Scale and Conduct in Passive Asset Management*

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Abstract

Passive funds manage $8 trillion, and their fees are widely believed to fall with scale. Whether investors capture these gains depends on two unobservables: scale economies and market conduct. We estimate both jointly in two adjacent markets – plain and leveraged index funds – using a comprehensive fund panel, instruments for fund size, and a model-selection test for conduct. The two markets exhibit similar scale economies: a 10% increase in assets lowers marginal cost by about 1%. Yet the test selects opposite conducts: perfect competition among plain index funds, and partial profit internalization between the leveraged duopolists ProShares and Direxion. Scale economies passed through at cost save index investors $38 billion per year, while duopoly conduct keeps leveraged fees several times above cost. When a 2020 SEC rule froze leveraged entry, grandfathered incumbents' costs fell almost 50% but their fees fell only 11%.

Keywords: Competition; Economies of Scale; Pass-through; Regulation

(PRELIMINARY)

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1 Intro

The rise of passive investing is the largest reorganization of financial intermediation in half a century (French, 2008; Bogle, 2016). Index mutual funds and ETFs now manage over $8 trillion in the United States, and the fees they charge have fallen from roughly 60 to under 40 basis points (about 10 basis points on an asset-weighted basis) over the last twenty years. The conventional interpretation is straightforward: as assets grow, unit costs fall, competition passes the savings on to households, and the cost of investing approaches zero. But economies of scale need not translate into lower fees, and how much of the gains from scale is passed through to investors remains unknown. At current assets, the answer is a first-order welfare question: every basis point is $800 million per year.

Fee data alone cannot provide the answer. The welfare object is not the change in the expense ratio but the wedge between the expense ratio and the cost of production, and the path of that wedge as the industry scales: if unit costs fell faster than fees, the celebrated decline coexists with growing margins. Indeed, the same force pushes fees in both directions. Economies of scale lower asset managers' costs; but because they advantage size they also concentrate the industry, and concentration can allow managers to retain the cost savings as markups rather than pass them on. Signing the net effect requires separately identifying two primitives that fee data confound: *technology* (how large are the (dis)economies of scale?) and *conduct* (to what extent are the savings passed on to investors?). Neither is directly observable, and the former shapes the incentives that determine the latter, so neither can be credibly estimated without the other.

We develop and estimate a structural framework that jointly identifies scale economies and competitive conduct in two closely related passive markets whose comparison is unusually revealing. Plain index funds are the $8 trillion market described above, in which three firms manage 70% of assets and asset-weighted fees have fallen by roughly half. Leveraged index funds, which deliver a constant multiple of index returns, are a $100 billion market in which ProShares and Direxion hold 90% of assets and fees have remained near 90 basis points for fifteen years despite a twenty-fold increase in assets. What makes the pair informative is that neither demand nor technology points in the expected direction: we find that demand for leveraged funds is more than twice as price-elastic as demand for plain index funds, and the two markets exhibit comparable scale economies. Why, then, does similar growth in scale economies not necessarily translate into lower fees? The remaining suspect is conduct, and we test it formally rather than assume it.

We proceed in three steps. First, we assemble a comprehensive panel of U.S. passive funds from 2010 to 2024, combining CRSP share-class-level data with hand-collected and validated benchmark

assignments from Bloomberg, SEC filings, and press releases, and the leveraged-fund universe of Lu and Qin (2021). Beyond the fee and concentration facts above, the data reveal a regulatory experiment we exploit throughout: SEC Rule 18f-4, proposed in 2015 and adopted in October 2020, caps new leveraged products at 200% exposure while grandfathering existing funds. Entry above the cap stops immediately and completely and exit stops with it, as incumbents preserve products with a now-protected status. Second, we develop and estimate a structural model of the two markets in which investors choose among differentiated funds and multi-product issuers set expense ratios given their costs and a conduct structure we deliberately leave unrestricted. Third, we use the estimated model to test conduct formally and to decompose observed fee dynamics into cost and markup movements through counterfactuals.

Estimating the model poses two main empirical challenges. The first is the endogeneity of expense ratios in demand: fees may be correlated with unobserved fund quality. Following the recent literature on fund demand (An et al., 2023; Brown et al., 2023), we combine fund fixed effects with a Hausman-style instrument, the average expense ratio charged by the same issuer on funds tracking *other* indexes, supplemented with differentiation instruments for the random coefficients (Berry and Haile, 2016). We estimate demand elasticities of about -2.4 for index funds and -6 for leveraged funds, in line with comparable estimates for index funds (Brown et al., 2023; An et al., 2023); investors in both markets value past returns and fund age and dislike tracking error. The random coefficients allow us to generate substantially higher substitution between funds tracking similar indexes. The second challenge is the endogeneity of assets under management in the cost function: low-cost funds attract assets, so a naive regression of implied marginal cost on size conflates scale economies with reverse causality. We address it with two independent research designs: an instrument based on residualized past index-return shocks, and a shift-share instrument that allocates pension investors' aggregate net purchases of index funds according to their lagged portfolio weights. Both designs, in different samples and at different frequencies, deliver a scale elasticity of marginal cost with respect to assets of 0.09-0.11, four to ten times the OLS estimate. A doubling of fund size lowers unit costs by roughly 6-14% of the mean, comparable to scale economies estimated for automobile production (Goldberg and Verboven, 2001; Duarte et al., 2025) and manufacturing (Bartelme et al., 2025): on the cost side, money management is an ordinary scale industry.

With demand and costs in hand, we let the data select the conduct. For each candidate model, perfect competition, multi-product Bertrand, Bertrand with partial profit internalization among the largest firms, Cournot, and monopoly, we compute implied markups and marginal costs from the pricing first-order conditions. Cournot and monopoly are rejected on inspection: they imply price-

cost margins above one for the largest products in both markets. To distinguish the remaining models we implement the non-nested model-selection test of Rivers and Vuong (2002) as developed for conduct testing by Backus et al. (2021) and Duarte et al. (2024), using as a demand rotator the interaction of residualized consumer sentiment with the number of close-substitute funds: sentiment shifts demand differentially for products with many close substitutes, rotating markups without entering costs. The results are stark. In the index-fund market, the test selects perfect competition. The model confidence set contains perfect competition with a p-value of 1.00 and rejects Bertrand and all partial-internalization alternatives: the Big-3 price as if they had no market power. In the leveraged market, every competitive model is rejected in favor of Bertrand with ProShares and Direxion internalizing 65% of each other's profits. The contrast rationalizes the fee facts: index-fund investors received scale economies at cost; leveraged-fund investors face prices of a comfortable duopoly.

We perform two counterfactual analyzes to quantify the relative role of scale and conduct. First, we focus on the competitive index funds market and remove scale economies. Without scale economies, marginal cost increases by 48 bps, and the higher marginal costs are passed through one-for-one to higher fees for investors. Economies of scale are worth $38 billion per year on $8 trillion of assets: the amount investors gained because scale economies exist *and* conduct forced them through. Second, we focus on the leveraged index fund market and, holding costs fixed, study the equilibrium effects of changing conduct. Moving the leveraged market from partial internalization to Bertrand lowers equilibrium expense ratios by 33 basis points, and moving it to the index market's conduct by 69 basis points, which corresponds to about $690 million per year on $100 billion of assets.

Finally, we study the effect of SEC rule 18f-4, which imposed a leverage limit that effectively transformed the 2.5x-3x segment into a statutorily protected incumbency, whose assets tripled on inflows while entry and exit froze. Our model is able to capture the decline in expense ratio for high leveraged funds after the policy. Most notably, after the 2020 SEC rule froze entry above 2x leverage, grandfathered funds' marginal costs fell by almost 50% on inflow-driven scale, while their fees fell only 11%, raising their Lerner index from 86% to 92%. Counterfactual analyses show that: (i) without economies of scale asset managers increase their fees relative to before the policy, showing that the observed decline in fees, in an environment where asset managers internalize each other's profits, is coming from economies of scale; (ii) under competitive conduct, the same scale gains would have cut fees by almost half. The policy allowed grandfathered 3x funds to exclusively benefits from scale gains and they reached investors via lower fees, but it simultaneously remove the entry threat that could have lowered equilibrium fees even further.

The comparison among our counterfactual analysis carries a lesson that travels beyond the indus-

try and the specific policy we study: price changes alone are uninformative about market power. Fees can fall in a market whose two firms internalize most of each other's profits, provided that demand growth meets scale economies; and fees can rise in a perfectly competitive market with increasing demand and no scale economies. Distinguishing these interpretations requires exactly the two primitives we estimate: technology and conduct.

Overview. The rest of this Section discusses the related literature. The remainder of the paper proceeds as follows. Section 2 presents the data and some facts on the index and leveraged fund markets. Section 3 develops the model. Section 4 discuss the estimation strategy for demand and economies of scale and presents the results. Section 5 shows the conduct test approach and result. Section 6 shows the counterfactual analysis and Section 7 concludes.

Related literature. Our paper contributes to three main streams of literature. The most related papers study the industrial organization of asset management. These papers explore the role of search costs, product differentiation across index providers, and information frictions in explaining price dispersion and market power (Hortaçsu and Syverson, 2004; An et al., 2023; Brown et al., 2023) and study the role of marketing and fund proliferation for investors' welfare (Gavazza, 2011; Roussanov et al., 2021; Ben-David et al., 2023; Loseto and Mainardi, 2023). These papers estimate demand and infer markups under a maintained conduct assumption. Our contribution is to treat conduct as the object of interest and to estimate the cost side jointly, which the two-market comparison shows is essential: similar cost curves coexist with opposite conducts.

Hence, our paper is related to the growing literature on empirical conduct testing (Bresnahan, 1982; Rivers and Vuong, 2002; Berry and Haile, 2014; Duarte et al., 2024). Recent papers have studied conduct in the car market (Duarte et al., 2025), the rental market (Calder-Wang and Kim, 2024), the labor market (Roussille and Scuderi, 2025), and the US government debt market (Choi et al., 2026). To our knowledge our paper is the first formal conduct testing in passive asset management. The partial-internalization models we test parameterize conduct exactly as the common-ownership literature does (Azar et al., 2018; Backus et al., 2021), with the twist that the Big-3 asset managers at the center of that debate are here the *firms* rather than the shareholders, and their market is the one our tests find behaving competitively.

Finally, our paper speaks to the large literature on scale economies in asset management. The vast majority of papers have studied both theoretically (Berk and Green, 2004; Pástor and Stambaugh, 2012; Gârleanu and Pedersen, 2018) and empirically (Chen et al., 2004; Pollet and Wilson, 2008;

Pástor et al., 2015) the relation between size and performance, mostly finding decreasing returns in active management, where scale erodes alpha. We study the production side of passive management, where scale lowers unit operating cost, the object industry participants describe (Adiraju et al., 2022) but do not identify. Our IV estimates give a scale elasticity of 0.09-0.11, comparable to estimates for automobile production (Goldberg and Verboven, 2001; Duarte et al., 2025) and manufacturing (Bartelme et al., 2025). We show that passive money management is, on the cost side, an ordinary scale industry; what is not ordinary is who captures the gains.

2 Data and Facts

In this section, we describe our data collection process and use the assembled dataset to present several motivating empirical facts about the passive index and leveraged fund markets.

2.1 Data

Sample Construction. We construct a comprehensive sample of U.S. domestic passive index mutual funds and exchange-traded funds (ETF) using the Center for Research in Security Prices (CRSP) Mutual Fund Database from January 2010 to September 2024. To identify passive index funds, we adopt the standard approach of combining the CRSP index fund flag supplemented with fund name parsing (Busse and Tong, 2012; Iliev and Lowry, 2015; Appel et al., 2016; Dannhauser and Pontiff, 2025).[1] To identify leveraged funds, we follow the collection process described in Lu and Qin (2021) to assemble the universe of funds tracking a constant multiple of the daily or monthly performance of an underlying benchmark index.[2] Similar to Brown et al. (2023), for demand estimation purposes, we keep the unit of observation at the share class level to capture how retail and institutional share classes contribute to price dispersion.

We collect monthly returns and total net assets (TNA), and quarterly characteristics such as fund names and expense ratios from CRSP. We obtain underlying index benchmarks and fund family issuer labels using a combination of CRSP, Bloomberg, company press releases, and SEC filings, validated with a mix of manual hand-checking and AI search. From Bloomberg, we also obtain index returns. To assign an index to a regular passive fund, we compute the OLS regression coefficient and R^2 of

[1] Our list includes all such funds identified by the CRSP index flag and fund name parsing algorithmn. Following Brown et al. (2023), we purposely keep a broad sample of index funds, unlike some of the mutual fund literature that typically focuses only on broad-based and sector funds, because these funds remain relatively homogenous and therefore is important for market definition. See Dannhauser and Pontiff (2025) for the complete list of the name parsing keywords.

[2] We refer readers to Section I of the Lu and Qin (2021) Internet Appendix for the detailed steps in this collection process.

fund returns on index returns across all fund-index combinations and use the best matching fund-index pair as the assigned index.[3] For leveraged funds, we use a combination of Bloomerg, SEC prospectuses, and press releases to identify the exact underlying index. Pension funds are identified with the corrected investor types from Koijen and Yogo (2019).

Other Data. We collect the VIX and other macro-economic variables from the St. Louis Fed FRED database, the Baker and Wurgler (2006) Sentiment Index from the authors' website, and the Consumer Sentiment Index from the University of Michigan Survey of Consumers. Institutional holdings and stock price, return, and shares outstanding data, which we use to construct a shift-share instrument, is from the Thomson Reuters 13F and CRSP databases.

Main Samples and the Outside Option. For the bulk of our analysis, we focus on a main sample of funds after excluding small funds as the outside option. For regular index funds, we classify small funds as those with less than 0.01% of market share and track their underlying index with an R^2 lower than 0.95. For leveraged funds, exclude those funds with less than 0.01% of market share and funds under Rydex, the smallest issuer.

Summary Statistics. Table 1 shows the summary statistics for the main variables of interest for our main samples. Panel A focuses on passive index funds and Panel B on leveraged funds. The average passive fund has an expense ratio of 29 basis points per annum, AUM of $9.2 billion and a market share of 0.13%. These averages hide large heterogeneity across funds. The cheapest funds have expense ratios of 1 basis points, while the most expensive ones reach expense ratios above 250 basis points. In terms of AUM, some small funds have less than $200 million, while some large funds are above $700 billion. With respect to other characteristics the average passive fund is 11 months old, with a past 1-year return of 10% and a tracking error of 3%.[4] There is a total 1302 unique index funds in our main sample after excluding the outside option. The number of rival funds is about 2500, while the number of rival funds tracking a similar index (a more direct measure of a competitor product) is about 134.

Leveraged index funds differ from plain passive index funds along several dimensions, reflecting the relatively younger age and perhaps higher concentration of the market. The average passive

[3] Specifically, for $k \in \{1, 2, ..., 10\}$, our algorithmn for the best match in order of priority is $|\beta_{\text{OLS}} - 1| < 1 + \frac{k}{100}$ and $R^2 \geq (1 - \frac{k}{100})$. We keep matches with $k \leq 5$ in our main analysis and relegate all other plain index funds into the outside option.

[4] Specifically, for index funds, a 3% mean tracking error indicates that $|\beta - 1|$ averages 0.03 where β is the OLS coefficient of fund return on index return in the past 12 months.

Table 1: SUMMARY STATISTICS

Panel A: Passive Index Funds

	Obs.	Mean	SD	Min	Median	Max
Expense Ratio (p.a.)	108,300	0.29	0.26	0.01	0.20	2.85
Monthly TNA ($ mil)	108,300	9201.35	28069.82	175.50	2292.95	700879.40
Market Share (%)	108,300	0.13	0.34	0.01	0.04	4.97
Age (months)	108,300	11.17	6.76	0.50	10.25	55.50
Past 1-year Tracking Error (Relative to β =1)	108,300	0.03	0.07	0.00	0.01	4.59
Past 1-year Return (%)	108,300	10.07	16.50	-62.23	8.38	257.88
Num. Rival Funds (All)	108,300	2594.47	412.30	1477.00	2698.00	3311.00
Num. Rival Funds (Similar Index)	108,300	134.41	163.11	0.00	63.00	523.00
Past 1-year Rival New Funds (All)	108,300	255.06	64.50	109.00	245.00	389.00
Past 1-year Rival New Funds (Similar Index)	108,300	9.75	12.94	0.00	4.00	56.00

Panel B: Leveraged Funds

	Obs.	Mean	SD	Min	Median	Max
Expense Ratio (p.a.)	15,401	1.34	0.57	0.04	0.95	2.92
Monthly TNA ($ mil)	15,401	309.48	1135.23	1.00	34.60	24666.60
Market Share (%)	15,401	1.08	2.64	0.01	0.16	30.31
Age (months)	15,401	10.51	5.83	0.33	10.42	26.75
Past 1-year Tracking Error (Relative to $\beta = \delta$)	15,401	0.02	0.03	0.00	0.01	0.48
Past 1-year Return (%)	15,401	22.74	54.93	-99.62	18.55	2000.69
Num. Rival Funds (All)	15,401	108.98	14.30	74.00	115.00	148.00
Num. Rival Funds (Similar Index)	15,401	4.74	5.46	0.00	2.00	16.00
Past 1-year Rival New Funds (All)	15,401	9.24	8.53	0.00	6.00	41.00
Past 1-year Rival New Funds (Similar Index)	15,401	0.13	0.47	0.00	0.00	3.00

Note: The table reports summary statistics at the fund-month level for passive index (Panel A) and leveraged funds (Panel B). The sample period is from January 2010 to September 2024.

leveraged fund has a higher expense ratio of 134 basis points per annum, smaller AUM of $300 million and a larger market share of 1.08%. Leveraged funds also differ substantially in the cross-section. Cheaper funds have expense ratios of 4-5 basis points, while more expensive funds reach expense ratios of almost 300 basis points. AUM ranges from a couple of million to over $20 billion. With respect to other characteristics the average passive fund is 11 months old, with a past 1-year return of 22% and a tracking error of 2%.[5] There are 145 unique leveraged funds in our main sample after excluding the outside option. The number of rival funds is about 109, while the number of rival funds tracking a similar index is only about 5.

[5]Specifically, for leveraged funds, a 2% mean tracking error indicates that $|\beta - \delta|$ averages 0.02 where β is the OLS coefficient of fund return on index return in the past 12 months, and δ is the targeted multiple of the fund.

2.2 Motivating Facts

We now present some patterns in the passive index funds and leveraged index funds markets, looking at (i) quantities and prices, (ii) market shares, and (iii) the effects of recent regulations affecting funds entry and exit.

2.2.1 Quantities and Prices

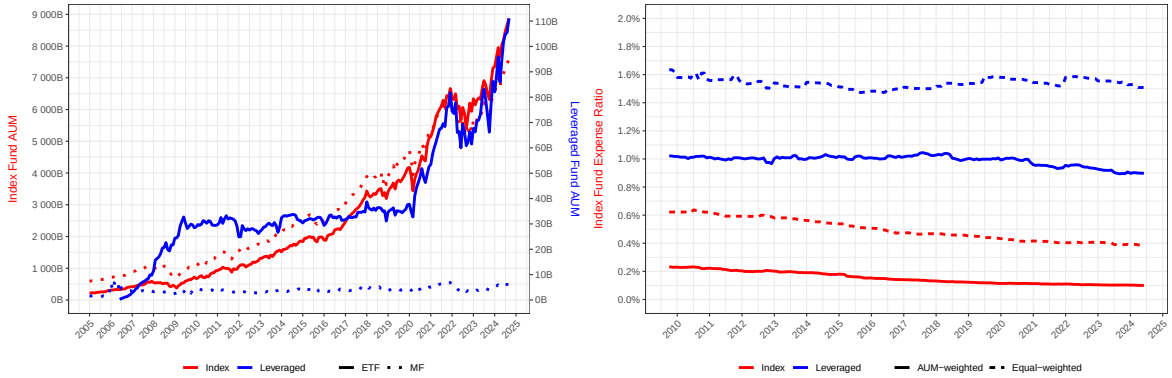
Figure 1a shows that the market for index funds has experienced remarkable growth in the last 20 years. AUM have grown from about $500 billion in 2005 to more than $8 trillion by 2025. This growth has been driven by ETFs, while AUM in mutual funds have been relatively stable. Leveraged funds have experienced a similar increase, but they started from a lower initial level. AUM have grown from less than $5 billion in 2006 to more than $100 billion by 2025. This growth has been driven by leveraged ETFs. It is worth noting that the growth trend for ETFs has been relatively stable, while leveraged ETF AUM has been fairly flat from 2009 to 2019 and experienced a sharp increase in AUM during the Covid-19 pandemic (2020-2021).

Figure 1b shows trends in expense ratios. The average expense ratio for index funds was about 60 bps in 2010 and declined to less than 40 bps by 2025. AUM-weighted expense ratio are even lower, in line with entry of AUM into cheaper indexed funds. The average AUM-weighted expense ratio for index funds was slightly more than 20 bps in 2010 and declined to about 10 bps by 2025.

The average expense ratio for leveraged funds is much higher than for index funds and relatively stable over time. The average expense ratio for leveraged funds was about 160 bps in 2010 and 150 in 2025, more than three times the average expense ratio for index funds. Similar to that of index funds, AUM-weighted expense ratio are lower also for leveraged funds. The average AUM-weighted expense ratio for leveraged funds was slightly more than 100 bps in 2010 and 90 bps by 2025. Adjusting for AUM, the expense ratio for leveraged funds is about ten times larger than for index funds.

In Section 3 we develop a structural model to explore: (i) the joint trends in price and quantities, such as increasing AUM leading to economies of scale which are passed on to investors as lower expense ratios; and (ii) alternative mechanisms for the difference in expense ratios between index and leveraged funds, such as higher costs (e.g., leverage), higher markups due to inelastic investors' demand, or different conduct. We summarize the patterns on prices and quantities for index and leveraged funds as follows.

