: out of the 115 funds, 52 had to reset leverage



- **Example**

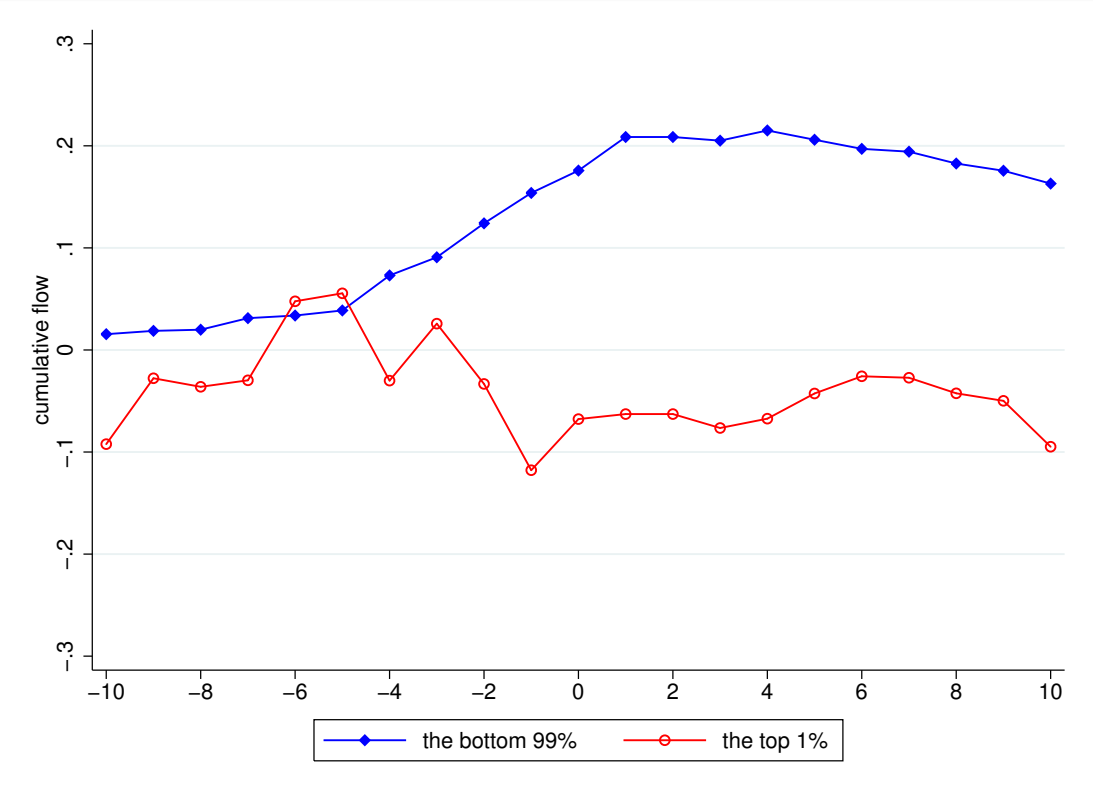
Time	NAV_B	$Price_B$	Shares	Total value
Month 12	0.22	0.44	100	**$44**
Post-restructuring	1.00	1.00	22	**$22**

Retail Flows During Restructuring Events



- Investors *increased* their holdings by 13% prior to the trigger
  - another 3% on day 1
  - 400 million RMB wealth vanished when resets hit

Retail Flows by Size Groups



- Differences in retail flows explain differences in returns
  - leverage resets: 250 million; 21-day window: 450 million
  - 25% to 45% of the total wealth transfer
- Similar results for groups sorted on wealth, literacy, and education
  - albeit with a similar magnitude

Behaviors of Other Participants

- **Brokers (issuers)**
  - discussion about risk is buried in lengthy prospectuses
    - average prospectus length: 130-pages
    - discussion about risk starts on page 86
  - issuers were aware of the risk associated with restructuring
    - based on their discussion about leverage-induced premium
  - however, they chose not to disclose it explicitly
    - out of 115 funds, only **three** explicitly disclose this risk
- **Institutional investors**
  - they almost completely liquidated prior to leverage resets
    - only a few dozen institutional investors in our data
    - but their behavior is sufficiently telling

Mechanisms

- **Alternative explanations**
  - rational gambling
  - liquidity provision
  - liquidity shocks
  - reluctance to realize losses (the disposition effect)
  - inattention
  - ...
- None of them can explain our results

Entry Decisions: Regression Specification

- For individuals i that have *not* purchased B funds as of month $m-1$

$$\text{Dummy}_{i,m}^{B} \times 100 = \alpha + \Theta \times \text{Determinants}_{i,m-1} + \epsilon_{i,m}$$

  - $\text{Dummy}_{i,m}^{B}$: 1 if i trades B in month m and 0 otherwise
  - $\text{Determinants}_{i,m-1}$: account characteristics up to month $m-1$, constructed from transactions of individual stocks
    - extrapolation
    - trading experience
    - gambling preference
    - prior returns
    - ...