Fact 1. *Both index funds and leveraged funds have experienced large increases in AUM in 2005-*



(a) Quantities: Asset Under Management (AUM)

(b) Prices: Expense Ratios

Figure 1: AUM and Expense Ratios

Note: The left panel plots the total assets under management in billions of dollars for the 2 by 2 combination of index vs. leveraged by mutual funds (MF) vs. exchange-traded funds (ETF) from 2005 to 2024. We include all funds in our main sample and the funds from the outside option. . The right panel plots the average expense ratio in percent per year from 2010 to 2024. Average expense ratios are equal-weighted or value-weighted by the fund AUM. We include all funds in our main sample and the funds from the outside option.

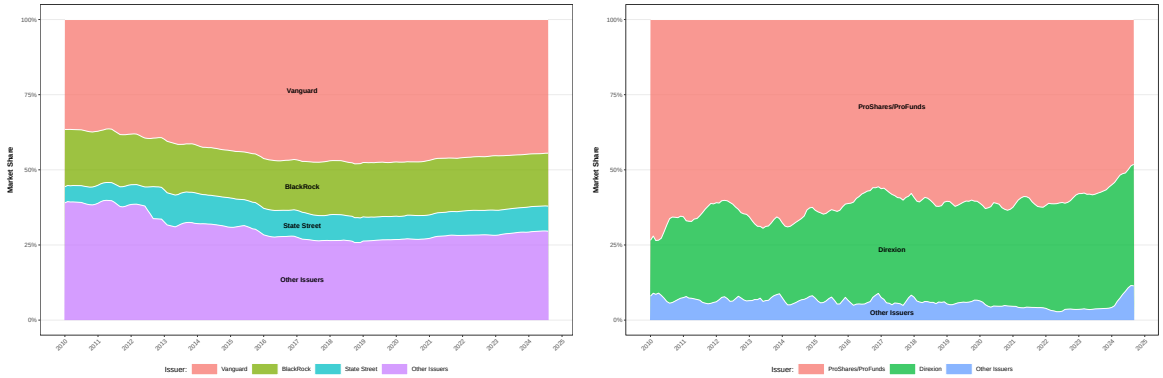
2025, but starting from a different initial level. Index funds expense ratio have experienced a contemporaneous decrease in expense ratios, while leveraged funds expense ratios have been mostly flat and are several order of magnitude larger than index funds expense ratios.

2.2.2 Market Shares and Market Concentration

Figure 2 shows the market shares over the last 15 years. Figure 2a shows that in the passive index fund market, three large players have dominated the market, and their relative importance has increased over time. In January of 2010, Blackrock, State Street, and Vanguard had market shares of 19%, 5%, and 37%, respectively. In June of 2024, the same firms have market shares of 18%, 8%, and 45%. These three firms combined then account for almost 70% of AUM in the passive index funds market.

Figure 2b shows that in the leveraged index funds market, two players have dominated the market: Proshares and Direxion. In 2010, Proshares had market shares of 75%, and Direxion of 20%. Over time Direxion has gained market share and by 2025 Proshares market share is about 50% and Direxion 40%. These two firms combined then account for about 90% of AUM in the leveraged index funds market.

Figure 3a shows the time-series Herfindahl-Hirschman index (HHI) for asset managers for the index fund market (red) and the leveraged fund market (blue). Over our sample period, the HHI for index funds is around 2,500, which is in line with An et al. (2023). For leveraged funds the HHI is



(a) Passive index funds

(b) Passive leveraged index funds

Figure 2: Market Shares

Note: The figure plots the market shares for major in the passive index (top) and leveraged (bottom) fund markets from 2010 to 2024. We smooth the market shares using 3-month moving averages.

around 4,500, declining over time from 5,500 to about 4,000 as Direxion takes market shares from ProShares. Following the standard definitions, both the index market and the leveraged market are highly concentrated. [6]

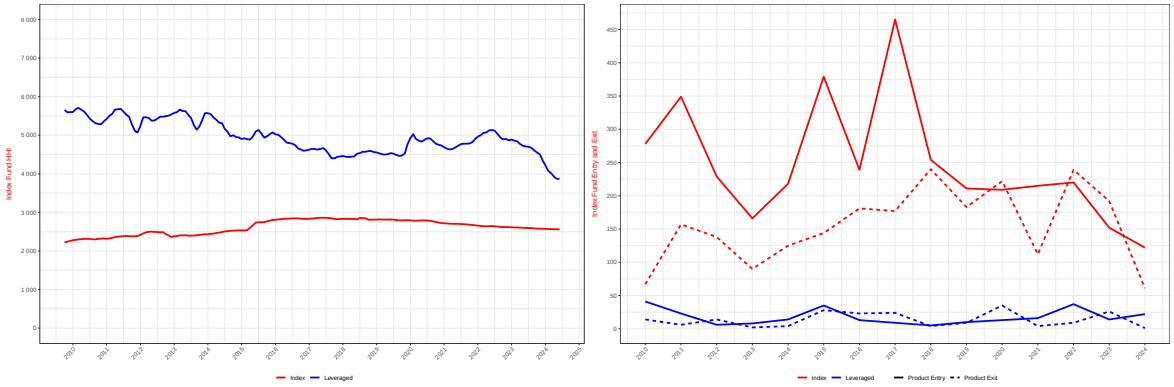
Finally, Figure 3b shows entry and exit of new funds. The larger fund market experienced both more entry of new product and exit of existing ones than the smaller leveraged fund market. Over our sample period, in the index fund market entry higher than exit, in line with Ben-David et al. (2023). On average 240 new funds are launched each year and approximately 150 are closed. In the leveraged fund market entry and exit are more comparable. On average 20 new funds are launched each year and approximately 15 are closed.

Fact 2: *The index funds market is best represented by a concentrated oligopoly and large product entry than exit. The leveraged funds market resembles a highly concentrated duopoly with more limited product entry and exit.*

2.2.3 Regulation

The asset management industry has been subject to several policy changes affecting reporting requirements and product creation. In this paper we focus on Rule 18f-4 which establish the SEC's derivatives framework for registered funds. The rule was first proposed in December 2015, then

[6] Markets are classified as unconcentrated if the HHI is below 1,000, as moderately concentrated if the HHI is between 1,000 and 1,800, and as highly concentrated if the HHI is above 1,800. See Section 5.3 of Horizontal Merger Guidelines of the U.S. Department of Justice and the Federal Trade Commission (https://www.justice.gov/atr/merger-guidelines).



(a) HHI **(b)** Entry and Exit

Figure 3: HHI and Product Entry and Exit

Note: The figure plots the Herfindahl-Hirschman Index (HHI) and the number of funds entering and exiting in the passive index (top) and leveraged (bottom) fund markets from 2010 to 2024. HHI is smoothed using 3-month moving averages.

adopted on October 28, 2020 (Investment Company Act Release No. 34084), effective on February 19, 2021, with a compliance date of August 19, 2022.

The rule extended a previous regulation (SEC 6c-11) to leveraged/inverse ETFs, which were previously excluded. This change remove the need of individual exemptive relief for open-end ETF, potentially leading to a reduction in costs and barriers to entry. At the same time Rule 18f-4 also introduced new reporting requirements and risk management programs, as well as leverage limits based on value at risk (VaR) on funds' use of derivatives. As a result, the creation of new funds with more than 200% leverage is forbidden, but existing products are grandfathered.

Figure 4 explores the effects of the SEC rule change for leveraged funds with 2x and 3x leverage tracking index funds.[7] Figure 4a shows that after the regulatory change there is an increase in the launch of products with 2x leverage, while there is no new entry of 3x leverage products following the rule cap at 2x. Figure 4b shows that the total number of products increases in the 2x market and slightly declines afterwards. In the 3x leverage market, the number of products stays flat at 25. Entry is capped by regulation, and exit is also frozen by the incentive of incumbents to keep products that are now granted a durable grandfathered status.

Turning to AUM, Figure 4c shows that after the policy adoption, AUM increased for both 2x and 3x funds. The increase is in line with the overall trend shown in Figure 1a and coincides with the Covid-19 Pandemic period. Finally, Figure 4d shows that the average expense ratio has been relatively flat at 94 bps for 2x funds around the SEC rule, while the expense ratio for 3x has decreased

[7] For these plots, we exclude single stock and crypto ETFs.

by about 10 bps, from 96 bps before the SEC rule to 86 bps after. This decline in expense ratio for 3x funds is potentially puzzling given their protected incumbent status. At the same time, the large increase in AUM, combined with economies of scale, could have led to a reduction in costs. The lower expense ratio is then the result of lower costs and (some) pass-through to expense ratio. The extent of the latter is a function of the conduct in the market, which might also have been impacted by the SEC regulation. We will exploit our structural model from Section 3 to understand if the lower expense ratios for 3x leveraged funds in Figure 4d arise from economies of scale and to what extent they reflect lower costs versus higher markups from a protected incumbent advantage.

Fact 3: *SEC Rule 18f-4 is associated with more product entry in the 2x leveraged fund market, but there are no changes in expense ratios. The 3x leveraged fund market experienced a decline in both product entry (due to the leverage cap) and exit (due to the grandfathered status on incumbent products), as well as a 10 bps decline in the expense ratio, which combines cost and markup changes.*



(a) Product Entry

(b) Number of Products

(c) AUM

(d) Expense Ratios

Figure 4: SEC Rule 18f-4

Note: The top left panel plots product entry for 1.2-2x and 2.5-3x leveraged ETFs. The top right panel plots the number of active product entry for 1.2-2x and 2.5-3x leveraged ETFs. The bottom left panel plots the total assets under management in billions of dollars for 1.2-2x and 2.5-3x leveraged ETFs. The bottom right panel plots the average expense ratio in percent for 1.2-2x and 2.5-3x leveraged ETFs. We only include index-tracking leveraged funds.

3 Model

Based on the three stylized facts documented in the previous section, we next present a structural equilibrium model of the fund and leveraged fund markets. This structural approach allows us to: (i) decompose the expense ratio into marginal costs and markups; (ii) estimate (dis)economies of scale; (iii) test conduct; and (iv) perform counterfactual analyses varying cost and conduct and quantifying their equilibrium impact on fund and leveraged fund expense ratios paid by investors.

The model works as follows. In each period $t = 1, 2, \ldots, T$, a continuum mass I_t of investors, indexed by i, choose among a discrete number of differentiated fund, indexed by $j = 1, 2, \ldots, J_t$ and offered by fund issuers indexed by $f = 1, \ldots, F_t$. Within each period t, first each fund issuer f sets expense ratios p_{jt} for all funds that it issue $j \in J_{ft}$ (We model fund issuers as multi-product firms). Then investors observe expense ratios p_{jt} and other characteristics X_{jt} and choose the fund in which

to invest their money.

In the subsections that follow, we specify each agent's optimization problem in turn. Our model is static for each period t.

3.1 Investors

Each investor i seeks to buy one unit of an fund from the J_t funds available. We follow the characteristics approach and assume that (i) each fund can be represented as a bundle of attributes and (ii) investor have preferences over these attributes. The indirect utility enjoyed by investor i for choosing fund j that is issued by sponsor f is given by the following equation:

$$u_{ijt} = \underbrace{\delta_{jt} + \mu_{ijt}}_{V_{ijt}} + \epsilon_{ijt}, \tag{1}$$

where the mean utility is given by:

$$\delta_{jt} = \alpha p_{jt} + \beta X_{jt} + \xi_{jt}, \tag{2}$$

where p_{jt} is the endogenous expense ratio; X_{jt} is a matrix of observable exogenous characteristics of fund j (in the estimation we include past return, tracking error, fund age, as well as product fixed effects); and ξ_{jt} captures unobserved demand-side fund characteristics.

We incorporate unobservable taste heterogeneity across investors through random coefficients. Most notably, the investor-specific portion of utility in a single market is given by

$$\mu_{ijt} = [p_{jt},\ X^1_{jt}]\Sigma\upsilon', \tag{3}$$

where X^1_{jt} is a matrix of nonlinear characteristics and is a subset of X_{jt}; and υ denote independent draws from the standard normal distribution.

Investor i chooses the fund j that delivers the highest utility among the J_t funds available on the market. As an alternative to choosing one of the j fund, each investor also has the option of not choosing any fund and investing its money in other asset classes. Hence, the probability that investor i chooses to invest in fund j is given by:

$$s_{ijt} = \text{Prob}(u_{ijt} \geq u_{ij't}, \forall j' \in \{0, 1, \ldots, J_t\}). \tag{4}$$

When taking the model to the data, we assume that random idiosyncratic preferences ϵ_{ijt} in

equation (1) follows an i.i.d. type-1 extreme value distribution. We also normalize the utility of the outside option to vary over time: $u_{i0t} = 0$. Hence, the probability that investor i chooses fund j in market t is given by:

$$s_{ijt} = \frac{e^{V_{ijt}}}{1 + \sum_{j' \in J_t} e^{V_{ij't}}}. \tag{5}$$

We obtain aggregate market share by summing across the continuum mass I_t of investors integrating over the distribution of investor heterogeneity. Hence, conditional on the heterogeneous coefficients, market shares follow the well-known logit form:

$$s_{jt} = \int s_{ijt} dF_t(i), \tag{6}$$

where F_t is the distribution of the random coefficients. This demand specification produces realistic substitution patterns, with similar fund families serving as close substitutes.

3.2 Asset Managers

Asset managers issuers maximize profits by setting optimal expense ratios for all the funds they offer $p_{jt} \in J_{ft} \subset J_t$ given their costs. Total profit of asset manager f is given as follows:

$$\pi_{ft} = \max_{p_{jt} \in J_{ft}} (p_{jt} - c_{jt}) s_{jt}, \tag{7}$$

where c_{jt} is the marginal cost of offering fund j in period t; and s_{jt} is the market share from equation (6).

In a single market t the corresponding first order conditions relative to expense ratios are (in vector form):

$$p = c + \frac{\overbrace{\quad\quad}^{\Delta}}{-\Omega \odot \frac{\partial s}{\partial p}'}. \tag{8}$$

where Δ measures the vector of markups; and Ω denotes the market-level ownership matrix ($\odot$ is the Hadamard (element-wise) multiplication). In a multi-product differentiated Bertrand setting $\Omega_{jk} = 1$ if the same issuer produces fund j and k, and 0 otherwise.[8] We will use variation of structure of the ownership matrix Ω in Section 5 to test for alternative conduct hypotheses.

[8] In a differentiated Bertrand setting where each ETF firm issue only one fund Ω becomes an identity matrix (i.e., $\Omega_{jj} = 1$ and zeros elsewhere). With perfect collusion among all firms Ω becomes a matrix of ones.

Finally, we assume a Cobb-Douglas production function, resulting in the following functional form for the marginal costs:

$$c_{jt} = \gamma log(q_{jt}) + \tau W_{jt} + \omega_{jt} \tag{9}$$

where q_{jt} is the asset under management corresponding to the level at which economies of scale accrue; W_{jt} is a matrix of observable supply side characteristics that affect the marginal cost of ETF (e.g., tracking error, fund age); and ω_{jt} is an unobserved cost shock. The parameter γ captures (dis)economies of scale in the production of fund.

In equation (9), we adopt a log-log functional form for marginal cost and assume the economies of scale accrues at the fund level in a given period. We also explore other functional forms (log-linear and non-monotonic marginal costs) and different levels of aggregation for economies of scale (at the index and sector level).

4 Estimation and Results

In this section we discuss our estimation procedure and the results. We estimate the model separately for plain index funds and leveraged index funds. We show demand estimates first, since they do not depend on the assumptions on conduct. We then discuss the supply estimation and present the model-implied scale economies.

4.1 Demand

Estimation. We first estimate the structural parameters for investor demand which consist of the sensitivity to (endogenous) expense ratios (α), the sensitivity to other exogenous characteristics (β), and random coefficients (Σ). We collect all these demand parameters in a vector $\theta = (\alpha, \beta, \Sigma)$. For plain index funds, we define the outside option as as all funds with market shares below 0.01% plus funds that track the underlying index with $R^2 < 0.95$. The resulting average market share is 12.15% (10.48% in the last 5-years). For leveraged funds, we define the outside option as all funds with market shares below 0.01% plus all products offered by Rydex, the smallest issuer, which as a whole has an average market share of 5.97% (5.00% in the last 5-years).

The key identification channel is that expense ratios might be correlated with unobservable index quality or other demand shocks, potentially biasing the estimate of α.[9] To address this endogeneity

[9] Investors may care about costs beyond the expense ratio. We address this concern with two approaches. First, in Table

concern, we first include fund fixed effects, which capture unobservable time-invariant differences in funds that can affect investors' demand.[10] Most notably, we instrument expense ratios with a Hausman instrument, which have been recently adapted to the index fund market (An et al., 2023; Brown et al., 2023). Our instrument for the expense ratio for fund j offered by issuer f at time t is the average expense ratio of other funds $k \neq j$ from the same issuer f at the same time t tracking a different index. For example, we instrument the expense ratio for ProShares UltraPro QQQ, which tracks the Nasdaq 100, using the average expense ratio of other ProShares LETFs tracking a different index (e.g., ProShares Ultra Financial, which tracks the S&P Financial Select Sector Index). The instrument is relevant because ProShares's costs of managing funds are correlated across funds (for example they share common data analysis tools), and the instrument is exogenous provided that ProShares expense ratio for funds tracking other indexes are uncorrelated with ProShares UltraPro QQQ demand shocks.

Tables A1 and A2 shows the first stage estimates for index and leveraged funds, respectively. Column (1) shows that higher expense ratios for other funds by the same issuer have a positive and statistically significant association with higher focal fund expense ratios. This fund family-wide pricing effect is stronger for leveraged funds: the within R^2 is about 8.7% and the Kleibergen and Paap (2006) Wald $F-$statistic on the excluded instrument is well above 120, indicating strong instrument relevance. For index funds, the within R^2 is only about 0.4%, but the $F-$statistic on the excluded instrument is 33.0, which is well above the conventional weak instrument threshold of 10 from Stock and Yogo (2005).

For the estimation of random coefficients in the BLP model, we need additional moments. We construct a number of potential instruments following the guidance of Berry and Haile (2016). We rank these instruments by their first stage $F-$statistic after filtering by $F > 10$ and use the top 3 in addition to the Hausman-style instrument from Column (1). For index funds, we add as IVs the total number of new fund issues in the previous year by other issuers; the log of the total age for rival funds

A8, we construct the all-in cost of a fund using the tracking difference (i.e., the residual between fund returns and target index returns), and find no investor sensitivity to these all-in costs. Second, because such a residual-based measurement is noisy, we alternatively examine if investor choice in the leveraged fund market is affected by the swap spread charged to finance leveraged index exposure. Swap spreads are reported in the SEC's N-Port filings and is cleanly observable since 2019. We find in Table A9 that investors show no sensitivity to the swap spread.

[10] Table A4 reports on a variance decomposition of the fund fixed effect. We observe that the fund fixed effect is largely associated with the time-invariant combination of firms issuing a particular index. The effect is relatively more important for leveraged funds. However, an important source of within-firm$\times$index variation is at the share class level (e.g., institutional vs. retail shares), which allows us to use fund fixed effects to control for time-invariant clientele effects. Consistent with this point, we report in Table A6 an alternative specification replacing fund fixed effects with firm$\times$index fixed effects, and observe much lower average elasticities that materially introduces outliers in the demand estimation's ability to generate realistic markups. Thus, we focus on the specification with fund fixed effects.

tracking a different index; and the log of the total tracking error for rival funds tracking a different index. For leveraged funds, we add as IVs the number of bullish leveraged funds from other issuers; the number of bearish leveraged funds from other issuers; and the total number of new fund issues in the previous year by other issuers.

The GMM estimator of the demand parameters is then given by:

$$\widehat{\theta} = \underset{\theta}{argmin}\ (Z\xi(\theta))' W (Z\xi(\theta)) \tag{10}$$

where $Z = [Z^D; X]$ are the instruments, which include the excluded instruments (Z^D) presented above and the exogenous characteristics (X) (In the X matrix we include past one-year fund return, (log) fund age, and tracking error, defined as the absolute value of the difference between stated leverage and 1-year moving window OLS leverage); $\xi(\theta) = \delta(\theta) - \alpha p - \beta X$ is the structural error; and W is a weighting matrix. For the latter, we follow Conlon and Gortmaker (2020). We use the 2SLS weighting matrix in the first stage and then update W in the second stage with clustered weighting matrices at the market level.

Results. Table 2 shows the results of the demand estimation for different specifications. Panel A reports the results for index funds and panel B for leveraged funds. In column (1), we present the logit estimation without an instrument for expense ratio. We estimate a downward sloping demand function with a negative coefficient on the expense ratio of about 1, which generate a relative inelastic demand (implied elasticity of about 0.26). In column (2) we show the logit estimates using the Hausman-style instrument for expense ratio. Accounting for the endogeneity of expense ratios makes demand more elastic, in line with a downward bias of the price coefficient in the simple logit. Most notably, the demand elasticity increases to about 1.6.

While the key endogenous characteristic is the expense ratio, the coefficients on other (exogenous) characteristics are useful to understand what investors value and the overall model's ability to capture substitution patterns in the data. We find that investors value high past-returns in line with the large literature on the flow-performance relationship (Berk and Green, 2004; Frazzini and Lamont, 2008; Dannhauser and Pontiff, 2025), and prefer older, potentially more well known funds. Finally, investors dislike high tracking errors, as expected.[11]

In column (3) we show the estimates for the BLP model, where we add a random coefficient on the expense ratio. The coefficient on the expense ratio increases (in absolute term) relative to the

[11] To give a sense of the relative economic importance, Table A5 reports on the elasticities and semi-elasticities associated with expense ratio and these other characteristics.

logit-IV specification, with a point estimate of almost 7. As a result the mean own-price elasticity is larger than the logit-IV at almost 2. The point estimates for the other exogenous characteristics are similar to the logit-IV ones. The BLP model shows statistically significant dispersion in expense ratio sensitivity, which is ignored by the logit model. Finally, in column (4) we show the estimates for the BLP model, where we add a random coefficient also on past-return and (log) age. The coefficient on the expense ratio increases, with an implied elasticity of about 2.5. These elasticities are similar in magnitudes to the ones found in the literature estimating comparable demand models for ETFs (An et al., 2023) and index funds more broadly (Brown et al., 2023).

Turning to LETFs in panel B of Table 2 we estimate a downward sloping demand function with a negative coefficient on the expense ratio of about 2. This translates into a demand elasticity of about 2.6. Similar to the pattern in panel A, accounting for the endogeneity of the expense ratio increase the elasticity to about 4.9. Finally the flexible BLP specification increase the average elasticity further to about 5.9. Demand for LETFs is more than twice more elastic to expense ratios than demand for ETFs, consistent with the popular notion that many leveraged fund investors are attentive day-traders. The coefficients on other characteristics are similar for ETFs and LETFs. Investors in leveraged products like higher past returns and older (and potentially more well known) leveraged funds and dislike leveraged funds with high tracking errors.

Figure 5 shows the distribution of own-price elasticities and aggregate elasticities across markets.[12] While the random coefficients are estimated with noise, the BLP advantage over the simple logit model is twofold. First, as shown in Table 2, the average elasticities increase from logit to BLP. Second, the BLP approach is able to capture substitution patterns better. For example, we compute cross-elasticities by issuer-pairs for similar and different underlying indices, and observe in Table A3 that the BLP model better captures substitution between similar indices, within the ETF (mutual fund) segments, and among different issuers.[13] This supports the notion that BLP allows products that are similar along dimensions consumers care about to have higher cross-elasticities with each other than with dissimilar products. So when random coefficient estimates are large — meaning consumers are very heterogeneous — the cross-elasticities between similar products can be substantially larger than what logit would predict, because the same group of consumers is contested by those similar products.

[12]The aggregate elasticity reflect the change in total AUM for ETF and LETF under a proportional increase in expense ratio 10%. Figure A1 in the appendix shows the distribution of own-price elasticities and aggregate elasticities across markets for the logit-IV model.

[13]Specifically, in Table A3, compared with that of the logit model, we observe higher BLP substitution within similar indices than within different indices, between LETF issuers ProShares and Direxion than for substitution with the mutual fund issuer ProFunds, and much more variation across ProShares/Direxion/ProFunds.

Table 2: DEMAND PARAMETERS

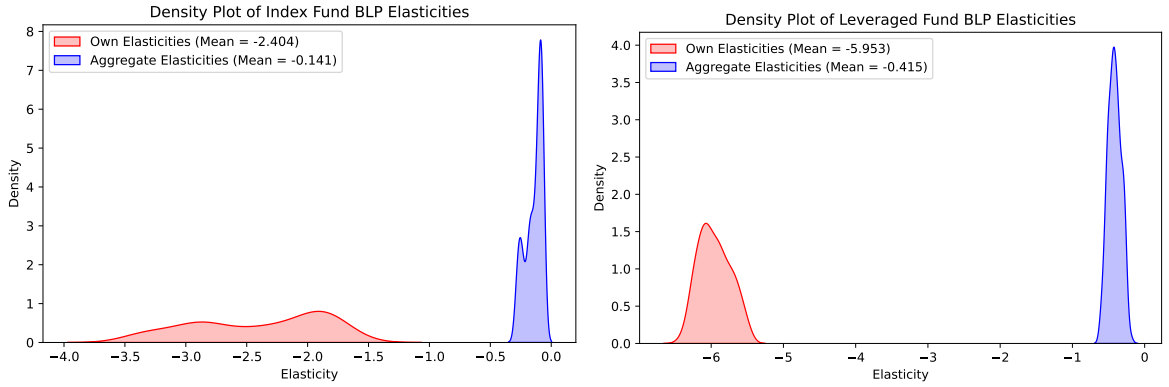
Panel A: Passive Index Funds

Model:	Logit		BLP	
	OLS	IV	IV	IV
Expense ratio	-0.938^{***}	-5.606^{***}	-6.771^{***}	-8.348^{***}
	(0.046)	(0.131)	(0.736)	(1.563)
Past 1-year return	0.413^{***}	0.413^{***}	0.414^{***}	0.387^{***}
	(0.037)	(0.034)	(0.014)	(0.028)
Age (log)	0.546^{***}	0.573^{***}	0.580^{***}	0.594^{***}
	(0.012)	(0.011)	(0.011)	(0.049)
Tracking error	-0.231^{**}	-0.451^{***}	-0.505^{***}	-0.544^{***}
	(0.039)	(0.066)	(0.062)	(0.095)
Dispersion expense ratio (RC)			0.027^{**}	-0.008
			(0.011)	(38.559)
Dispersion past 1-year return (RC)				-0.009
				(4.872)
Dispersion age (RC)				0.001
				(30.556)
Fund FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	108,300	108,300	108,300	108,300
Average own-price elasticity	-0.268	-1.614	-1.950	-2.404

Panel B: Passive Leveraged Funds

Model:	Logit		BLP	
	OLS	IV	IV	IV
Expense ratio	-2.024^{***}	-3.712^{***}	-6.484^{***}	-6.141^{***}
	(0.098)	(0.328)	(0.079)	(0.688)
Past 1-year return	0.259^{***}	0.255^{***}	0.261^{***}	0.244^{***}
	(0.037)	(0.040)	(0.029)	(0.041)
Age (log)	0.658^{***}	0.706^{***}	0.779^{***}	0.785^{***}
	(0.038)	(0.040)	(0.031)	(0.100)
Tracking error	-1.183^{**}	-1.376^{***}	-1.546^{***}	-1.644^{***}
	(0.224)	(0.247)	(0.239)	(0.252)
Dispersion expense ratio (RC)			2.084^{***}	1.813^{***}
			(0.112)	(0.314)
Dispersion past 1-year return (RC)				-0.095
				(0.077)
Dispersion age (RC)				-0.075
				(0.717)
Fund FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	15,401	15,401	15,401	15,401
Average own-price elasticity	-2.684	-4.892	-5.911	-5.953

Note: The table shows the estimated demand parameters for passive index funds (Panel A) and for passive leveraged funds (Panel B). Expense ratio is the portion of total investment that investors pay for operating expenses. Past 1-year return is the 1-year return ending in month $t-1$. Age is the number of months since fund inception. Tracking error is the absolute value of the difference between stated leverage and OLS-estimated leverage in the 1-year ending in month $t-1$. Columns (3) and (4) include additional random coefficients (RC) on prices and/or past 1-year return in the BLP specification. Robust standard errors are clustered at the market level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% nominal levels, respectively.



(a) Passive index funds

(b) Passive leveraged index funds

Figure 5: Demand Elasticities

Note: The figure plots the elasticities implied by BLP estimation for passive index (top) and leveraged funds (bottom), respectively. See Column (4) of Panel A and B from Table 2, where the linear model is augmented with random coefficients on price, past 1-year return, and fund age.

4.2 Supply

Estimation. To estimate the supply side, we need to first compute the markups associated to different conduct assumptions. As equation (8) shows, the markups (Δ) are a function of market shares (s), demand elasticities ($\frac{\partial s'}{\partial p}$), and conduct ($\Omega$). We follow the approach in Duarte et al. (2025). Given the observed data and estimated demand primitives, for each conduct model (e.g., multi-product Bertrand) we compute the implied markups ($\Delta^{Bertrand}$). Using the model-implied markups and observed expense ratios, we can then back out model-implied marginal costs: $c^{Bertrand} = p - \Delta^{Bertrand}$. We can then estimate the marginal cost function given by equation (9).

When regressing the model-implied marginal cost on (log) AUM and product characteristics we need to account for the endogeneity of AUM. A simple linear regression faces a reverse causality issue. Rather than higher AUM leading to lower costs, the lower costs increase the AUM given investors preference for LETF with lower expense ratios (captured by our α parameter in equation (2), which is indeed negative as shown in Table 2). To address this concern, we need an instrument that shifts AUM but is uncorrelated with unobserved cost shifters (ω_{jt}).

We adopt two research designs. First, for both ETF and LETFs j, we regress in 60-month moving windows ending in month t the fund's underlying index returns on market returns and record the residual in the last month as the value in month t.[14] We compute our instrument as the negative of this residualized index return (i.e., the negative one times the mininum between zero and these

[14] We also tested a version where we residualize with respect to market returns and changes in the VIX, and find similar quantitative results.

residuals). For example, we instrument AUM for ProShares UltraPro QQQ using its past negative residualized index returns. The instrument is relevant if investors want to move out from ProShares UltraPro QQQ when its index return underperforms relative to aggregate market conditions. The instrument is exogenous provided that past negative residualized index returns are uncorrelated with ProShares UltraPro QQQ contemporaneous cost shocks. Table A10 shows the first stage estimates. Column (1) shows that higher underperformance of index returns relative to the market is associated with lower AUM for both ETFs (panel A) and LETFs (panel B). The within R^2 is around 6 to 8%, and the Kleibergen and Paap (2006) $F-$statistics on the excluded instrument is large at 75-100, signaling strong relevance.

Second, we implement a shift-share research design for a subset of index funds with available pension investor holdings data at the quarterly frequency. We exploit two sources of variation: the cross-sectional variation stemming from pension funds' pre-determined mandate to allocate towards index funds, and the time-series variation in pensions' aggregate net buying of index funds.[15] We compute our instrument as

$$\text{Expected Pension Buys}_{j,q} = \sum_{i \in S_{j,q}} \underbrace{\text{weight}_{i,j,q-4}}_{\text{Share}} \times \underbrace{\text{Buys} - \text{Sells}_{i,-j,q}}_{\text{Shift}}, \tag{11}$$

where $\text{weight}_{i,j,q-4}$ is the weight ("exposure") of an index fund j in pension investor i's portfolio from 4-quarters previously, $\text{Buys} - \text{Sells}_{i,-j,q}$ is the investor-level aggregate buys minuses aggregate sells of index funds by investor i excluding focal fund j, and $S_{j,q}$ is the set of investors holding index fund j. This instrument is relevant if it is positively correlated with actual fund AUM, and satisfies shift-share exclusion if the aggregate (exposure-weighted) net buying of index funds by a pension fund is uncorrelated with the contemporaneous cost shocks of the focal fund. This exogeneity condition is more likely satisfied in our construction because we remove the focal fund from pension-level buying. Moreover, because $\text{Pension Exposure}_{j,t} = \sum_{i \in S_{j,q}} \text{weight}_{i,j,q-4} \neq 1$, we follow the prescriptions of Borusyak et al. (2022) and include controls for $\text{Pension Exposure}_{j,t}$ interacted with quarter fixed effects to account for the impact of "incomplete shares" in our construction.

Intuitively, equation (11) describes a measure of expected pension buying based on the differential allocation of aggregate pension investor buys based on a heterogeneous mandate to invest in index

[15] We follow Agarwal et al. (2013) in computing buys and sells from 13F investor holdings data. Following standard procedure, we adjust reported shares in the 13F data for share splits, correct the splitting of BlackRock across investor-identifiers, and remove any holdings whose split-adjusted shares exceed a fund's shares outstanding.

funds based on past portfolio weights. As a simple example, we instrument AUM for SPY using CalPERS buying of other ETFs (shift) interacted by share of SPY in CalPERS portfolio (share) one-year ago. Table A11 shows the first stage estimates. Column (1) shows that higher expected pension buys is associated with higher AUM for index funds, as expected. The within R^2 is around 14%, and the Kleibergen and Paap (2006) $F-$statistics on the excluded instrument is above 11.4, signaling strong relevance.

The exclusion restriction for the identification of the supply parameters is then: $E[\omega_{jt}|Z^S_{jt}, W_{jt}] = 0$, where Z^S_{jt} are our instruments (negative residualized returns and the shift-share based on pension funds' index mandates), and W_{jt} are exogenous supply side characteristics that affect the marginal cost.

Results. Panel A of Table 3 shows the result from the estimation of the marginal cost equation (9) for ETFs. In column (1), we present the results in the case of perfect competition with no instrument. Note that in this case marginal costs are equal to expense ratios (the markup is zero). We find that higher AUM is associated with lower marginal costs, consistent with economies of scale. The point estimates is statistically significant, but small in magnitude with an implied elasticity of 0.02. In column (2), we present the results in the case of perfect competition but accounting for the endogeneity of (log) AUM with our first instrument. The point estimate is now four times larger in absolute value, in line with stronger economies of scale, giving an implied elasticity of about 0.09. A doubling of AUM lowers marginal cost by roughly 1.7 bps, or 6% of mean marginal cost.

Columns (3) and (4) of Table 3 show the results from the estimation of the marginal cost equation (9) when conduct is Bertrand. In this case, marginal costs are lower than expense ratios due to the positive markups. The point estimates are similar to the perfect competition case, showing that the estimation of economies of scale for ETF is robust to the different conduct assumptions. However, since the implied marginal costs are now about 12 bps, a doubling of AUM lowers marginal cost by roughly 14% of mean marginal cost.

In columns (5) and (6) of Table 3 we find that our point estimates are also robust to a (rejected by the data) conduct assumption based on profit internalization of the largest three index providers (Vanguard, State Street, and Blackrock). The point estimates are similar to the perfect competition and Bertrand case, but the implied marginal costs are now only 7 bps (the markup from partial internalization accounts for a larger share of observed expense ratios); a doubling of AUM lowers marginal cost by roughly 21% of mean marginal cost.

Panel B of Table 3 shows the result from the estimation of the marginal cost equation (9) for lever-

Table 3: SUPPLY PARAMETERS AND ECONOMIES OF SCALE

Panel A: Passive Index Funds

Dependent Variable:	Marginal Cost (percentage points per annum)					
Conduct:	Perfect Competition		Bertrand		$\text{Bertrand}_{\text{PW}}$	
	OLS	IV	OLS	IV	OLS	IV
AUM (log)	-0.006^{***}	-0.024^{***}	-0.007^{***}	-0.024^{***}	-0.008^{***}	-0.021^{***}
	(0.0003)	(0.005)	(0.0004)	(0.005)	(0.0004)	(0.005)
Tracking error	-0.042^{***}	-0.046^{***}	-0.048^{***}	-0.052^{***}	-0.049^{***}	-0.052^{***}
	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
Age (log)	-0.002^{***}	0.008^{***}	-0.001^{*}	0.008^{***}	0.003^{***}	0.010^{***}
	(0.0006)	(0.003)	(0.0007)	(0.003)	(0.0008)	(0.003)
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	108,300	108,300	108,300	108,300	108,300	108,300
Average Marginal Cost	0.273	0.273	0.122	0.122	0.068	0.068
Average Markup	0.000	0.000	0.151	0.151	0.205	0.205

Panel B: Leveraged Funds

Dependent Variable:	Marginal Cost (percentage points per annum)					
Conduct:	Perfect Competition		Bertrand		$\text{Bertrand}_{\text{PW}}$	
	OLS	IV	OLS	IV	OLS	IV
AUM (log)	-0.027^{***}	-0.052^{***}	-0.026^{***}	-0.041^{***}	-0.023^{***}	-0.040^{***}
	(0.001)	(0.012)	(0.001)	(0.010)	(0.0010)	(0.009)
Tracking error	-0.128^{***}	-0.155^{***}	-0.094^{**}	-0.109^{**}	-0.097^{***}	-0.115^{***}
	(0.041)	(0.045)	(0.043)	(0.046)	(0.037)	(0.040)
Age (log)	0.076^{***}	0.091^{***}	0.042^{***}	0.051^{***}	0.049^{***}	0.059^{***}
	(0.005)	(0.009)	(0.005)	(0.008)	(0.004)	(0.007)
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,401	15,401	15,401	15,401	15,401	15,401
Average Marginal Cost	1.337	1.337	0.881	0.881	0.449	0.449
Average Markup	0.000	0.000	0.454	0.454	0.887	0.887

Note: The table shows the estimated supply parameters and economies of scale for the passive index (Panel A) and leveraged fund (Panel B) markets under OLS and IV models. Marginal costs are computed from expense ratio minus model-implied markup. Marginal costs and markups are winsorized at the 5% and 95% tails by month. The $\text{Bertrand}_{\text{PW}}$ model refers to a Bertrand model where the Big 3 ETF sponsors (Vanguard, State Street, and Blackrock) or ProShares/ProFunds and Direxion, respectively, have a profit weight of 0.65 on each other's products. AUM is assets under management in the current month at the fund, index, and issuer-levels. Age is the number of months since fund inception. Tracking error is the absolute value of the difference between stated leverage and OLS-estimated leverage in the 1-year ending in month $t-1$. We instrument AUM with negative residualized (with respect to market return and changes in VIX) index returns. Robust standard errors are clustered at the market level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% nominal levels, respectively.

aged funds following the same logic: across three conduct models (perfect competition, Bertrand, and partial internalization) and OLS (odd columns) vs IV (even columns). In column (1) we present the results in the case of perfect competition with no instrument. We find that higher AUM are associated with lower marginal costs, consistent with economies of scale for LETF as well. The point estimate is statistically significant, with an implied elasticity of 0.02. In column (2) we present the results in the

case of perfect competition but accounting for the endogeneity of (log) AUM with out first instrument. The point estimate is now about two times larger in absolute value, in line with stronger economies of scale. A doubling of AUM lowers marginal cost by roughly 3.6 bps, or 2.7% of mean marginal cost. The point estimates are relatively robust irrespective of the conduct assumptions, in line with the results for ETFs. However, with Bertrand and even more so with partial profit internalization, the marginal costs are lower and the relative effect increase accordingly. With partial internalization a doubling of AUM lowers marginal cost by roughly 6% of mean marginal cost.

Next we report in Table 4 the results based on the pension-based shift-share instrument for a subset of index funds that have available 13F holdings data. Despite the different sample and being at the quarterly rather than monthly frequency, the estimated marginal costs are comparable: 28 basis points relative to 27 basis points in the full sample (Panel A of Table 3). In column (1) we present the results in the case of perfect competition with no instrument. We find that higher AUM are associated to lower marginal costs consistent with economies of scale. The point estimates is statistically significant, but small in magnitude with an implied elasticity of 0.01.

In column (2) of Table 4 we present the results in the case of perfect competition but accounting for the endogeneity of (log) AUM. The point estimate is now ten times larger in absolute value, in line with stronger economies of scale. The implied elasticity is 0.11, which is remarkably similar to the one from column (2) of Table 3, despite the different sample, frequency, and identification strategy. In the other columns of Table 4 we report similarly robust results for other conduct models and for a different version of the instrument based on index portfolio weights, where we re-compute the portfolio weight among the index holdings of the pension investor rather than all holdings.

Overall, both plain index and leveraged funds exhibit economies of scale. The effects are stronger in absolute terms for LETFs (a 20% increase in AUM decreases the cost by about 0.45 bps for ETF and 0.8 for LETF), but are similar in relative terms.[16] Most notably, under each product's preferred conduct model, a 20% increase in AUM lowers marginal cost by about 1.6% of its mean. Overall, our estimate of economies of scale for ETF is smaller, but in the same order of magnitude to what Adiraju et al. (2022) find in reduced-form for index funds in general.[17] Most notably, our scale elasticity of

[16]Our estimates are robust under an extensive battery of robustness tests: Table A12 reports similar estimates when marginal costs are estimated from an alternative demand estimation using firm×index fixed effects that generate much lower average elasticities; Table A13 shows that markups are not driving the scale estimates; Tables A14 and A15 shows that the economies of scale show up on average across fund size terciles but are strongest for smaller funds; Tables A16 and A17 survive controlling for fund return volatility; and Table A18 shows similar results accounting for the differential elasticities of large funds tracking broad-based indices.

[17]Column (3) in Exhibit 6 in Adiraju et al. (2022) shows that a 20% increase in size will reduce the cost of an index fund by about 2 basis points. Economies of scale can also affect product entry decisions for mutual funds, as shown by Khorana and Servaes (1999) and Loseto and Mainardi (2023).

Table 4: SUPPLY PARAMETERS AND ECONOMIES OF SCALE: PENSION-BASED SHIFT-SHARE IDENTIFICATION

Dependent Variables:	Marginal Cost (percentage points per annum)						
Conduct:	Perfect Competition (PC)	Bertrand	$\text{Bertrand}_{\text{PW}}$	PC	Bertrand	$\text{Bertrand}_{\text{PW}}$	
Estimation:	OLS	IV: Portfolio Weight × Net Index Buys IV		IV: Index Portfolio Weight × Net Index Buys IV			
Model:	(1)	(2)	(3)	(4)	(5)	(6)	(7)
AUM (log)	-0.003^{***}	-0.030^{**}	-0.040^{***}	-0.051^{***}	-0.029^{**}	-0.039^{***}	-0.051^{***}
	(0.0009)	(0.012)	(0.014)	(0.014)	(0.012)	(0.014)	(0.014)
Tracking error	0.013	0.014	0.008	0.020	0.014	0.008	0.020
	(0.017)	(0.018)	(0.019)	(0.019)	(0.018)	(0.019)	(0.019)
Age (log)	-0.026^{***}	−0.005	0.000	0.020	−0.006	−0.0005	0.020
	(0.004)	(0.011)	(0.013)	(0.012)	(0.011)	(0.013)	(0.012)
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-Qtr FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pension Exposure × Year-Qtr FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6,936	6,936	6,936	6,936	6,936	6,936	6,936
Average Marginal Cost	0.283	0.283	0.134	0.037	0.283	0.134	0.037
Average Markup	0.000	0.000	0.149	0.246	0.000	0.149	0.246

Note: The table shows the estimated supply parameters and economies of scale for for the passive index market for a sub-sample of funds with an available shift-share instrument constructed from pension investors' expected index investing. Marginal costs are computed from expense ratio minus model-implied markup. Marginal costs and markups are winsorized at the 5% and 95% tails by month. The $\text{Bertrand}_{\text{PW}}$ model refers to a Bertrand model where the Big 3 ETF sponsors (Vanguard, State Street, and Blackrock) have a profit weight of 0.65 on each other's products. AUM is assets under management in the current month at the fund, index, and issuer-levels. Age is the number of months since fund inception. Tracking error is the absolute value of the difference between stated leverage and OLS-estimated leverage in the 1-year ending in month $t-1$. We instrument AUM with a shift-share IV that is the sum of quarter t index fund net buying by pension funds, weighted by these investors' pre-determined index fund portfolio weights in quarter $t-4$. Pension Exposure × Year-Qtr FE is the "incomplete shares" control for the interaction of the Year-Qtr fixed effect with a fund's total index fund portfolio weight exposure in $t-4$ to pensions. Robust standard errors are clustered at the market level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% nominal levels, respectively.