- In other words, we examine what factors triggered people to start investing in B funds

Entry Decisions: Regression Results

	(1)	(2)	(3)
Market return, in %	0.091***	0.044***	0.057***
	(0.018)	(0.013)	(0.015)
Extrapolation		-0.000	-0.003
		(0.008)	(0.006)
Market return, in % × Extrapolation		0.344***	0.301***
		(0.067)	(0.062)
Have a margin account, dummy			0.001**
			(0.001)
Experience in stocks			-0.001***
			(0.000)
Account size, log			0.001***
			(0.000)
Traded warrants before			0.004***
			(0.001)
Return rate, in %			0.021***
			(0.006)
Volatility			0.008
			(0.012)
Skewness			0.000
			(0.000)
Turnover			0.000
			(0.000)
Survey responses	NO	NO	YES
Observations	4,541,691	4,541,691	2,520,409
R-squared	0.002	0.004	0.006

Discussion: Policy Implications

- **Prior literature**: interaction between brokers and households
  - implications about the regulation of broker conduct
- **This paper**: exchange-traded setting
  - naive investors may self-select into these products
  - implications about product design and investor education

- In the U.S.,
  - the pool of exchange-traded assets has expanded dramatically
    - leveraged ETNs, inverse ETFs, etc.
  - apps like Robinhood make them more accessible to retail investors
  - no clear evidence that they help investor welfare
    - contributed to personal bankruptcies in the pandemic ("Individual Investors Get Burned by Collapse of Complex Securities", *WSJ*)
- Our evidence presents a cautionary tale for policy makers

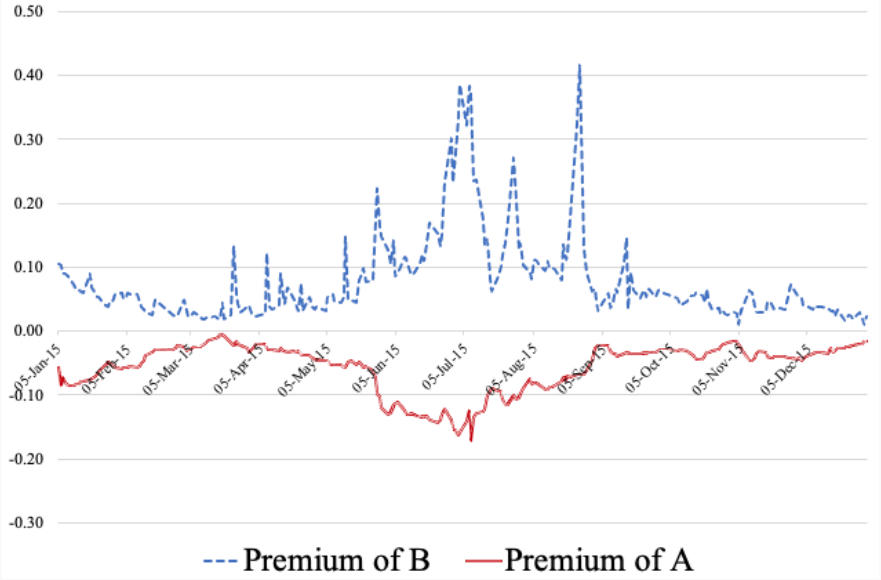
- Post-events, the China Securities Regulatory Commission
  - halted the issuance of new structured funds
  - placed a higher barrier to entry for new investors

Conclusion

- There is a growing literature that examines the welfare implications of structured financial products, and we contribute to this literature in two ways
  1. existing work focuses on the *average* effect
     $\rightarrow$ we document a heterogeneous effect and redistributional consequences
  2. existing work shows that naive investors are tricked by brokers
     $\rightarrow$ we show they can also be exploited by the design of the product itself
- Implications of complexity
  - a form of tax (subsidy)
  - a contributor of cross-subsidization
    - and, perhaps, wealth inequality
  - a source of retail sub-optimal performance

Why Was the B Premium Not Corrected?

- Failure of the main arbitrage mechanism
  - B shares *cannot* be redeemed or created directly
- Arbitrageurs would have to create parent shares, split them into A and B shares, and sell them on the exchange
  - the entire process could take up to 2-3 days to complete
- A shares were substantially underpriced
  - they could hold on to them, but prices could drop even more



Comparison with ETF Returns: Regressions

Return Rate$_i = \beta_0 + \beta * \text{Dummies}_i + \epsilon_i$			
	B Fund Return	ETF Return	B Fund Return
	(1)	(2)	(3)
Wealth (>1M)	0.010**	0.005	0.010**
	(0.004)	(0.005)	(0.004)
Size (top 1%)	0.035***	0.013	0.035***
	(0.011)	(0.011)	(0.011)
Financial literacy (good)	0.019***	-0.008	0.019***
	(0.004)	(0.005)	(0.004)
College	0.015***	-0.000	0.015***
	(0.004)	(0.004)	(0.004)
Female	0.003	0.018***	0.003
	(0.004)	(0.004)	(0.004)
Experienced with B	0.097***	0.009*	0.097***
	(0.004)	(0.005)	(0.004)
ETF return			0.041
			(0.033)
Observations	17,567	3,341	17,567
R-squared	0.032	0.007	0.032