0.09 to 0.11 is also in line with scale economies in the automotive market (Goldberg and Verboven, 2001; Duarte et al., 2025) and the manufacturing sector in general (Bartelme et al., 2025).[18]

5 Conduct Testing

We consider several models of conduct. Given our demand estimates from Table 2 we compute the implied markup for each model Δ^{model} and the price (expense ratio)-cost margins Δ^{model}/p. Using the observed expense ratio and the first-order-condition given by equation (8) we compute the implied marginal costs.

We begin by inspecting price-cost margins for the most popular products in the index fund and leveraged fund markets based on AUM in the third quarter of 2024. Panel A of Table 5 shows the top five products for the three largest firms in the index funds market: Vanguard, State Street and

[18] For example Duarte et al. (2025) find that a 10% increase in cars production reduces marginal cost by about 1%.

Blackrock. The price-cost margins for the most popular products offered by Vanguard, State Street and BlackRock under Bertrand conduct are between zero and one. Products with higher market share tend to have lower own-price elasticities and therefore higher markups. However, there are products with similar own-price elasticities and different markups. For example, Vanguard Total Stock Market Index Fund (-0.160) and SPDR Portfolio S&P 500 ETF (-0.167) have almost identical own-price elasticities, but the price-cost margin for Vanguard Total Stock Market Index Fund (0.224) is notably higher than SPDR Portfolio S&P 500 ETF (0.130).[19]

We also compute the implied price-cost margins for Bertrand competition when the largest three sponsors partially internalize the effects of their actions on their rivals' profits. We compute those by adjusting the ownership matrix Ω in the first-order-condition given by equation (8) accordingly. Consider as an example, the case in which Vanguard, State Street and BlackRock internalize each other profits with a weight of 65%. This case can be accommodated by setting $\Omega_{jk} = 0.65$ if product j is offered by Vanguard and product k is offered by State Street or BlackRock. These partial internalization conduct models imply higher price-cost margins than Bertrand and more similar across the three providers. For example, going from differentiated Bertrand to partial internalization increase the price-cost margin for Vanguard from 0.21 to 0.29 and for State Street from 0.13 to 0.25.

We then consider the implied price-cost margins with Cournot competition. All the most popular products by Vanguard, State Street and BlackRock experience an increase in price-cost margins relative to Bertrand competition. Vanguard experience the largest increase at about 0.25, while State Street the lowest at about 0.07. The increase in price-cost margin is in line with the result that in differentiated product markets Cournot markups are generally larger than Bertrand markups because firms internalize a less aggressive competitive response from rivals. Finally, in the case of monopoly, all ETF sponsors are setting expense ratios to maximize their joint profits. This conduct is represented by an ownership matrix Ω with ones in each element. Under this conduct assumption, the implied price-cost margins for the largest sponsors are above one, which makes monopoly conduct implausible.

Panel B of Table 5 shows the top five products for the two largest firms in the leveraged funds market: ProShares and Direxion. The price-cost margins for the most popular products offered by ProShares and Direxion under Bertrand conduct are around 0.24-0.43. Hence, despite the larger elasticities, price-cost margins are higher for LETF than for ETF. Funds with higher market share

[19]Large fund issuers might have large price-cost margins (even while pricing at average cost like Vanguard) with large scale economies and multiproduct recapture. Tables A7, A18, and A19 also report an alternative demand estimation and associated supply and conduct results accounting for the differential presence of large funds tracking broad-based indices by interacting expense ratio with an indicator for broad-based index and find qualitatively similar results.

Table 5: PRICE-COST MARGINS FOR LARGEST FUNDS

Panel A: Index Funds

Fund	Leverage	AUM (mil)	Elasticity	Bertrand	$\text{Bertrand}_{\text{PW}}$	Cournot	Monopoly
Vanguard Total Stock Market Index Fund	1.00	$ 700,879.40	−0.160	0.224	0.310	0.645	1.128
Vanguard 500 Index Fund (MF)	1.00	$ 542,138.10	−0.323	0.215	0.293	0.573	1.016
Vanguard 500 Index Fund (ETF)	1.00	$ 508,721.60	−0.243	0.217	0.297	0.587	1.037
Vanguard Total Stock Market Index Fund (MF)	1.00	$ 430,969.10	−0.244	0.215	0.293	0.573	1.016
Vanguard Total Stock Market Index Fund (ETF)	1.00	$ 395,577.90	−0.326	0.215	0.293	0.573	1.016
SPDR S&P 500 ETF Trust	1.00	$ 566,342.00	−0.725	0.131	0.262	0.211	1.068
SPDR Gold Shares	1.00	$ 69,692.60	−3.325	0.131	0.255	0.204	1.016
Technology Select Sector SPDR Fund	1.00	$ 69,366.00	−0.665	0.131	0.255	0.204	1.016
Financial Select Sector SPDR Fund	1.00	$ 45,922.80	−0.666	0.131	0.255	0.204	1.016
SPDR Portfolio S&P 500 ETF	1.00	$ 44,366.40	−0.167	0.130	0.267	0.213	1.157
iShares Core S&P 500 ETF	1.00	$ 521,628.90	−0.242	0.145	0.264	0.296	1.016
iShares Core MSCI EAFE ETF	1.00	$ 124,056.90	−0.580	0.145	0.272	0.308	1.083
iShares Core US Aggregate Bond ETF	1.00	$ 116,890.20	−0.249	0.145	0.264	0.296	1.016
iShares Russell 1000 Growth ETF	1.00	$ 96,427.60	−1.494	0.145	0.264	0.296	1.016
iShares Core S&P Mid-Cap ETF	1.00	$ 89,662.40	−0.415	0.145	0.264	0.296	1.016

Panel B: Leveraged Funds

Fund	Leverage	AUM (mil)	Elasticity	Bertrand	$\text{Bertrand}_{\text{PW}}$	Cournot	Monopoly
ProShares UltraPro QQQ	3.00	$ 24,666.60	−3.839	0.426	0.825	1.694	2.748
ProShares Ultra QQQ	2.00	$ 7,248.80	−5.077	0.435	0.833	1.694	2.733
ProShares Ultra S&P500	2.00	$ 5,275.90	−5.000	0.429	0.825	1.681	2.712
ProShares UltraPro S&P500	3.00	$ 4,186.40	−5.123	0.432	0.830	1.689	2.726
ProShares Ultra Semiconductors	2.00	$ 1,165.80	−5.412	0.435	0.833	1.694	2.733
Direxion Daily Semiconductor Bull 3X Shares	3.00	$ 11,818.10	−4.035	0.246	0.732	1.086	2.769
Direxion Daily 20+ Year Treasury Bull 3X Shares	3.00	$ 6,627.00	−4.926	0.246	0.734	1.072	2.749
Direxion Daily S&P 500 Bull 3X Shares	3.00	$ 5,019.00	−4.981	0.245	0.737	1.057	2.729
Direxion Daily Technology Bull 3X Shares	3.00	$ 3,361.20	−5.101	0.247	0.740	1.061	2.738
Direxion Daily Small Cap Bull 3X Shares	3.00	$ 2,550.00	−5.209	0.246	0.739	1.060	2.735

Note: The Table shows the elasticity and markups averaged over the entire sample period for the top 5 largest products of the Big 3 index fund providers (Panel A, BlackRock, State Street and Vanguard), and the Big 2 leveraged fund providers (Panel B, ProShares and Direxion). Leverage is the stated leverage that the fund tracks. AUM is assets under management as of 2024 Q3. Elasticity is the BLP-implied (See Column (4) from 2) elasticity. The remaining columns report on the lerner index implied by various models of conduct, where BertrandPW is a Bertrand model where the Big 3 or the Big 2 have a profit weight of 0.65 on each other's funds.

tend to have lower own-price elasticities and, therefore, higher markups. However, there are products with similar own-price elasticities and different markups. For example, ProShares Ultra S&P500 (-5.077) and Direxion Daily S&P500 Bull 3X Shares (-4.981) have very similar own-price elasticities, but the price-cost margin for ProShares Ultra S&P500 (0.435) is notably higher than Direxion Daily S&P500 Bull 3X Shares (0.245).

We then compute the implied price-cost margins for Bertrand competition when LETF sponsors partially internalize the effects of their actions on their rivals' profits. For example, ProShares and Direxion internalize each other profits with a weight of 65%. These partial internalization conduct models imply higher price-cost margins than Bertrand, but still below one.

Finally, we compute the implied price-cost margins under Cournot and monopoly. For leveraged funds, implied price-cost margins for the most popular products under Cournot are above 1.5 for ProShares and above 1 for Direxion. Under Cournot firms internalize a less aggressive competitive response from rivals and this mechanism is likely to be especially strong in the LETF market, where the combined market share of ProShares and Direxion is about 90%. In the case of monopoly the implied price-cost margins for the largest LETFs by both ProShares and Direxion are above 2.5, which makes monopoly conduct implausible.

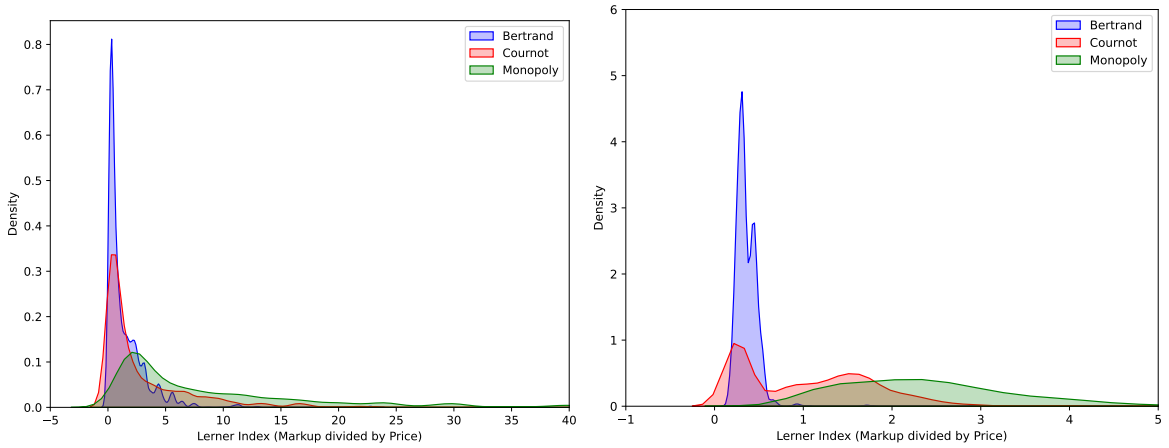
Estimation. We now turn to our approach for conduct testing. Figure 6 reports the price-cost margins for several conduct models for both index funds and leveraged funds (Figure A3 reports the implied marginal costs for the same conduct models). Panel (a) shows that with monopoly the implied price-cost margins are above one 97.2% of the time, since model-implied marginal costs are negative. This is true for the leveraged fund market in panel (b) as well (above one 96.8%), so we can rule out monopoly in both markets just by visual inspection.[20]

For Cournot competition, the implied price-cost margins are above one 52.1% and 50.5% of the time for the index and leveraged fund markets, respectrively, while under Bertrand competition, the figures are 41.% and 0.4%. Thus, we can rule out Cournot competition in the leveraged fund market under similar reasoning as that of monopoly. For the index fund market, despite generating similar ballpark proportions of negative marginal cost as Bertrand, we rule out Cournot based on its unrealistic implied-marginal cost distribution. At the 5th (10th) percentile, Cournot competition implies a marginal cost of -65 bps (-56 bps), which is four to five times higher than the -17 bps (-15 bps) cost implied by Bertrand competition. So, the Cournot negative costs are unrealistically large, whereas the Bertrand negative costs are within the realm of realistic security lending income.[21]

Other forms of conducts, such as perfect competition, Bertrand, and partial internalization imply price-cost margins and marginal cost distributions that are reasonable. Therefore to make progress in differentiating among them, we rely on formal conduct testing following the approach in the industrial organization literature (Backus et al., 2021; Duarte et al., 2024, 2025). To build the intuition for testing alternative conduct models, suppose we want to see if the behavior in the data is more in line with Bertrand relative to perfect competition. Given the estimated demand parameters (θ), we can compute the markup under Bertrand ($\Delta_{jt}^{Bertrand}(\theta)$) and perfect competition ($\Delta_{jt}^{PC}(\theta) = 0$). Combining the

[20] The formal test discussed below also rule out monopoly conduct.

[21] Brown et al. (2023) report a similar proportion of negative marginal costs in their demand estimation, and cite as an explanation that income generated from lending out their holdings earn a fee that is passed to investors. Security lending income for index mutual funds and ETFs can be as high as 30 bps per year, and averages 2 to 7 bps based on Morningstar analysis from 2007 to 2018. (See Exhibits 4 and 5 from https://www.morningstar.com/content/dam/marketing/shared/pdfs/Research/Securities_Lending-An_Examination_of_the_Risks_and_Rewards.pdf)



(a) Index Fund Market **(b)** Leveraged Fund Market

Figure 6: Distribution of price (expense ratio)-cost margins

Note: The figure plots the distribution of price (expense ratio)-cost margins for different conduct models: Differentiated Bertrand, Cournot, and Monopoly. Sub-figures (a) and (b) reports on the passive index and leveraged fund markets, respectively.

first order conditions for expense ratios (equation (8)) and the supply side equation for marginal cost (equation (9)) we can compute the structural supply side error term ω_{jt} under different conduct models:

$$\begin{aligned} p_{jt} - \Delta_{jt}^{PC}(\theta) - \gamma log(q_{it}) - \tau W_{jt} &= \omega_{jt}^{PC} \\ p_{jt} - \Delta_{jt}^{Bertrand}(\theta) - \gamma log(q_{it}) - \tau W_{jt} &= \omega_{jt}^{Bertrand} \end{aligned} \tag{12}$$

The goodness of fit measure is based on the exclusion restriction $E[\omega_{jt}^{model}|W_{jt}, Z_{jt}]$, where Z_{jt} are instruments that affect firms'markups but not marginal costs ("demand rotators"). Under the true model, this moment condition should hold; hence, the test will favor the model in which the empirical counterpart of this moment condition $E[\omega_{jt}^{model}|W_{jt}, Z_{jt}]$ is closer to zero. For each model, we then compute a measure of fit: $Q^{model} = E[Z_{jt}\omega_{jt}^{model}]'WE[Z_{jt}\omega_{jt}^{model}]$. Following Rivers and Vuong (2002) and Duarte et al. (2024) we adopt a non-nested model selection test. For example, going back to equation (12) we test the null hypothesis that the two competing models have the same fit:

$$H_0^{RV} : Q^{PC} = Q^{Bertrand}, \tag{13}$$

against the alterative hypotheses that perfect competition fits better than Bertrand (or viceversa):

$$H_1^{RV} : Q^{PC} < Q^{Bertrand} \quad and \quad H_2^{RV} : Q^{PC} > Q^{Bertrand}. \tag{14}$$

Given this measure the RV test statistics is then:

$$T^{RV} = \frac{\sqrt{n}(Q^{PC} - Q^{Bertrand})}{\sigma^{RV}}, \tag{15}$$

where T^{RV} has a standard normal distribution. This implies that we can reject the null hypothesis in favor of perfect competition if $T^{RV} < -1.96$ and we can reject the null hypothesis in favor of Bertrand if $T^{RV} > 1.96$.

We construct a demand rotator Z_{jt} as the interaction of the residualized consumer sentiment with the number of rival funds. The former is a measure of consumer sentiment residualized after controlling for index returns and changes in the VIX, the latter is the number of funds tracking an index with a greater than 0.99 correlation with the index tracked by fund j. The intuition is that consumer optimism about personal finances differentially shifts demand for a 2X S&P 500 funds (which has many close substitutes) compared with the 1.5X AAPL fund (which does not). This instrument is relevant if it affects the pricing power (and markups Δ_{jt}) by rotating the sentiment-driven demand when close substitute funds are high or low. The instrument satisfies the exclusion restriction if the residualized consumer sentiment index is uncorrelated with the cost shocks (ω_{jt}).

Results. Table 6 shows the result. Our alternative models of conduct are perfect competition, Bertrand, and three versions of Bertrand competition with partial internalization of profits for the largest fund issuers in the market. A negative RV test statistic suggests a better fit of the row model.

Panel A reports the results for index funds. The test results favor the model in which all issuers behave as if they are in perfect competition. This model is included in the model confidence set with a p-value of 1.00. The instrument is very powerful across all model tests, as shown by the F-statistics always above 80.

Panel B of Table 6 shows the results for leveraged funds. The test results favor the model in which Proshares and Direxion internalize their profits with a profit weight of 65%. This model is included in the model confidence set with a p-value of 1.00 and all other conduct models are rejected.

In Table A20 we report the results under alternative instruments: (i) Baker-Wurgler sentiment interacted with the number of rival funds; (ii) residualized Baker-Wurgler sentiment interacted with the number of rival funds; (iii) consumer sentiment index interacted with the number of rival funds; (iv) residualized index return interacted with the number of rival funds; (v) the number of rival funds; and (vi) residualized consumer sentiment index. The results are robust.

Table 6: CONDUCT TEST RESULTS

Panel A: Index Fund Market Conduct

Models	1	2	3	4	5	MCS $p-$values
Baseline Test Results (T^{RV})						
1. Perfect Competition		-4.936	-4.033	-2.361	-1.928	1.000
2. Baseline Bertrand			0.687	0.006	-0.444	0.000
3. B: Big 3 Asset Managers (Profit Weight: 0.25)				-0.416	-0.785	0.000
4. B: Big 3 Asset Managers (Profit Weight: 0.50)					-1.137	0.026
5. B: Big 3 Asset Managers (Profit Weight: 0.65)						0.054
$F-$**Statistics**						
1. Perfect Competition		$128.7^{***,\dagger}$	$116.9^{***,\dagger}$	$109.2^{***,\dagger}$	$99.0^{***,\dagger}$	
2. Baseline Bertrand			$145.7^{***,\dagger}$	$129.7^{***,\dagger}$	$115.0^{***,\dagger}$	
3. B: Big 3 Asset Managers (Profit Weight: 0.25)				$117.7^{***,\dagger}$	$103.5^{***,\dagger}$	
4. B: Big 3 Asset Managers (Profit Weight: 0.50)					$88.6^{***,\dagger}$	
5. B: Big 3 Asset Managers (Profit Weight: 0.65)						

Panel B: Leveraged Fund Market Conduct

Models	1	2	3	4	5	MCS $p-$values
Baseline Test Results (T^{RV})						
1. Perfect Competition		0.400	1.237	1.925	2.260	0.024
2. Baseline Bertrand			2.475	2.622	2.716	0.018
3. B: ProShares + Direxion (Profit Weight: 0.25)				2.751	2.826	0.014
4. B: ProShares + Direxion (Profit Weight: 0.50)					2.907	0.012
5. B: ProShares + Direxion (Profit Weight: 0.65)						1.000
$F-$**Statistics**						
1. Perfect Competition		$15.8^{***,\dagger}$	$16.6^{***,\dagger}$	$17.1^{***,\dagger}$	$17.4^{***,\dagger}$	
2. Baseline Bertrand			$8.2^{***,\dagger}$	$8.1^{***,\dagger}$	$7.9^{***,\dagger}$	
3. B: ProShares + Direxion (Profit Weight: 0.25)				$8.1^{***,\dagger}$	$8.0^{***,\dagger}$	
4. B: ProShares + Direxion (Profit Weight: 0.50)					$8.0^{***,\dagger}$	
5. B: ProShares + Direxion (Profit Weight: 0.65)						

Note: The Table shows the conduct test results. Panels A and B focus on the passive index and leveraged fund markets. We compare conduct based on perfect competition vs. bertrand competition where models 3–5 assume the Big 3 asset managers or ProShares + Direxion have profit weights of 0.25, 0.50, and 0.65 with each other. We report the RV test statistic (T^{RV}) and the $F-$Statistic for all pairs of conduct models, respectively, as well as the model confidence set (MCS) $p-$values. A negative T^{RV} indicates the test favors the row model. For the $F-$Statistics, a *** label shows that it is above the appropriate critical value for a worst-case size of 0.075, while a † label shows that it is above the appropriate critical value for a best-case power of 0.95. MCS $p-$values below 0.05 indicate the row model is rejected from the model confidence set at 5% nominal level. The T^{RV} and $F-$Statistics are computed based on clustering at the market level.

6 Counterfactuals

6.1 Quantifying Scale and Conduct

We perform two counterfactuals analyses to quantify the relative role of scale and conduct. First, we focus on the index fund market and study the role of economies of scale for equilibrium fees and welfare. We start from the baseline equilibrium and remove economies of scale, by setting the struc-

Table 7: COUNTERFACTUALS: SCALE AND CONDUCT

	c_{jt}	p	$1 - \sum s_{jt}$	π_{jt}	CS_{it}
Counterfactual I: Economies of Scale in the Index Fund Market					
Baseline ($\gamma = -0.024$, perfect competition)	0.157	0.157	0.121	0.000	0.254
Set $\gamma = 0$	0.642	0.642	0.865	0.000	0.084
Δ	0.485	0.485	0.744	0.000	−0.170
Δ (%)	308.9	308.9	614.9	0.0	−66.9
Counterfactual II: Economies of Scale and Conduct in the Leveraged Fund Market					
Baseline ($\gamma = -0.040$, profit internalization $= 0.65$)	0.173	0.864	0.028	0.773	0.940
Set $\gamma = 0$	0.446	1.137	0.132	0.694	0.697
Δ	0.273	0.273	0.104	−0.079	−0.243
Δ (%)	157.8	31.6	371.4	−10.2	−25.9
Set conduct to Bertrand	0.173	0.532	0.002	0.404	1.269
Δ	0.000	−0.332	−0.026	−0.369	0.329
Δ (%)	0.0	−38.4	−92.9	−47.7	35.0
Set conduct to perfect competition	0.173	0.173	0.0002	0.000	1.635
Δ	0.000	−0.691	−0.0278	−0.773	0.695
Δ (%)	0.0	−80.0	−99.3	−100.0	73.9
Set conduct to perfect competition and $\gamma = 0$	0.446	0.446	0.001	0.000	1.376
Δ	0.273	−0.418	−0.027	−0.773	0.436
Δ (%)	157.8	−48.4	−96.4	−100.0	46.4

Note: The table reports on counterfactual analysis. We report two sets of counterfactuals holding fixing the demand primitives and marginal costs with the estimated economies of scale under the selected market conduct. In counterfactual I, we report the baseline selected model in the index fund market and set the index fund economies of scale to 0. In counterfactual II, we we report the baseline selected model in the leveraged fund market, and set economies of scale to zero and/or the conduct to either bertrand or perfect competition. We report in the columns the AUM-weighted marginal cost (c_{jt}), AUM-weighted expense ratios (p_{jt}), the total outside option share ($1 - \sum s_{jt}$), the total firm profits (π_{jt}), and the total consumer surplus (CS_{jt}). We compute the AUM-weighting or cross-sectional total each month and then take the time-series average. Δ and Δ (%) report the level and percentage change, respectively, from the baseline to the counterfactual.

tural parameter γ in the marginal cost equation (9) equal to zero. We then let asset managers optimize fees given the new marginal costs until we find the new equilibrium. Removing scale economies increases marginal cost by 48 bps, from 16 bps to 64 bps. We keep the competitive conduct model in line with our results in Panel (a) of Table 6. As a result, the higher marginal costs are passed through one-for-one to higher fees. Economies of scale are worth $38 billion per year on $8 trillion of assets: the amount investors gained because scale economies exist *and* conduct has forced them through.

Second, we repeat the same exercise for the leveraged index fund market. Removing scale economies increases marginal cost by 27 bps, from 17 bps to 44 bps. The higher marginal costs are passed through one-for-one to higher fees, which increase from 86 bps to 113 bps. Both asset managers and investors lose in equilibrium, but the loss is larger for investors (-26%) than for asset managers (-10%).

Most notably, we study the role of conduct in the leveraged index fund market. Holding costs fixed, moving the leveraged market from partial internalization (the preferred conduct model from our test in Panel (b) of Table 6, to Bertrand lowers equilibrium expense ratios by 33 basis points, and moving it to the index market's conduct by 69 basis points, which corresponds to about $690 million per year on $100 billion of assets. We also explore the equilibrium impact of jointly removing scale economies and changing conduct to perfect competition. In this scenario, marginal costs increase by 27 bps, but despite this increase, equilibrium fees decrease by 41 basis points, benefiting investors. Hence, the positive effect of more competitive conduct dominates the negative effect of lost economies of scale.

6.2 Policy Restricting Entry: Unpacking the SEC rule 18f-4

We now exploit our estimated model to study the impact of scale and conduct on the equilibrium in the leveraged fund market after the implementation of SEC rule 18f-4. Our Fact 3 in Section 2 shows that the 3x leveraged fund market experienced a decline in both product entry (due to the leverage cap) and exit (due to the grandfathered status on incumbent products), as well as a 10 bps decline in the expense ratio. As we discussed, this equilibrium change in fees is potentially puzzling given that 3x products now face less competition. However, the 3x funds experienced large inflows, which could have lowered marginal costs via economies of scale.

In Table 8 we report several variables of interest before and after the adoption of SEC Rule 18f-4 (October 2020), under the baseline estimated model (Bertrand with 0.65 profit internalization, scale parameter $\gamma = -0.40$). The top panel shows that marginal costs for grandfathered 3x leveraged funds decrease by about 5.5 bps, or almost 50% relative to the pre-policy marginal costs. Our model is able to capture the decline in expense ratio for high leveraged funds after the policy, which decreases by about 8.8 bps, or 10% relative to before the policy. Overall, markup declines by about 3.2 bps, and the lerner index raises by almost 6 percentage points from 86% to 92%. The bottom panel of Table 8 shows that marginal costs for 2x leveraged funds did not experience a similar decline in marginal costs, and an overall smaller decrease in fees driven by lower markups, which left the lerner index

Table 8: COUNTERFACTUALS: SEC RULE 18F-4.

	MC (bps)	Fees (bps)	Markup (bps)	Lerner (%)
Treated: leverage 2.5-3x				
Pre	11.5	83.2	71.7	86.2
Post	5.9	74.4	68.5	92.1
Δ	-5.6	-8.8	-3.2	$+5.9$
Δ (%)	-48.7	-10.6	-4.5	$+6.8$
Control: leverage 1.2-2x				
Pre	13.1	84.9	71.8	84.6
Post	13.0	81.3	68.3	84.0
Δ	-0.1	-3.6	-3.5	-0.6
Δ (%)	-0.8	-4.2	-4.9	-0.7

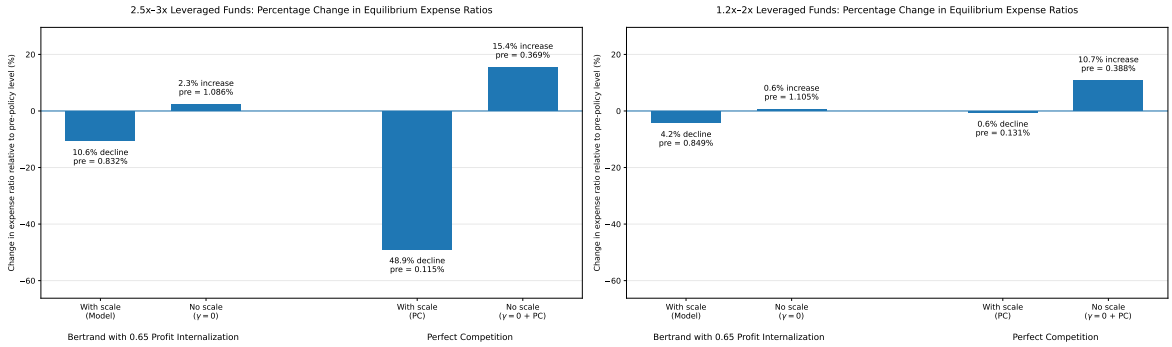
Note: The table reports AUM-weighted marginal costs, expense ratios, and markups for leveraged index funds before and after the adoption of SEC Rule 18f-4 (October 2020), under the baseline estimated model (Bertrand with 0.65 profit internalization, scale parameter $\gamma = -0.40$). Markup = Fees $-$ MC; Lerner = Markup/Fees; the Change row for Lerner is in percentage points. The fee change decomposes exactly into the MC and markup changes.

almost unaffacted.

In Figure 7a we report the change in fees (in %) for funds with leverage above 2.5x under different counterfactual scenarios to unpack how scale and conduct contributed to the observed dynamics.[22] The first bar reports the percentage change in fees in the baseline, like the one in second column of the top panel of Table 8. We then remove economies of scale by setting the structural parameter γ in the marginal cost equation (9) equal to zero. In the new equilibrium, asset managers increase their fees relative to before the policy by about 2.3%. The comparison of this counterfactual with the baseline shows that the decline in fees, in an environment where asset managers internalize each other's profits, can be explained by economies of scale.

We then compute the equilibrium, keeping the same economies of scale but assuming asset managers behave competitively. In this case, after the policy change, the expense ratio declines by almost 50%, one-for-one with the marginal cost decline. Putting everything together, the grandfathered status allows incumbent 3x products to benefit from scale-driven cost reductions, which are passed through to expense ratios slightly more than one-for-one in levels. But because conduct preserves fees at several times marginal cost, fees fall by only 11% while costs fall by almost 50%, and the Lerner index rises: under competitive conduct, the same scale gains would have cut fees by almost half. The policy

[22] Figure A5a reports for the same scenarios the change in fees in basis points.



(a) Treated Funds: 2.5x to 3x Leverage

(b) Control Funds: 1.5x to 2x Leverage

Figure 7: SEC Rule 18f4 Counterfactuals

Note: The figure plots counterfactuals to the adoption of Rule 18f4 in October 2020, that effectively limited leverage to a maximum of 2x. We report the average percentage change in AUM-weighted expense ratios pre- and post-policy under our baseline estimated model of conduct with scale parameter $\gamma = -0.40$, and three counterfactuals: i) no scale ($\gamma = 0$), ii) setting conduct to perfect competition, and iii) both no scale ($\gamma = 0$) and setting conduct to perfect competition.

allowed grandfathered 3x funds to exclusively benefits from scale gains and they reached investors via lower fees, but it simultaneously remove the entry threat that could have lowered equilibrium fees even further.

Finally, we remove economies of scale and impose competitive conduct jointly. In this scenario, fees increase after the policy: without scale economies, the post-policy inflows no longer lower unit costs, and competitive pricing passes the rising residual costs through one-for-one. Taken together, the four scenarios deliver the section's broader lesson: fee changes alone are uninformative about market power. Fees can fall in a market whose two firms internalize most of each other's profits, provided that demand growth meets scale economies; and fees can rise in a perfectly competitive market with increasing demand and no scale economies. Distinguishing these interpretations requires exactly the two primitives we estimate, technology and conduct.

7 Conclusions

Whether investors capture the gains from scale is the central welfare question raised by the rise of passive investing, and it cannot be answered from fee data alone. This paper answers it by jointly estimating the two primitives that fee dynamics confound – technology and conduct – in two adjacent passive markets. We find that in both plain and leveraged index funds, marginal costs decline with assets with an elasticity of about 0.1, making money management, on the cost side, an ordinary scale industry. Formal model-selection tests find that the concentrated index-fund market prices in a way indistinguishable from perfect competition, so scale economies reached investors in full, a

pass-through worth $38 billion per year; while the leveraged duopoly prices as if internalizing most of each other's profits, keeping fees several times marginal cost despite more elastic demand. The adoption of SEC Rule 18f-4 sharpens the mechanism: grandfathered high-leverage incumbents passed scale-driven cost declines through to fees slightly more than one-for-one, yet their Lerner index rose, because the rule froze the entry margin that could have competed away the markup level itself. Fees can thus fall in a market where firms internalize rivals' profits and rise in a competitive one; only the estimated primitives distinguish the two.

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Online Appendix

In this online appendix we report additional figures and tables about results on the facts and structural model.

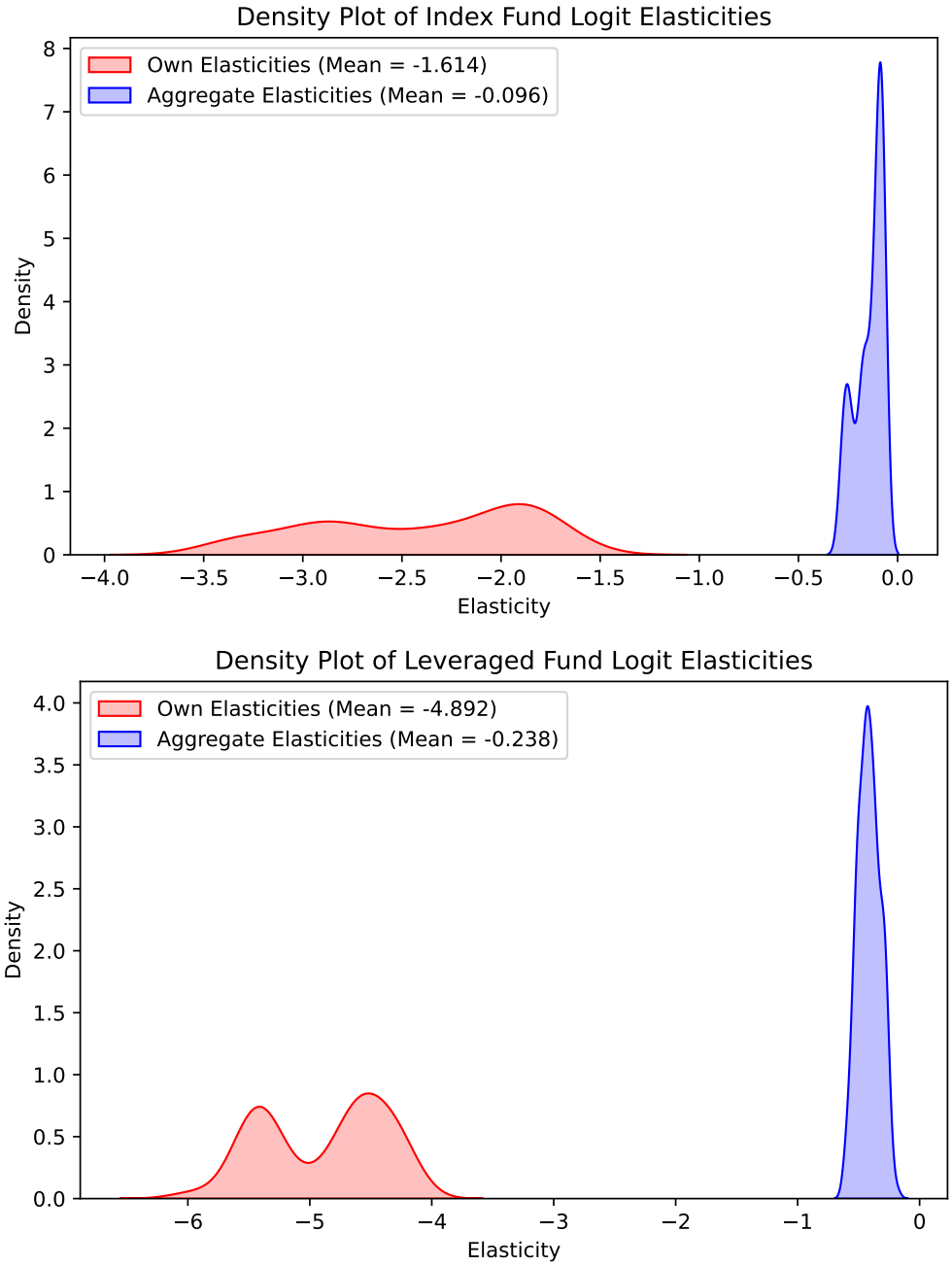
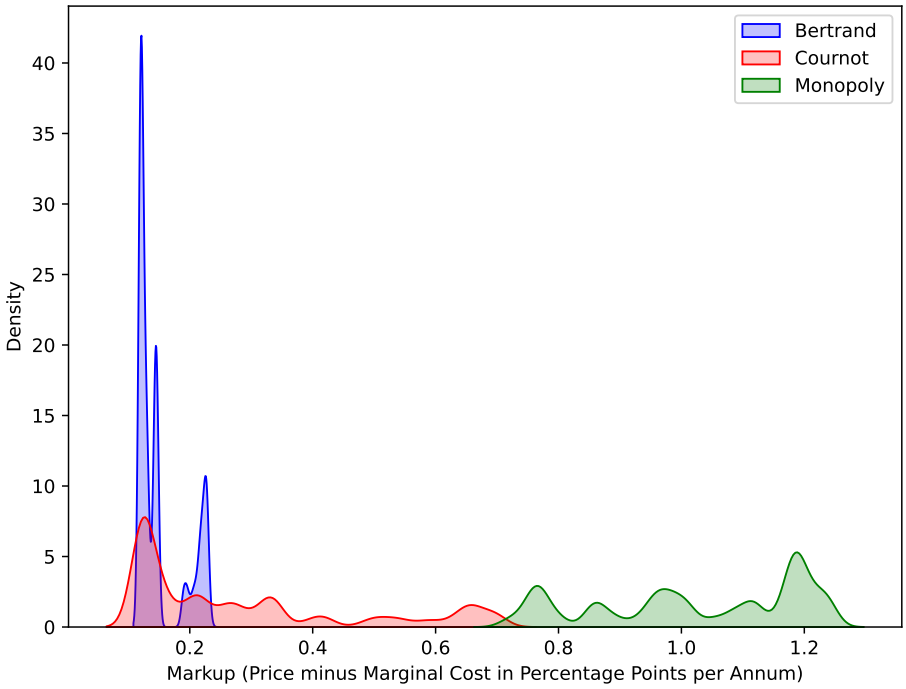
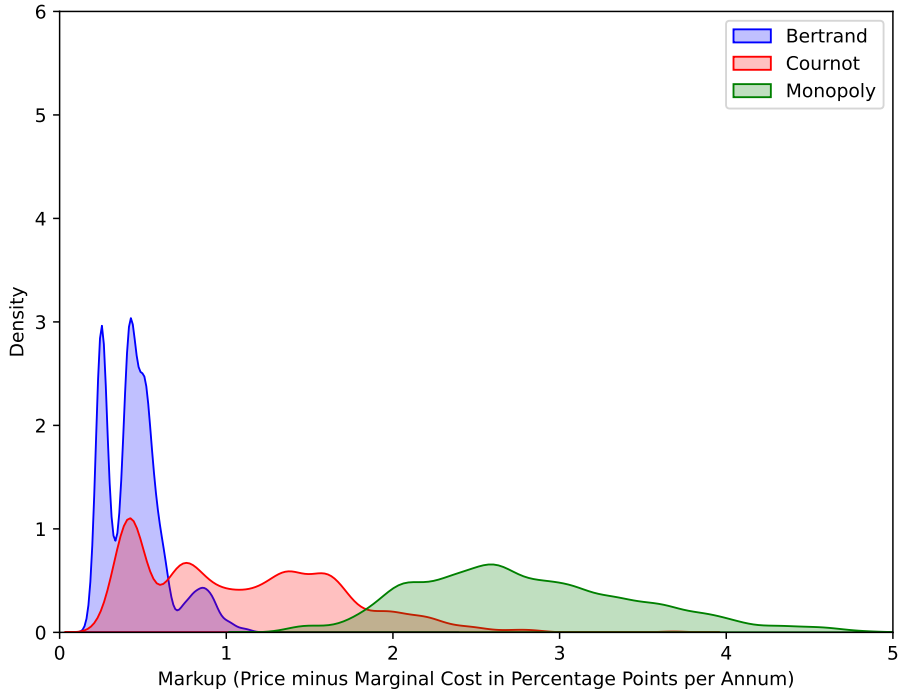


Figure A1: Elasticities

Note: The figure plots the elasticities implied by logit estimation for passive index (top) and leveraged funds (bottom), respectively. See Column (2) of Panel A and B from Table 2.



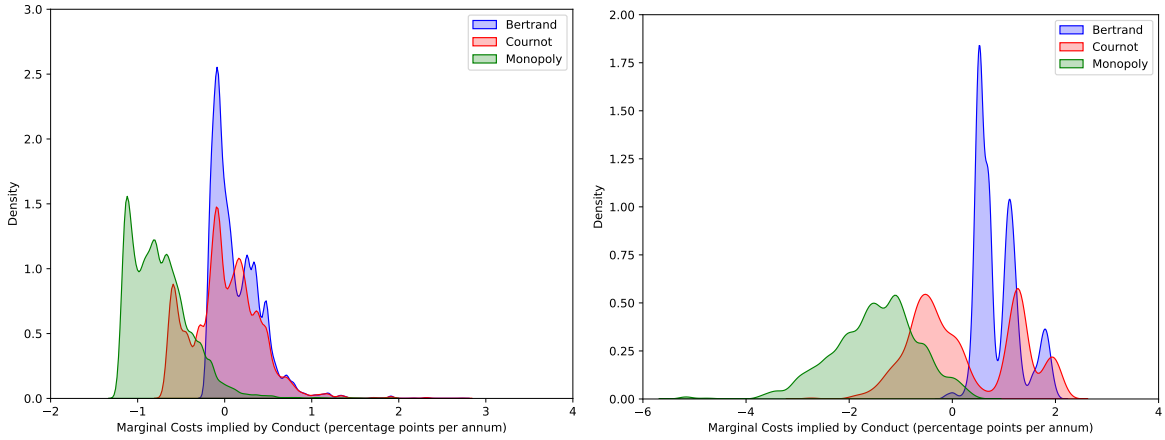
(a) Index Fund Market



(b) Leveraged Fund Market

Figure A2: Distribution of price (expense ratio)-cost margins in levels

Note: The figure plots the distribution of price (expense ratio)-cost margins in levels for different conduct models: Differentiated Bertrand, Cournot, and Monopoly. Sub-figures (a) and (b) reports on the passive index and leveraged fund markets, respectively.



(a) Index Fund Market **(b)** Leveraged Fund Market

Figure A3: Distribution of marginal costs

Note: The figure plots the distribution of marginal costs for different conduct models: Differentiated Bertrand, Cournot, and Monopoly. Sub-figures (a) and (b) reports on the passive index and leveraged fund markets, respectively.

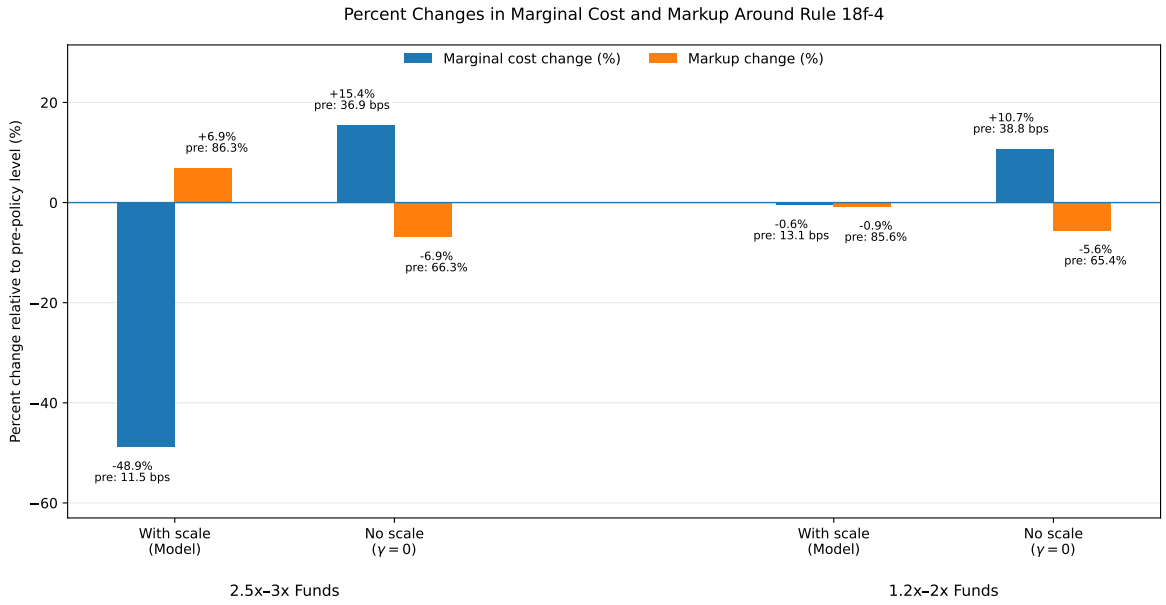
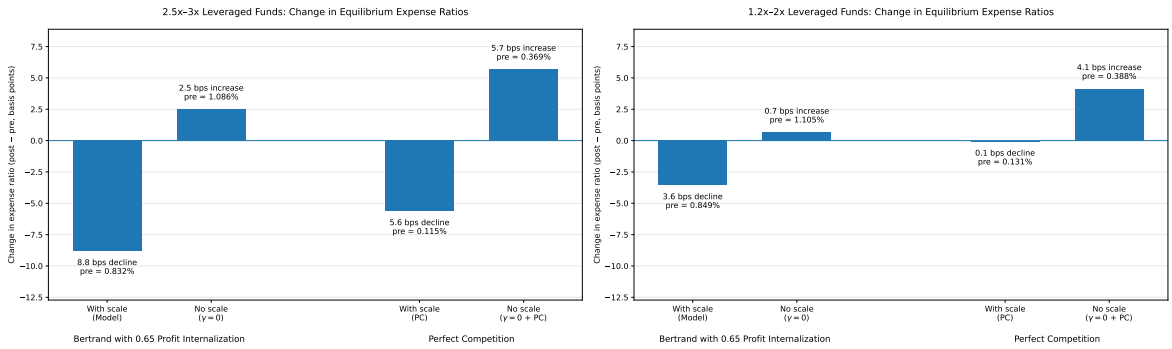


Figure A4: SEC Rule 18f4: Marginal Cost and Markups

Note: The figure plots counterfactuals to the adoption of Rule 18f4 in October 2020, that effectively limited leverage to a maximum of 2x. We report the average percentage change in AUM-weighted marginal cost and markup (price-cost divided by price) pre- and post-policy under our baseline estimated model of conduct with scale parameter $\gamma = -0.40$, and a counterfactual where we revove the economies of scale ($\gamma = 0$).



(a) Treated Funds: 2.5x to 3x Leverage

(b) Control Funds: 1.5x to 2x Leverage

Figure A5: Rule 18f4 Counterfactuals

Note: The figure plots counterfactuals to the adoption of Rule 18f4 in October 2020, that effectively limited leverage to a maximum of 2x. We report the average basis point change in AUM-weighted expense ratios pre- and post-policy under our baseline estimated model of conduct with scale parameter $\gamma = -0.40$, and three counterfactuals: i) no scale ($\gamma = 0$), ii) setting conduct to perfect competition, and iii) both no scale ($\gamma = 0$) and setting conduct to perfect competition.

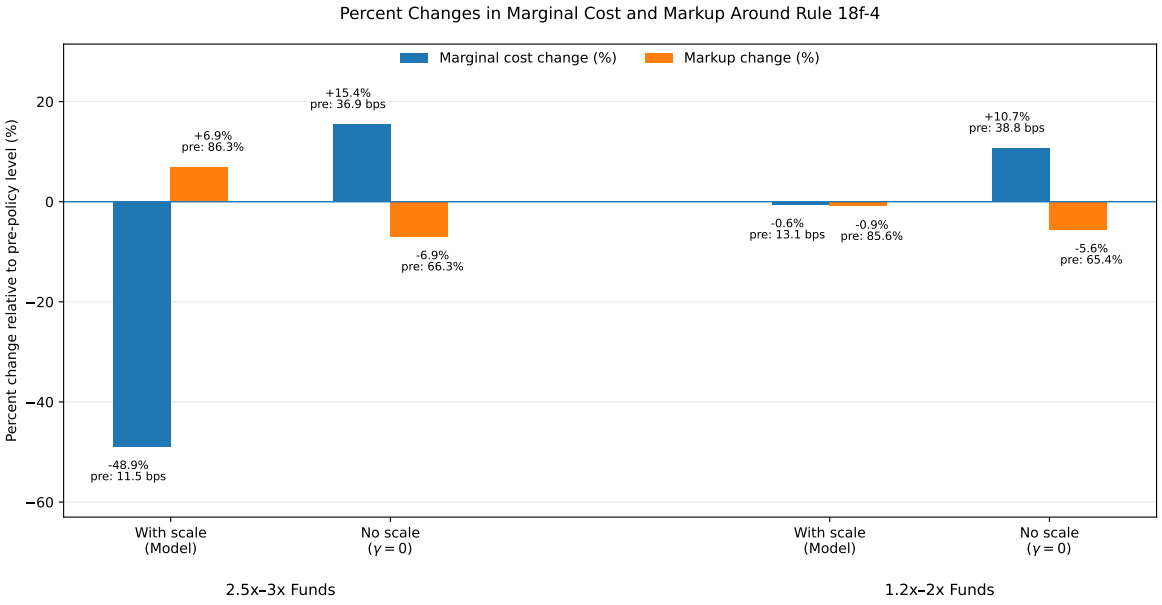


Figure A6: SEC Rule 18f4: Marginal Cost and Markups

Note: The figure plots counterfactuals to the adoption of Rule 18f4 in October 2020, that effectively limited leverage to a maximum of 2x. We report the average percentage level change in AUM-weighted marginal cost and markup (price-cost divided by price) pre- and post-policy under our baseline estimated model of conduct with scale parameter $\gamma = -0.40$*, and a counterfactual where we revove the economies of scale (*$\gamma = 0$*).*

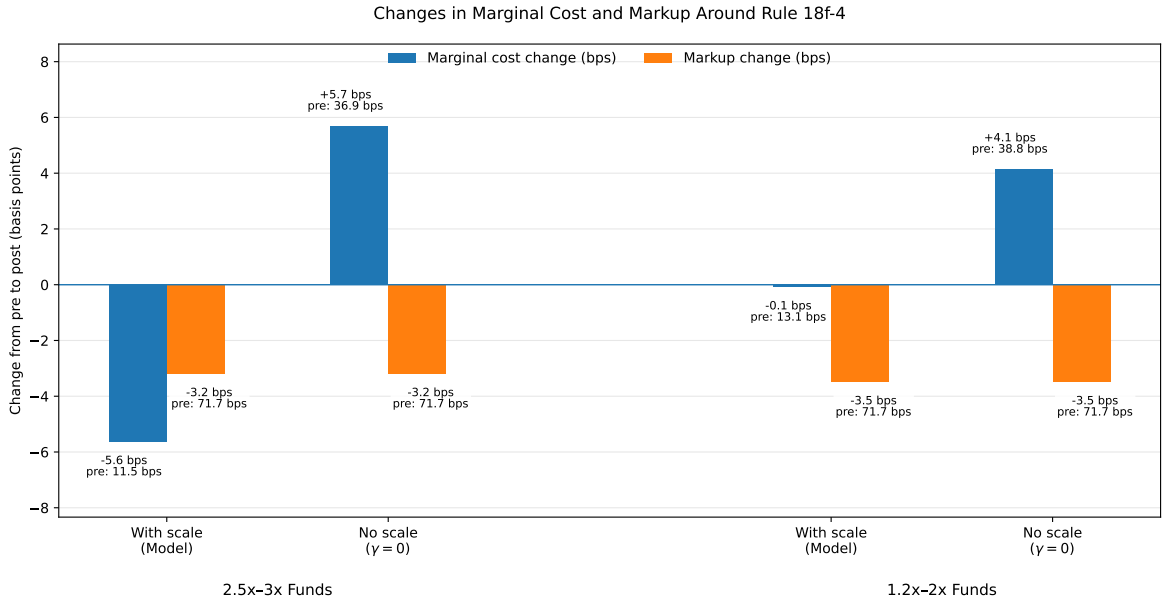


Figure A7: SEC Rule 18f4: Marginal Cost and Markup Decomposition

Note: The figure plots counterfactuals to the adoption of Rule 18f4 in October 2020, that effectively limited leverage to a maximum of 2x. We report the decomposition of the price change into AUM-weighted marginal cost and markup (price-cost divided by price) pre- and post-policy under our baseline estimated model of conduct with scale parameter $\gamma = -0.40$*, and a counterfactual where we revove the economies of scale (*$\gamma = 0$*).*

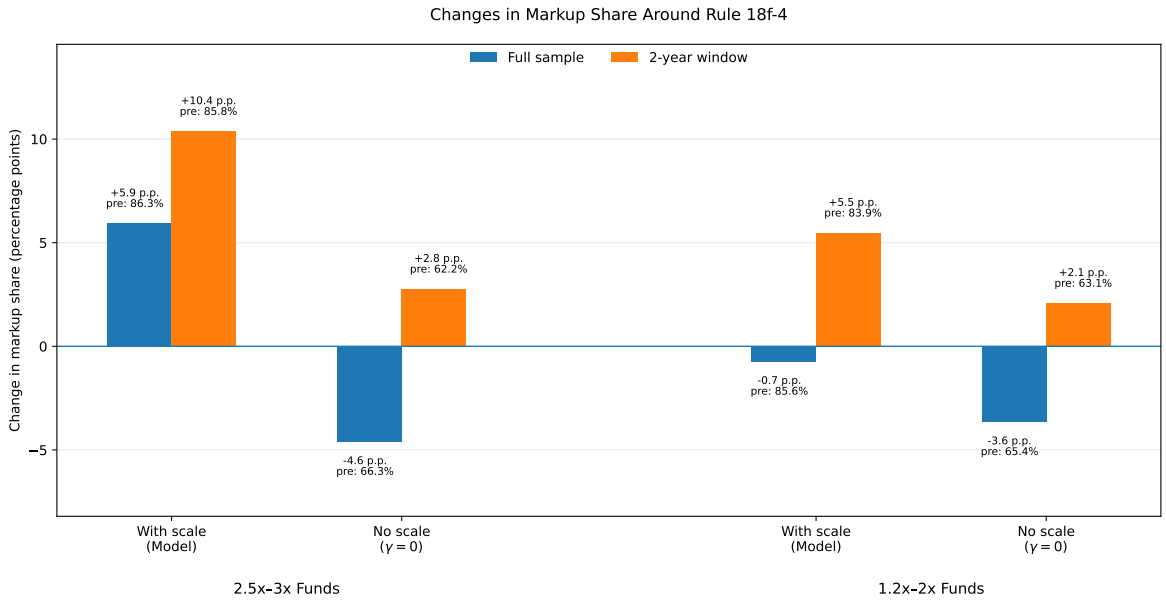


Figure A8: SEC Rule 18f4: Changes in Markup-Shares

Note: The figure plots changes in the markup-share around the adoption of Rule 18f4 in October 2020, that effectively limited leverage to a maximum of 2x. We compute the AUM-weighted markup (price-cost divided by price) pre- and post-policy under our baseline estimated model of conduct with scale parameter $\gamma = -0.40$, and a counterfactual where we revove the economies of scale ($\gamma = 0$).

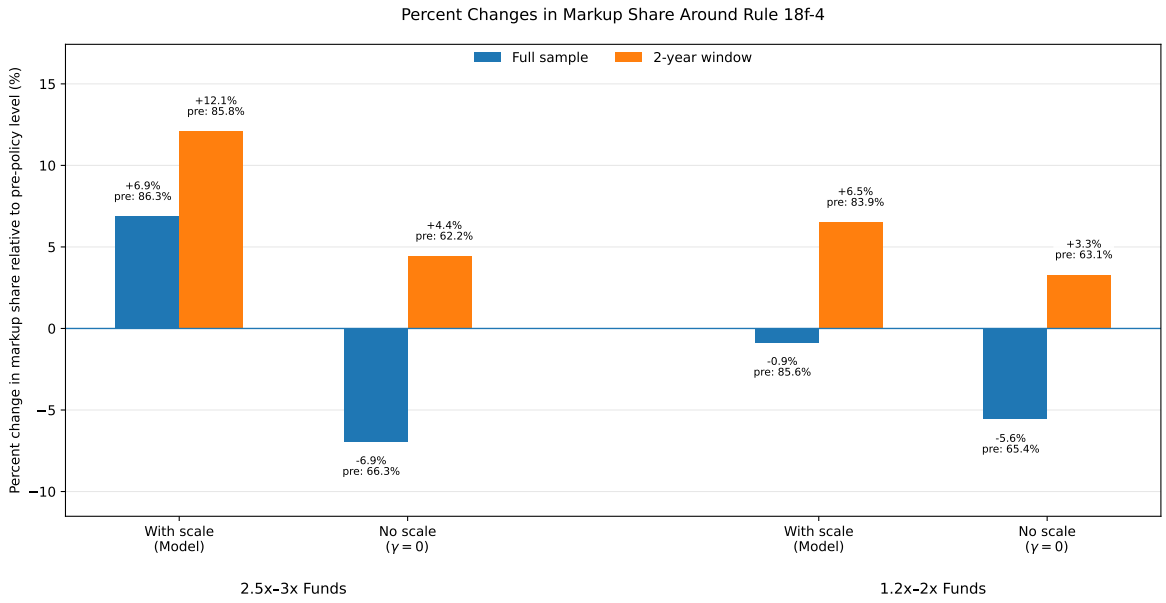


Figure A9: SEC Rule 18f4: % Changes in Markup-Shares

Note: The figure plots % changes in the markup-share around the adoption of Rule 18f4 in October 2020, that effectively limited leverage to a maximum of 2x. We compute the AUM-weighted markup (price-cost divided by price) pre- and post-policy under our baseline estimated model of conduct with scale parameter $\gamma = -0.40$, and a counterfactual where we revove the economies of scale ($\gamma = 0$).

Table A1: FIRST STAGE FOR INDEX FUND DEMAND PARAMETER ESTIMATION

Dependent Variable:	Prices		
	(1)	(2)	(3)
Instrument: Hausman-style expense ratio	0.030^{***}	0.027^{***}	0.024^{***}
	(0.005)	(0.005)	(0.005)
Instrument: Number of rival new products		0.0003^{***}	0.0003^{***}
		(0.00006)	(0.00006)
Instrument: Log of rival fund age			-0.034^{***}
			(0.007)
Instrument: Log of rival fund tracking error			0.062^{***}
			(0.011)
Tracking error	-0.048^{***}	-0.048^{***}	-0.043^{***}
	(0.006)	(0.006)	(0.005)
Age (log)	0.005^{***}	0.004^{***}	0.004^{***}
	(0.001)	(0.001)	(0.001)
Past 1-year return	0.0002	0.000	0.0003
	(0.001)	(0.001)	(0.001)
Fund FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Observations	108,300	108,300	108,300
R^2	0.966	0.966	0.966
Within R^2	0.004	0.007	0.008
IV $F-$Statistic	33.0^{***}	42.2^{***}	30.9^{***}

Note: The Table shows the first stage regression of expense ratios (prices) on a set of demand instruments and controls that we use to estimate demand parameters for the passive index fund market. We report the Kleibergen and Paap (2006) F-statistic to test for weak instrument strength.

Table A2: FIRST STAGE FOR LEVERAGED FUND DEMAND PARAMETER ESTIMATION

Dependent Variable:	Prices		
	(1)	(2)	(3)
Instrument: Hausman-style expense ratio	0.461^{***}	0.365^{***}	0.358^{***}
	(0.018)	(0.026)	(0.021)
Instrument: Number of rival bull funds		0.005^{***}	0.009^{***}
		(0.0005)	(0.0006)
Instrument: Number of rival bear funds			-0.005^{***}
			(0.0004)
Instrument: Number of rival new funds			-0.002^{***}
			(0.0004)
Tracking error	-0.130^{***}	-0.139^{***}	-0.139^{***}
	(0.045)	(0.042)	(0.040)
Age (log)	0.009^{***}	0.025^{***}	0.044^{***}
	(0.003)	(0.004)	(0.004)
Past 1-year return	-0.003^{***}	-0.004^{***}	-0.006^{***}
	(0.001)	(0.001)	(0.001)
Fund FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
Observations	15,401	15,401	15,401
R^2	0.982	0.982	0.983
Within R^2	0.087	0.126	0.151
IV $F-$Statistic	648.4^{***}	389.5^{***}	228.7^{***}

Note: The Table shows the first stage regression of expense ratios (prices) on a set of demand instruments and controls that we use to estimate demand parameters for the passive leveraged fund market. We report the Kleibergen and Paap (2006) F-statistic to test for weak instrument strength.

Table A3: LOGIT VS. BLP CROSS-ELASTICITIES IN THE LEVERAGED FUND MARKET

Issuer k	Issuer j	Logit ϵ_{jk} ($\times 100$)	BLP ϵ_{jk} ($\times 100$)
Tracking similar index			
ProShares	ProShares	13.14	21.94
ProShares	ProFunds	10.22	8.87
ProShares	Direxion	14.98	22.20
Direxion	Direxion	4.51	6.62
Direxion	ProFunds	4.38	5.11
Direxion	ProShares	4.34	6.91
ProFunds	ProFunds	1.43	3.07
ProFunds	ProShares	1.41	1.60
ProFunds	Direxion	1.99	3.11
Tracking different index			
ProShares	ProShares	6.19	10.31
ProShares	ProFunds	6.13	5.54
ProShares	Direxion	6.25	9.92
Direxion	Direxion	4.45	6.99
Direxion	ProFunds	4.73	4.70
Direxion	ProShares	4.67	7.60
ProFunds	ProFunds	1.05	2.42
ProFunds	ProShares	1.04	1.14
ProFunds	Direxion	1.03	1.29

Note: The Table reports the average cross-elasticities ($\epsilon_{jk} = \frac{x_k}{s_j}\frac{\partial s_j}{\partial x_k}$ for fund $k \neq j$) implied by the logit and BLP models in the leveraged fund market. We focus on the BLP specification that has random coefficients on price, fund age, and past 1-year return. The top panel reports on when fund k and j track similar indices, which have > 0.99 correlation with each other. The bottom panel reports on all other k and j pairs that track different indices.

Table A4: VARIANCE DECOMPOSITION OF THE FUND FE

Panel A: Passive Index Funds							
R^2	0.175	0.273	0.594				
Firm FE	Yes	No	No				
Index FE	No	Yes	No				
Firm $\times$ Index FE	No	No	Yes				
Panel B: Leveraged Funds							
R^2	0.019	0.683	0.149	0.074	0.728	0.851	0.829
Firm FE	Yes	No	No	No	No	No	No
Index FE	No	Yes	No	No	No	No	No
Leverage FE	No	No	Yes	No	No	No	No
Firm $\times$ Leverage FE	No	No	No	Yes	No	No	No
Index $\times$ Leverage FE	No	No	No	No	Yes	No	No
Firm $\times$ Index FE	No	No	No	No	No	Yes	No
Firm $\times$ Index $\times$ Leverage FE	No	No	No	No	No	No	Yes

Note: The Table reports on a variance decomposition of the fund fixed effect under the OLS logit demand estimation model. We compute the adjusted R-squared under combinations of the firm fixed effect, a similar (¿0.99 correlation) fixed effect, and the index fixed effect.

Table A5: DEMAND PARAMETERS: ELASTICITIES AND SEMI-ELASTICITIES

Panel A: Passive Index Funds				
Model:	Units	IV Logit	IV BLP-1RC	IV BLP-3RC
Expense ratio	elasticity	-1.614	-1.950	-2.404
	per 1 bps per year	$[-0.143]$	$[-0.172]$	$[-0.212]$
Past 1-year return	elasticity	0.042	0.042	0.040
	per 1 p.p. yearly return	$[0.078]$	$[0.078]$	$[0.074]$
Age (log)	elasticity	1.247	1.263	1.294
	per 1 year age	$[0.196]$	$[0.198]$	$[0.203]$
Tracking error	elasticity	-0.015	-0.017	-0.019
	per 1 p.p. tracking coef.	$[-0.244]$	$[-0.277]$	$[-0.309]$
Fund FE		Yes	Yes	Yes
Time FE		Yes	Yes	Yes
Observations		108,300	108,300	108,300
Panel B: Leveraged Funds				
Model:	Units	IV Logit	IV BLP-1RC	IV BLP-3RC
Expense ratio	elasticity	-4.892	-5.911	-5.953
	per 1 bps per year	$[-0.045]$	$[-0.054]$	$[-0.054]$
Past 1-year return	elasticity	0.057	0.059	0.056
	per 1 p.p. yearly return	$[-0.0002]$	$[-0.0002]$	$[-0.0002]$
Age (log)	elasticity	1.494	1.643	1.660
	per 1 year age	$[0.275]$	$[0.301]$	$[0.305]$
Tracking error	elasticity	-0.023	-0.025	-0.027
	per 1 p.p. tracking coef.	$[-0.358]$	$[-0.389]$	$[-0.420]$
Fund FE		Yes	Yes	Yes
Time FE		Yes	Yes	Yes
Observations		15,401	15,401	15,401

Note: The table reports the average own-variable elasticity (top of each row) and semi-elasticity (bottom of each row in brackets) for the various demand estimation models in Table 2. The variables include: expense ratio which is the portion of total investment that investors pay for operating expenses; past 1-year return which is the 1-year return ending in month $t-1$; age which is the number of months since fund inception; and tracking error which is the absolute value of the difference between stated leverage and OLS-estimated leverage in the 1-year ending in month $t-1$. IV Logit is the IV estimation of the logit specification. IV BLP-1RC is the IV estimation of a BLP specification that includes a random coefficient on expense ratio, while IV BLP-3RC additionally includes random coefficients (RC) on past 1-year return and age. Semi-elasticities are per units of 1 bps per annum expense ratio, 1 percentage point past 1 -year return, 1 year older, and 0.01 units of tracking error in its tracking coefficient.

Table A6: DEMAND PARAMETERS: FIRM × INDEX FIXED EFFECTS

Panel A: Passive Index Funds

Model:	Logit		BLP	
	OLS	IV	IV	IV
Expense ratio	-1.623^{***}	-0.892^{***}	-2.570^{***}	-1.641
	(0.075)	(0.182)	(0.848)	(1.129)
Past 1-year return	0.416^{***}	0.421^{***}	0.418^{***}	0.402^{***}
	(0.036)	(0.037)	(0.019)	(0.029)
Age (log)	0.459^{***}	0.442^{***}	0.458^{***}	0.452^{***}
	(0.006)	(0.007)	(0.011)	(0.053)
Tracking error	-0.492^{**}	-0.482^{***}	-0.514^{***}	-0.498^{***}
	(0.054)	(0.053)	(0.060)	(0.059)
Dispersion expense ratio (RC)			2.261^{***}	1.381
			(0.635)	(0.878)
Dispersion past 1-year return (RC)				0.021
				(1.164)
Dispersion age (RC)				0.004
				(0.158)
Firm × Index FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	108,300	108,300	108,300	108,300
Average own-price elasticity	-0.463	-0.257	-0.273	-0.275

Panel B: Leveraged Funds

Model:	Logit		BLP	
	OLS	IV	IV	IV
Expense ratio	-2.011^{***}	-4.226^{***}	-3.160^{***}	-2.525^{***}
	(0.020)	(0.335)	(0.0191)	(0.728)
Past 1-year return	0.310^{***}	0.304^{***}	0.281^{***}	$0.1.957^{***}$
	(0.038)	(0.044)	(0.032)	(0.735)
Age (log)	1.133^{***}	1.608^{***}	1.322^{***}	1.208^{***}
	(0.050)	(0.086)	(0.058)	(0.142)
Tracking error	-2.803^{**}	-2.182^{***}	-2.498^{***}	-4.369^{***}
	(0.304)	(0.378)	(0.299)	(0.789)
Dispersion expense ratio (RC)			-0.006^{***}	-0.050
			(0.0005)	(4.980)
Dispersion past 1-year return (RC)				2.984^{**}
				(1.376)
Dispersion age (RC)				0.0007
				(0.455)
Firm × Index FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	15,401	15,401	15,401	15,401
Average own-price elasticity	-2.666	-5.569	-4.164	-3.306

Note: The table reports the estimated demand parameters with alternative Firm × Index fixed effects instead of Firm fixed effects for passive index funds (Panel A) and leveraged funds (Panel B). Expense ratio is the portion of total investment that investors pay for operating expenses. Past 1-year return is the 1-year return ending in month $t-1$. Age is the number of months since fund inception. Tracking error is the absolute value of the difference between stated leverage and OLS-estimated leverage in the 1-year ending in month $t-1$. Columns (3) and (4) include additional random coefficients (RC) on prices and/or past 1-year return in the BLP specification. Robust standard errors are clustered at the market level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% nominal levels, respectively.

Table A7: DEMAND PARAMETERS: BROAD-BASED VS. SPECIALIZED FUNDS

Panel A: Passive Index Funds

Model:	Logit		BLP	
	OLS	IV	IV	IV
Expense ratio	-1.317^{***}	-7.503^{***}	-6.934^{***}	-5.343^{***}
	(0.079)	(0.177)	(1.295)	(1.582)
Expense ratio × Broad-based Fund	0.695^{***}	-5.278^{***}	-6.186^{***}	-6.080^{***}
	(0.066)	(0.372)	(0.607)	(0.525)
Past 1-year return	0.413^{***}	0.413^{***}	0.410^{***}	0.398^{***}
	(0.037)	(0.031)	(0.015)	(0.021)
Age (log)	0.552^{***}	0.558^{***}	0.516^{***}	0.551^{***}
	(0.012)	(0.011)	(0.016)	(0.103)
Tracking error	-0.247^{**}	-0.552^{***}	-0.520^{***}	-0.438^{***}
	(0.041)	(0.085)	(0.077)	(0.083)
Dispersion expense ratio (RC)			2.253^{***}	0.122
			(0.680)	(6.022)
Dispersion past 1-year return (RC)				0.001
				(0.518)
Dispersion age (RC)				0.003
				(0.188)
Fund FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	108,300	108,300	108,300	108,300
Average own-price elasticity	-0.285	-2.858	-2.346	-2.341

Panel B: Leveraged Funds

Model:	Logit		BLP	
	OLS	IV	IV	IV
Expense ratio	-2.019^{***}	-3.737^{***}	-6.780^{***}	-6.279^{***}
	(0.100)	(0.349)	(0.077)	(0.669)
Expense ratio × Broad-based Fund	-0.142	0.179	0.512	0.555
	(0.236)	(0.377)	(0.313)	(0.350)
Past 1-year return	0.259^{***}	0.254^{***}	0.262^{***}	0.254^{***}
	(0.037)	(0.036)	(0.029)	(0.039)
Age (log)	0.659^{***}	0.705^{***}	0.785^{***}	0.780^{***}
	(0.038)	(0.040)	(0.032)	(0.105)
Tracking error	-1.179^{**}	-1.383^{***}	-1.579^{***}	-1.681^{***}
	(0.224)	(0.252)	(0.240)	(0.255)
Dispersion expense ratio (RC)			2.247^{***}	1.836^{***}
			(0.130)	(0.320)
Dispersion past 1-year return (RC)				-0.059
				(0.964)
Dispersion age (RC)				-0.059
				(0.120)
Fund FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	15,401	15,401	15,401	15,401
Average own-price elasticity	-2.694	-4.904	-5.921	-6.024

Note: The table compares the estimated demand parameters for broad-based versus specialized passive index funds (Panel A) and leveraged funds (Panel B). Expense ratio is the portion of total investment that investors pay for operating expenses. Past 1-year return is the 1-year return ending in month $t-1$. Age is the number of months since fund inception. Tracking error is the absolute value of the difference between stated leverage and OLS-estimated leverage in the 1-year ending in month $t-1$. Columns (3) and (4) include additional random coefficients (RC) on prices and/or past 1-year return in the BLP specification. Robust standard errors are clustered at the market level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% nominal levels, respectively.

Table A8: DEMAND PARAMETERS: TRACKING DIFFERENCE AS A COST

Market:	Passive Index Funds				Leveraged Funds			
Model:	OLS	IV			OLS	IV		
Dependent Variables:	log(AUM)	Exp. Ratio	Track Dif.	log(AUM)	log(AUM)	Exp. Ratio	Track Dif.	log(AUM)
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Expense ratio	-0.938^{***}			-5.54	-2.02^{***}			-4.08^{***}
	(0.046)			(3.55)	(0.098)			(0.629)
Tracking difference	-0.0002			0.076	-0.0004			0.556
	(0.0002)			(0.191)	(0.004)			(0.668)
Instrument: Hausman-style expense ratio		0.030^{***}	-0.012			0.460^{***}	0.285	
		(0.005)	(1.24)			(0.018)	(0.280)	
Instrument: Hausman-style tracking difference		-0.0002^{**}	0.010			0.0006	0.010	
		(0.0001)	(0.015)			(0.0008)	(0.011)	
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other Ctrls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,401	15,401	15,401	15,401	108,300	108,300	108,300	108,300
IV $F-$Stat (Expense ratio)				18.1^{***}				325.9^{**}
IV $F-$Stat (Tracking difference)				0.24				0.97

Note: The table augments the baseline logit demand estimation with tracking difference as an additional (endogeneous) dimension of cost. Monthly tracking difference (in percent per annum) is defined as the fund-month median of the daily difference in realized fund returns and target fund returns based on the funds' underlying index. To reduce the effect of outliers, tracking difference is further winsorized across funds within-month at the 5% and 95% levels. Other controls (Ctrls) include past 1-year return, log fund age, tracking error. Robust standard errors are clustered at the market level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% nominal levels, respectively.

Table A9: DEMAND PARAMETERS: SWAP SPREAD AS A COST

Model:	OLS	IV		
Dependent Variables:	log(AUM)	Exp. Ratio	Track Dif.	log(AUM)
	(1)	(2)	(3)	(4)
Expense ratio	-4.93^{***}			20.1
	(0.533)			(18.8)
Swap spread	-0.012			-0.622^{*}
	(0.046)			(0.369)
Instrument: Hausman-style expense ratio		-0.089	1.80^{***}	
		(0.063)	(0.298)	
Instrument: Hausman-style swap spread		0.016^{**}	0.785^{***}	
		(0.007)	(0.039)	
Fund FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Other Ctrls	Yes	Yes	Yes	Yes
Observations	3,024	3,024	3,024	3,024
IV $F-$Stat (Expense ratio)				2.74^{*}
IV $F-$Stat (Tracking difference)				215.8^{***}

Note: The table augments the baseline logit demand estimation for leveraged funds with the swap spread as an additional (endogeneous) dimension of cost. Swap spreads are collected from NPORT filings for 2019 to 2024. Other controls (Ctrls) include past 1-year return, log fund age, tracking error. Robust standard errors are clustered at the market level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% nominal levels, respectively.

Table A10: FIRST STAGE FOR SUPPLY PARAMETER ESTIMATION

Panel A: Index Funds

Dependent Variable:	log(AUM)			
Sample:	All Funds	Small	2	Large
Instrument: Negative residualized index returns	-0.467^{***}	-0.291^{***}	-0.313^{***}	-0.368^{***}
	(0.053)	(0.025)	(0.034)	(0.059)
Tracking error	-0.201^{***}	-0.131^{***}	-0.006	-0.070
	(0.037)	(0.033)	(0.022)	(0.043)
Age (log)	0.540^{***}	0.103^{***}	0.202^{***}	0.391^{***}
	(0.013)	(0.008)	(0.011)	(0.012)
Fund FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	108,300	36,155	36,053	36,092
R^2	0.897	0.916	0.876	0.903
Within R^2	0.078	0.017	0.032	0.053
IV $F-$Statistics	76.1^{***}	133.5^{***}	87.1^{***}	38.8^{***}

Panel B: Leveraged Funds

Dependent Variable:	log(AUM)			
Sample:	All Funds	Small	2	Large
Instrument: Negative residualized index returns	-1.06^{***}	-1.06^{***}	-0.265^{***}	0.308^{**}
	(0.099)	(0.099)	(0.089)	(0.128)
Tracking error	-1.06^{***}	-0.934^{***}	-0.834^{***}	-1.52^{***}
	(0.232)	(0.304)	(0.293)	(0.284)
Age (log)	0.606^{***}	0.179^{***}	0.094^{**}	0.751^{***}
	(0.037)	(0.043)	(0.038)	(0.043)
Fund FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	15,401	5,197	5,072	5,132
R^2	0.875	0.699	0.719	0.807
Within R^2	0.063	0.034	0.005	0.063
IV $F-$Statistics	114.7^{***}	112.8^{***}	8.9^{***}	5.8^{**}

Note: The Table shows the first stage regression of log AUM (demand) on a set of instruments and controls that we use to estimate economies of scale parameters for passive index (Panel A) and leveraged (Panel B) funds. We report the Kleibergen and Paap (2006) F-statistic to test for weak instrument strength.

Table A11: FIRST STAGE FOR PENSION IV IN SUPPLY PARAMETER ESTIMATION

Dependent Variable:	log(AUM)	
IV:	Overall Portfolio Weight × Index Net Buys	Index Portfolio Weight × Index Net Buys
Model:	(1)	(2)
Variables		
Instrument: Expected Pension Buys	0.259***	0.773***
	(0.077)	(0.229)
Tracking error	0.039	0.038
	(0.204)	(0.205)
Age (log)	0.802***	0.801***
	(0.047)	(0.047)
Fund FE	Yes	Yes
Time FE	Yes	Yes
Observations	6,936	6,936
R^2	0.924	0.924
Within R^2	0.137	0.137
IV $F-$Statistics	11.4***	11.4***

Note: The Table shows the first stage regression of log AUM (demand) on the two versions of the pension-based shift-share instrument that we use for supply paramter estimation. We report the Kleibergen and Paap (2006) F-statistic to test for weak instrument strength.

Table A12: SUPPLY PARAMETERS AT THE FIRM-INDEX AND FIRM LEVELS

Panel A: Passive Index Funds (Firm-Index Level)

Dependent Variable:	Marginal Cost (percentage points per annum)					
Conduct:	Perfect Competition		Bertrand		$\text{Bertrand}_{\text{PW}}$	
	OLS	IV	OLS	IV	OLS	IV
AUM (log)	-0.011^{***}	-0.033^{***}	-0.012^{***}	-0.032^{***}	-0.013^{***}	-0.032^{***}
	(0.0005)	(0.006)	(0.0006)	(0.006)	(0.0006)	(0.006)
All Ctrls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	69,432	69,432	69,432	69,432	69,432	69,432
Average Marginal Cost	0.321	0.321	0.180	0.180	0.128	0.128
Average Markup	0.000	0.000	0.140	0.140	0.192	0.192
IV $F-$stat		67.7^{***}		67.7^{***}		67.7^{***}

Panel B: Passive Index Funds (Firm Level)

Dependent Variable:	Marginal Cost (percentage points per annum)					
Conduct:	Perfect Competition		Bertrand		$\text{Bertrand}_{\text{PW}}$	
	OLS	IV	OLS	IV	OLS	IV
AUM (log)	-0.001	-1.32	-0.002^{*}	-1.27	-0.003^{**}	-1.18
	(0.001)	(3.03)	(0.001)	(2.92)	(0.001)	(2.70)
All Ctrls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,464	8,464	8,464	8,464	8,464	8,464
Average Marginal Cost	0.406	0.406	0.282	0.282	0.274	0.274
Average Markup	0.000	0.000	0.123	0.123	0.129	0.129
IV $F-$stat		0.2		0.2		0.2

Panel C: Leverage Funds (Firm-Index Level)

Dependent Variable:	Marginal Cost (percentage points per annum)					
Conduct:	Perfect Competition		Bertrand		$\text{Bertrand}_{\text{PW}}$	
	OLS	IV	OLS	IV	OLS	IV
AUM (log)	-0.030^{***}	-0.040^{***}	-0.030^{***}	-0.048^{***}	-0.026^{***}	-0.041^{***}
	(0.002)	(0.011)	(0.002)	(0.009)	(0.002)	(0.009)
All Ctrls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	12,298	12,298	12,298	12,298	12,298	12,298
Average Marginal Cost	1.238	1.238	0.813	0.813	0.379	0.379
Average Markup	0.000	0.000	0.425	0.425	0.856	0.856
IV $F-$stat		100.2^{***}		100.2^{***}		100.2^{***}

Panel D: Leverage Funds (Firm Level)

Dependent Variable:	Marginal Cost (percentage points per annum)					
Conduct:	Perfect Competition		Bertrand		$\text{Bertrand}_{\text{PW}}$	
	OLS	IV	OLS	IV	OLS	IV
AUM (log)	-0.049^{***}	0.016	-0.104^{***}	-0.004	-0.070^{***}	-0.001
	(0.012)	(0.041)	(0.011)	(0.053)	(0.009)	(0.037)
All Ctrls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	531	531	531	531	531	531
Average Marginal Cost	1.185	1.185	0.778	0.778	0.341	0.341
Average Markup	0.000	0.000	0.407	0.407	0.844	0.844
IV Stage $F-$stat		30.4^{***}		30.4^{***}		30.4^{***}

Note: The Table shows the economies of scale estimates at the firm-index and firm levels for passive index funds (Panels A and B), and leveraged funds (Panels C and D). We sum up assets under management (AUM) by firm-index or firm and value-weighted all other variables by firm-index or firm using the prior month's AUM. All Ctrls include Firm-Index or Firm fixed effects, month fixed effects, tracking error and log of the fund age. Robust standard errors are clustered at the market level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% nominal levels, respectively.

Table A13: ROBUSTNESS: USING MARKUP IN SUPPLY ESTIMATION

Panel A: Passive Index Funds

Dependent Variable:	Markup (percentage points per annum)			
Conduct:	Bertrand		$\text{Bertrand}_{\text{PW}}$	
	OLS	IV	OLS	IV
AUM (log)	0.001^{***}	0.0005	0.003^{***}	0.0002
	(0.00009)	(0.0005)	(0.0002)	(0.001)
Trackinge error	0.005^{***}	0.005^{***}	0.007^{***}	0.007^{***}
	(0.0005)	(0.0005)	(0.001)	(0.001)
Age (log)	-0.0004^{***}	0.0001	-0.005^{***}	-0.004^{***}
	(0.0001)	(0.0003)	(0.0004)	(0.0007)
Fund FE	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes
Observations	108,300	108,300	108,300	108,300
Average Marginal Cost	0.122	0.122	0.068	0.068
Average Markup	0.151	0.151	0.205	0.205

Panel B: Leveraged Funds

Dependent Variable:	Markup (percentage points per annum)			
Conduct:	Bertrand		$\text{Bertrand}_{\text{PW}}$	
	OLS	IV	OLS	IV
AUM (log)	-0.001^{**}	-0.010^{***}	-0.004^{***}	-0.012^{***}
	(0.0007)	(0.003)	(0.0005)	(0.003)
Tracking error	-0.039^{**}	-0.048^{***}	-0.035^{***}	-0.043^{***}
	(0.016)	(0.016)	(0.009)	(0.010)
Age (log)	0.037^{***}	0.042^{***}	0.029^{***}	0.034^{***}
	(0.003)	(0.004)	(0.002)	(0.003)
Fund FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Observations	15,401	15,401	15,401	15,401
Average Marginal Cost	0.881	0.881	0.449	0.449
Average Markup	0.454	0.454	0.887	0.887

Note: The table shows the supply estimation using model-implied markups as the dependent variable for the passive index (Panel A) and leveraged fund (Panel B) markets under OLS and IV models. Markups are winsorized at the 5% and 95% tails by month. The $\text{Bertrand}_{\text{PW}}$ model refers to a Bertrand model where the Big 3 Index providers (Vanguard, State Street, and Blackrock) or ProShares/ProFunds and Direxion, respectively, have a profit weight of 0.65 on each other's products. AUM is assets under management in the current month at the fund, index, and issuer-levels. Age is the number of months since fund inception. Tracking error is the absolute value of the difference between stated leverage and OLS-estimated leverage in the 1-year ending in month $t-1$. We instrument AUM with negative residualized (with respect to market return and changes in VIX) index returns. Robust standard errors are clustered at the market level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% nominal levels, respectively.

Table A14: ECONOMIES OF SCALE BY FUND SIZE

Panel A: Passive Index Funds

Dependent Variable:	Marginal Cost (percentage points per annum)					
	OLS			IV		
Fund Size Tercile ($t-1$):	Small	Medium	Large	Small	Medium	Large
AUM (log)	-0.008^{***}	-0.004^{***}	-0.011^{***}	-0.064^{***}	-0.008	0.003
	(0.001)	(0.0009)	(0.0005)	(0.013)	(0.010)	(0.008)
Tracking error	0.016^{**}	-0.041^{***}	-0.086^{***}	0.009	-0.041^{***}	-0.085^{***}
	(0.006)	(0.008)	(0.005)	(0.006)	(0.008)	(0.005)
Age (log)	0.016^{***}	-0.007^{***}	-0.006^{***}	0.022^{***}	-0.006^{**}	-0.011^{***}
	(0.002)	(0.002)	(0.001)	(0.002)	(0.003)	(0.004)
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	36,155	36,053	36,092	36,155	36,053	36,092
Average Marginal Cost	0.215	0.148	0.004	0.215	0.148	0.004
Average Markup	0.138	0.145	0.169	0.138	0.145	0.169

Panel B: Leveraged Funds

Dependent Variable:	Marginal Cost (percentage points per annum)					
	OLS			IV		
Fund Size Tercile ($t-1$):	Small	Medium	Large	Small	Medium	Large
AUM (log)	-0.025^{***}	-0.037^{***}	-0.015^{***}	-0.040^{**}	0.035	0.131^{*}
	(0.003)	(0.003)	(0.0010)	(0.017)	(0.048)	(0.072)
Tracking error	-0.077^{*}	-0.042	-0.114^{***}	-0.092^{*}	0.020	0.114
	(0.045)	(0.115)	(0.029)	(0.048)	(0.126)	(0.115)
Age (log)	0.050^{***}	0.046^{***}	-0.017^{**}	0.053^{***}	0.040^{***}	-0.127^{**}
	(0.005)	(0.007)	(0.009)	(0.006)	(0.009)	(0.055)
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,197	5,072	5,132	5,197	5,072	5,132
Average Marginal Cost	1.133	0.842	0.665	1.133	0.842	0.665
Average Markup	0.544	0.435	0.383	0.544	0.435	0.383

Note: The table shows the estimated supply parameters and economies of scale across fund size terciles (by month) for the passive index (Panel A) and leveraged fund (Panel B) markets under OLS and IV models. Marginal costs are computed from expense ratio minus model-implied markup based on bertrand competition. Marginal costs are winsorized at the 5% and 95% tails by month. AUM is assets under management in the current month at the fund, index, and issuer-levels. Age is the number of months since fund inception. Tracking error is the absolute value of the difference between stated leverage and OLS-estimated leverage in the 1-year ending in month $t-1$. We instrument AUM with negative residualized (with respect to market return and changes in VIX) index returns. Robust standard errors are clustered at the market level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% nominal levels, respectively.

Table A15: ROBUSTNESS: ECONOMIES OF SCALE BY FUND SIZE UNDER PERFECT COMPETITION

Panel A: Passive Index Funds

Dependent Variable:	Marginal Cost (percentage points per annum)					
	OLS			IV		
Fund Size Tercile ($t-1$):	Small	Medium	Large	Small	Medium	Large
AUM (log)	-0.007^{***}	-0.002^{**}	-0.009^{***}	-0.061^{***}	-0.009	-0.0003
	(0.001)	(0.0009)	(0.0004)	(0.013)	(0.010)	(0.007)
Tracking error	0.017^{***}	-0.039^{***}	-0.072^{***}	0.010	-0.039^{***}	-0.072^{***}
	(0.006)	(0.007)	(0.005)	(0.007)	(0.007)	(0.005)
Age (log)	0.016^{***}	-0.006^{***}	-0.004^{***}	0.022^{***}	-0.004^{*}	-0.008^{**}
	(0.002)	(0.002)	(0.0009)	(0.002)	(0.003)	(0.003)
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	36,155	36,053	36,092	36,155	36,053	36,092
Average Marginal Cost	0.353	0.292	0.172	0.353	0.292	0.172

Panel B: Leveraged Funds

Dependent Variable:	Marginal Cost (percentage points per annum)					
	OLS			IV		
Fund Size Tercile ($t-1$):	Small	Medium	Large	Small	Medium	Large
AUM (log)	-0.035^{***}	-0.038^{***}	-0.012^{***}	-0.077^{***}	-0.011	0.117^{*}
	(0.003)	(0.003)	(0.001)	(0.023)	(0.046)	(0.069)
Tracking error	-0.137^{***}	-0.161	-0.126^{***}	-0.179^{***}	-0.139	0.075
	(0.040)	(0.111)	(0.025)	(0.048)	(0.117)	(0.105)
Age (log)	0.083^{***}	0.072^{***}	0.025^{***}	0.090^{***}	0.070^{***}	-0.072
	(0.005)	(0.007)	(0.005)	(0.008)	(0.008)	(0.053)
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,197	5,072	5,132	5,197	5,072	5,132
Average Marginal Cost	1.682	1.279	1.047	1.682	1.279	1.047

Note: The table shows the estimated supply parameters and economies of scale for the passive index (Panel A) and leveraged fund (Panel B) markets under OLS and IV models. Marginal costs are expense ratios under a perfect competition conduct assumption. Marginal costs are winsorized at the 5% and 95% tails by month. The $\text{Bertrand}_{\text{PW}}$ model refers to a Bertrand model where the Big 3 Index providers (Vanguard, State Street, and Blackrock) or ProShares/ProFunds and Direxion, respectively, have a profit weight of 0.65 on each other's products. AUM is assets under management in the current month at the fund, index, and issuer-levels. Age is the number of months since fund inception. Tracking error is the absolute value of the difference between stated leverage and OLS-estimated leverage in the 1-year ending in month $t-1$. We instrument AUM with negative residualized (with respect to market return and changes in VIX) index returns. Robust standard errors are clustered at the market level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% nominal levels, respectively.

Table A16: ROBUSTNESS: SUPPLY PARAMETERS AND ECONOMIES OF SCALE CONTROLLING FOR REALIZED VOLATILITY

Panel A: Passive Index Funds

Dependent Variable:	Marginal Cost (percentage points per annum)					
Conduct:	Perfect Competition		Bertrand		$\text{Bertrand}_{\text{PW}}$	
	OLS	IV	OLS	IV	OLS	IV
AUM (log)	-0.006***	-0.022***	-0.007***	-0.021***	-0.008***	-0.019***
	(0.0003)	(0.005)	(0.0004)	(0.005)	(0.0004)	(0.005)
Tracking error	-0.042***	-0.046***	-0.048***	-0.051***	-0.049***	-0.051***
	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
Age (log)	-0.002***	0.007**	-0.001	0.007**	0.003***	0.009***
	(0.0006)	(0.003)	(0.0007)	(0.003)	(0.0008)	(0.003)
Realized index volatility	0.001***	0.001**	0.002***	0.001**	0.001***	0.001**
	(0.0004)	(0.0005)	(0.0004)	(0.0005)	(0.0004)	(0.0005)
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	108,300	108,300	108,300	108,300	108,300	108,300
Average Marginal Cost	0.273	0.273	0.122	0.122	0.068	0.068
Average Markup	0.000	0.000	0.151	0.151	0.205	0.205

Panel B: Leveraged Funds

Dependent Variable:	Marginal Cost (percentage points per annum)					
Conduct:	Perfect Competition		Bertrand		$\text{Bertrand}_{\text{PW}}$	
	OLS	IV	OLS	IV	OLS	IV
AUM (log)	-0.027***	-0.049***	-0.026***	-0.039***	-0.023***	-0.038***
	(0.001)	(0.011)	(0.001)	(0.009)	(0.0010)	(0.008)
Tracking error	-0.128***	-0.151***	-0.093**	-0.106**	-0.097***	-0.113***
	(0.041)	(0.044)	(0.043)	(0.046)	(0.037)	(0.040)
Age (log)	0.076***	0.090***	0.042***	0.050***	0.049***	0.058***
	(0.005)	(0.008)	(0.005)	(0.008)	(0.004)	(0.007)
Realized index volatility	0.003	0.007*	0.003	0.005	0.003	0.005
	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,401	15,401	15,401	15,401	15,401	15,401
Average Marginal Cost	1.337	1.337	0.881	0.881	0.449	0.449
Average Markup	0.000	0.000	0.454	0.454	0.887	0.887

Note: The table shows the estimated supply parameters and economies of scale for the passive index (Panel A) and leveraged fund (Panel B) markets under OLS and IV models, controlling for realized volatility of the underlying index. Marginal costs are computed from expense ratio minus model-implied markup. Marginal costs and markups are winsorized at the 5% and 95% tails by month. The $\text{Bertrand}_{\text{PW}}$ model refers to a Bertrand model where the Big 3 Index providers (Vanguard, State Street, and Blackrock) or ProShares/ProFunds and Direxion, respectively, have a profit weight of 0.65 on each other's products. AUM is assets under management in the current month at the fund, index, and issuer-levels. Age is the number of months since fund inception. Tracking error is the absolute value of the difference between stated leverage and OLS-estimated leverage in the 1-year ending in month $t-1$. We instrument AUM with negative residualized (with respect to market return and changes in VIX) index returns. Robust standard errors are clustered at the market level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% nominal levels, respectively.

Table A17: ROBUSTNESS: ECONOMIES OF SCALE BY FUND SIZE CONTROLLING FOR REALIZED VOLATILITY

Panel A: Passive Index Funds

Dependent Variable:	Marginal Cost (percentage points per annum)					
	OLS			IV		
Fund Size Tercile ($t-1$):	Small	Medium	Large	Small	Medium	Large
AUM (log)	-0.008***	-0.004***	-0.011***	-0.058***	0.0009	0.004
	(0.001)	(0.0009)	(0.0005)	(0.014)	(0.011)	(0.009)
Tracking error	0.017***	-0.041***	-0.086***	0.010	-0.041***	-0.085***
	(0.006)	(0.008)	(0.005)	(0.006)	(0.008)	(0.005)
Age (log)	0.016***	-0.007***	-0.006***	0.021***	-0.008***	-0.012***
	(0.002)	(0.002)	(0.001)	(0.002)	(0.003)	(0.004)
Realized index volatility	0.003***	0.003***	-0.0003	0.002***	0.003***	0.0003
	(0.0006)	(0.0007)	(0.0003)	(0.0008)	(0.0009)	(0.0005)
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	36,155	36,053	36,092	36,155	36,053	36,092
Average Marginal Cost	0.215	0.148	0.004	0.215	0.148	0.004
Average Markup	0.138	0.145	0.169	0.138	0.145	0.169

Panel B: Leveraged Funds

Dependent Variable:	Marginal Cost (percentage points per annum)					
	OLS			IV		
Fund Size Tercile ($t-1$):	Small	Medium	Large	Small	Medium	Large
AUM (log)	-0.025***	-0.037***	-0.016***	-0.041**	0.028	0.176
	(0.003)	(0.003)	(0.0010)	(0.017)	(0.043)	(0.127)
Tracking error	-0.077*	-0.042	-0.114***	-0.093*	0.011	0.179
	(0.045)	(0.115)	(0.029)	(0.048)	(0.124)	(0.194)
Age (log)	0.050***	0.046***	-0.017*	0.053***	0.040***	-0.162*
	(0.005)	(0.007)	(0.009)	(0.006)	(0.009)	(0.097)
Realized index volatility	-0.005	-0.001	0.010**	-0.004	-0.005	-0.029
	(0.007)	(0.003)	(0.004)	(0.007)	(0.004)	(0.028)
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,197	5,072	5,132	5,197	5,072	5,132
Average Marginal Cost	1.133	0.842	0.665	1.133	0.842	0.665
Average Markup	0.544	0.435	0.383	0.544	0.435	0.383

Note: The table shows the estimated supply parameters and economies of scale for the passive index (Panel A) and leveraged fund (Panel B) markets under OLS and IV models, controlling for realized volatility of the underlying index. Marginal costs are computed from expense ratio minus model-implied markup. Marginal costs and markups are winsorized at the 5% and 95% tails by month. The $\text{Bertrand}_{\text{PW}}$ model refers to a Bertrand model where the Big 3 Index providers (Vanguard, State Street, and Blackrock) or ProShares/ProFunds and Direxion, respectively, have a profit weight of 0.65 on each other's products. AUM is assets under management in the current month at the fund, index, and issuer-levels. Age is the number of months since fund inception. Tracking error is the absolute value of the difference between stated leverage and OLS-estimated leverage in the 1-year ending in month $t-1$. We instrument AUM with negative residualized (with respect to market return and changes in VIX) index returns. Robust standard errors are clustered at the market level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% nominal levels, respectively.

Table A18: ROBUSTNESS: SUPPLY PARAMETERS AND ECONOMIES OF SCALE UNDER ALTERNATIVE DEMAND SYSTEMS

Panel A: Passive Index Funds

Conduct:	Perfect Competition		Bertrand		$\text{Bertrand}_{\text{PW}}$	
	OLS	IV	OLS	IV	OLS	IV
Dependent Variable:	Marginal Cost (D.S. w/ Broad vs. Specialized)					
AUM (log)	-0.006^{***}	-0.024^{***}	-0.006^{***}	-0.028^{***}	-0.008^{***}	-0.025^{***}
	(0.0003)	(0.005)	(0.0004)	(0.005)	(0.0004)	(0.005)
Average Marginal Cost	0.273	0.273	0.107	0.107	0.041	0.041
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	108,000	108,000	108,000	108,000	108,000	108,000

Panel B: Leveraged Funds

Conduct:	Perfect Competition		Bertrand		$\text{Bertrand}_{\text{PW}}$	
	OLS	IV	OLS	IV	OLS	IV
Dependent Variable:	Marginal Cost (D.S. w/ Broad vs. Specialized)					
AUM (log)	-0.027^{***}	-0.052^{***}	-0.026^{***}	-0.040^{***}	-0.024^{***}	-0.039^{***}
	(0.001)	(0.012)	(0.001)	(0.010)	(0.001)	(0.009)
Average Marginal Cost	1.337	1.337	0.884	0.884	0.457	0.457
Fund FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	15,401	15,401	15,401	15,401	15,401	15,401

Note: The table shows the estimated supply parameters and economies of scale for the passive index (Panel A) and leveraged fund (Panel B) markets under OLS and IV models with alternative demand systems. We present results under a demand system that adds a broad vs. specialized interaction with price. Marginal costs are computed from expense ratio minus model-implied markup. Marginal costs and markups are winsorized at the 5% and 95% tails by month. The $\text{Bertrand}_{\text{PW}}$ model refers to a Bertrand model where the Big 3 Index providers (Vanguard, State Street, and Blackrock) or ProShares/ProFunds and Direxion, respectively, have a profit weight of 0.65 on each other's products. AUM is assets under management in the current month at the fund, index, and issuer-levels. Age is the number of months since fund inception. Tracking error is the absolute value of the difference between stated leverage and OLS-estimated leverage in the 1-year ending in month $t-1$. We instrument AUM with negative residualized (with respect to market return and changes in VIX) index returns. Robust standard errors are clustered at the market level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% nominal levels, respectively.

Table A19: CONDUCT TEST RESULTS UNDER ALTERNATIVE DEMAND SYSTEMS

Panel A: Index Fund Market Conduct

Models	1	2	3	4	5	MCS $p-$values
Test Results (T^{RV}, D.S. w/ Broad vs. Specialized)						
1. Perfect Competition		-2.887	-0.523	-0.205	-0.450	1.000
2. Baseline Bertrand			1.236	0.502	-0.045	0.011
3. B: Big 3 Asset Managers (Profit Weight: 0.25)				0.063	-0.411	0.708
4. B: Big 3 Asset Managers (Profit Weight: 0.50)					-0.846	0.838
5. B: Big 3 Asset Managers (Profit Weight: 0.65)						0.509

Panel B: Leveraged Fund Market Conduct

Models	1	2	3	4	5	MCS $p-$values
Test Results (T^{RV}, D.S. w/ Broad vs. Specialized)						
1. Perfect Competition		2.803	3.056	3.191	3.234	0.003
2. Baseline Bertrand			2.650	2.836	2.91	0.004
3. B: ProShares + Direxion (Profit Weight: 0.25)				2.961	2.989	0.004
4. B: ProShares + Direxion (Profit Weight: 0.50)					3.002	0.004
5. B: ProShares + Direxion (Profit Weight: 0.65)						1.000

Note: The Table shows the conduct test results assuming a demand system with broad vs. specialized funds. Panels A and B focus on the passive index and leveraged fund markets. We compare conduct based on perfect competition vs. bertrand competition where models 3–5 assume the Big 3 asset managers or ProShares + Direxion have profit weights of 0.25, 0.50, and 0.65 with each other. We report the RV test statistic (T^{RV}) and the $F-$Statistic for all pairs of conduct models, respectively, as well as the model confidence set (MCS) $p-$values. A negative T^{RV} indicates the test favors the row model. For the $F-$Statistics, a *** label shows that it is above the appropriate critical value for a worst-case size of 0.075, while a † label shows that it is above the appropriate critical value for a best-case power of 0.95. MCS $p-$values below 0.05 indicate the row model is rejected from the model confidence set at 5% nominal level. The T^{RV} and $F-$Statistics are computed based on clustering at the market level.

Table A20: CONDUCT TEST RESULTS FOR ALTERNATIVE IVS IN THE INDEX FUND MARKET

Panel A: IV - Rival Funds Tracking Similar Index × Baker-Wurgler Sentiment

Index Fund Market Conduct						
Models	1	2	3	4	5	MCS $p-$values
Test Results (T^{RV})						
1. Perfect Competition		-6.037	-5.637	-5.245	-5.045	1.000
2. Baseline Bertrand			-3.692	-4.089	-4.237	0.000
3. B: Big 3 Asset Managers (Profit Weight: 0.25)				-4.287	-4.366	0.000
4. B: Big 3 Asset Managers (Profit Weight: 0.50)					-4.435	0.000
5. B: Big 3 Asset Managers (Profit Weight: 0.65)						0.000
Leveraged Fund Market Conduct						
Models	1	2	3	4	5	MCS $p-$values
Test Results (T^{RV})						
1. Perfect Competition		-1.222	-0.429	0.468	0.967	0.333
2. Baseline Bertrand			2.378	2.321	2.285	0.050
3. B: ProShares + Direxion (Profit Weight: 0.25)				2.244	2.205	0.064
4. B: ProShares + Direxion (Profit Weight: 0.50)					2.134	0.072
5. B: ProShares + Direxion (Profit Weight: 0.65)						1.000

Panel B: IV - Rival Funds Tracking Similar Index × Residualized Baker-Wurgler Sentiment

Index Fund Market Conduct						
Models	1	2	3	4	5	MCS $p-$values
Test Results (T^{RV})						
1. Perfect Competition		-5.971	-5.590	-4.973	-4.648	1.000
2. Baseline Bertrand			-2.841	-3.280	-3.464	0.000
3. B: Big 3 Asset Managers (Profit Weight: 0.25)				-3.517	-3.627	0.000
4. B: Big 3 Asset Managers (Profit Weight: 0.50)					-3.730	0.000
5. B: Big 3 Asset Managers (Profit Weight: 0.65)						0.000
Leveraged Fund Market Conduct						
Models	1	2	3	4	5	MCS $p-$values
Test Results (T^{RV})						
1. Perfect Competition		-1.097	-0.421	0.249	0.630	0.529
2. Baseline Bertrand			2.342	2.293	2.267	0.052
3. B: ProShares + Direxion (Profit Weight: 0.25)				2.228	2.201	0.063
4. B: ProShares + Direxion (Profit Weight: 0.50)					2.148	0.066
5. B: ProShares + Direxion (Profit Weight: 0.65)						1.000

Note: The Table shows the conduct test results under different conduct IVs. In Panels A and B, we replace the residualized consumer sentiment index with the original and residualized Baker and Wurgler (2006) index. Similarly, in Panels C and D, we focus on the original consumer sentiment index, and negative residualized index returns. In Panels E and F, we report on the results using either the number of rival funds tracking a similar index or the residualized consumer sentiment index, without interacting them. We report the RV test statistic (T^{RV}) and the $F-$Statistic for all pairs of conduct models, respectively, as well as the model confidence set (MCS) $p-$values. A negative T^{RV} indicates the test favors the row model. MCS $p-$values below 0.05 indicate the row model is rejected from the model confidence set at 5% nominal level. The T^{RV} and $F-$Statistics are computed based on clustering at the market level.

Panel C: IV - Rival Funds Tracking Similar Index × Consumer Sentiment Index

Index Fund Market Conduct						
Models	1	2	3	4	5	MCS $p-$values
Test Results (T^{RV})						
1. Perfect Competition		−4.888	−4.041	−2.403	−1.965	1.000
2. Baseline Bertrand			0.683	0.001	−0.450	0.000
3. B: Big 3 Asset Managers (Profit Weight: 0.25)				−0.424	−0.794	0.000
4. B: Big 3 Asset Managers (Profit Weight: 0.50)					−1.149	0.024
5. B: Big 3 Asset Managers (Profit Weight: 0.65)						0.049
Leveraged Fund Market Conduct						
Models	1	2	3	4	5	MCS $p-$values
Test Results (T^{RV})						
1. Perfect Competition		0.553	1.405	2.059	2.357	0.018
2. Baseline Bertrand			2.442	2.587	2.677	0.019
3. B: ProShares + Direxion (Profit Weight: 0.25)				2.712	2.782	0.016
4. B: ProShares + Direxion (Profit Weight: 0.50)					2.854	0.014
5. B: ProShares + Direxion (Profit Weight: 0.65)						1.000

Panel D: IV - Rival Funds Tracking Similar Index × Residualized Index Returns

Index Fund Market Conduct						
Models	1	2	3	4	5	MCS $p-$values
Test Results (T^{RV})						
1. Perfect Competition		−5.861	−5.224	−4.567	−4.230	1.000
2. Baseline Bertrand			−1.900	−2.509	−2.763	0.000
3. B: Big 3 Asset Managers (Profit Weight: 0.25)				−2.836	−2.988	0.000
4. B: Big 3 Asset Managers (Profit Weight: 0.50)					−3.134	0.000
5. B: Big 3 Asset Managers (Profit Weight: 0.65)						0.000
Leveraged Fund Market Conduct						
Models	1	2	3	4	5	MCS $p-$values
Test Results (T^{RV})						
1. Perfect Competition		−0.654	0.602	1.643	2.109	0.035
2. Baseline Bertrand			3.408	3.346	3.299	0.002
3. B: ProShares + Direxion (Profit Weight: 0.25)				3.253	3.196	0.003
4. B: ProShares + Direxion (Profit Weight: 0.50)					3.084	0.005
5. B: ProShares + Direxion (Profit Weight: 0.65)						1.000

Panel E: IV - Rival Funds Tracking Similar Index

Index Fund Market Conduct						
Models	1	2	3	4	5	MCS $p-$values
Test Results (T^{RV})						
1. Perfect Competition		-5.927	-5.290	-4.638	-4.304	1.000
2. Baseline Bertrand			-1.914	-2.554	-2.819	0.000
3. B: Big 3 Asset Managers (Profit Weight: 0.25)				-2.896	-3.055	0.000
4. B: Big 3 Asset Managers (Profit Weight: 0.50)					-3.207	0.000
5. B: Big 3 Asset Managers (Profit Weight: 0.65)						0.000
Leveraged Fund Market Conduct						
Models	1	2	3	4	5	MCS $p-$values
Test Results (T^{RV})						
1. Perfect Competition		-0.309	0.087	0.609	0.793	0.720
2. Baseline Bertrand			0.773	0.732	0.703	0.479
3. B: ProShares + Direxion (Profit Weight: 0.25)				0.674	0.638	0.518
4. B: ProShares + Direxion (Profit Weight: 0.50)					0.565	0.572
5. B: ProShares + Direxion (Profit Weight: 0.65)						1.000

Panel F: IV - Residualized Consumer Sentiment Index

Index Fund Market Conduct						
Models	1	2	3	4	5	MCS $p-$values
Test Results (T^{RV})						
1. Perfect Competition		0.768	0.820	0.877	0.904	0.649
2. Baseline Bertrand			-0.045	0.169	0.312	0.755
3. B: Big 3 Asset Managers (Profit Weight: 0.25)				0.369	0.488	0.804
4. B: Big 3 Asset Managers (Profit Weight: 0.50)					0.617	0.752
5. B: Big 3 Asset Managers (Profit Weight: 0.65)						1.000
Leveraged Fund Market Conduct						
Models	1	2	3	4	5	MCS $p-$values
Test Results (T^{RV})						
1. Perfect Competition		-0.065	-0.068	-0.066	-0.063	1.000
2. Baseline Bertrand			-0.071	0.001	0.052	0.997
3. B: ProShares + Direxion (Profit Weight: 0.25)				0.073	0.121	0.995
4. B: ProShares + Direxion (Profit Weight: 0.50)					0.183	0.988
5. B: ProShares + Direxion (Profit Weight: 0.65)						1.000