

Indexing and the Elasticity of Stock Demand ^{*}

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Abstract

Passive investing changes stock demand, but aggregate measures cannot show which stocks become inelastic. We construct the Indexing Inclusion Ratio (IXI) to measure realized indexing from portfolio holdings, including benchmark overlap inside active funds. Stocks with the most indexing have about 25 percent lower estimated demand elasticity than those with the least, and the negative relationship persists within firms. Indexing shocks raise prices with little corresponding increase in fundamental value. Changes in discounted payouts and terminal stock values over ten years explain only 12 percent of the initial price response to indexing.

Keywords: Passive investing, demand elasticity, index inclusion, Active Share, closet indexing, demand system, asset pricing

JEL Codes: G11, G12, G14, G23

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1 Introduction

The growth of passive investing changes how stock markets absorb demand. Index funds allocate capital according to benchmark weights, with little discretion to respond to individual stock valuations. As their ownership rises, a given demand shock can require a larger price adjustment. The effect depends on where indexing capital is invested and how other investors respond. Aggregate passive ownership cannot reveal these differences across stocks. We study which stocks have less elastic demand as indexing grows and what this means for their prices.

We construct the Indexing Inclusion Ratio (IXI) to measure how much of each stock is held through realized indexing. IXI includes declared index funds and the benchmark allocation implemented inside active funds. An active fund can follow benchmark weights in some stocks while taking substantial active positions in others. We therefore measure indexing position by position, counting the overlap between the fund’s holdings and its benchmark allocation. A benchmark constituent that the fund does not hold contributes nothing.

Stocks with more realized indexing have less elastic estimated demand. Those in the most indexed fifth have about 25 percent lower demand elasticity than those in the least indexed fifth, and the negative relationship persists within firms. Ownership differences extend beyond the share held by index funds. The active investors holding heavily indexed stocks are themselves less responsive to prices. Indexing shocks also raise prices with little corresponding increase in fundamental value.

Realized indexing differs substantially from the exposure implied by benchmark assignments. In a comparison using the same active funds, about two thirds of the capital allocated at benchmark weights lies beyond the funds’ actual portfolio overlap. This includes stocks they do not hold and positions smaller than the benchmark allocation. The distinction matters for prices. Our monthly price test rejects the restriction that this additional attributed exposure moves prices in proportion to realized indexing capital.

The overlap inside active portfolios also behaves like indexing. Economically meaningful overlap positions turn over less and are more persistent than active overweights. They also follow benchmark deletions more closely. These findings support measuring indexing at the level of the position, including within nominally active funds.

We estimate stock demand elasticity using the demand system of [Koijen and Yogo \(2019\)](#). The model estimates investor demand from holdings, prices, and stock characteristics, then aggregates investor responses into an elasticity for each stock. Larger stocks are both more likely to be indexed and often less elastic for other reasons. The negative relationship between

indexing and elasticity remains after controlling for size and when we follow the same firm over time. We instrument IXI with an equalized measure of index exposure and also estimate demand without including IXI. Stocks with more indexing have less elastic demand in this latter model as well, so the relationship does not depend on including IXI in the demand equation.

Ownership composition helps explain why heavily indexed stocks have less elastic demand. These stocks have more index ownership, but they also attract active investors who are less responsive to prices. About half of the negative relationship between indexing and elasticity remains when we calculate elasticity using only active holders. The difference therefore extends beyond the direct contribution of index funds.

Which investors hold a stock and how each investor responds to its prices are separate questions. In our instrumented estimates, the same active fund family responds more strongly to prices in its heavily indexed holdings, in the direction documented by [Haddad et al. \(2025\)](#). This response can coexist with the ownership pattern. An investor can respond more strongly in its heavily indexed holdings while remaining less responsive than the investors who hold lightly indexed stocks.

Index additions provide complementary evidence. Relative to matched controls, S&P 500 additions raise IXI by 1.3 percentage points in the addition year and 1.7 points the following year. Estimated demand elasticity falls after inclusion. The ownership and elasticity changes therefore line up around a discrete change in benchmark membership.

Demand from index funds has a large price effect. Using changes in index exposure to instrument changes in declared index fund ownership, we estimate an 8.8 percentage point cumulative log return response per percentage point of ownership. The return window covers the month of the exposure change and the preceding month to allow for announcements before implementation.

We then ask how much of the price increase is matched by subsequent fundamental value. We discount the payouts investors receive over the following ten years and the value of the shares at the end of that period. Changes in this claim value explain only 12 percent of the price response in the month of the exposure change. The remaining 88 percent is the valuation wedge, the portion of the initial price increase unmatched by subsequent fundamental value.

Our measurement contribution builds on [Pavlova and Sikorskaya \(2023\)](#), who show how benchmark incentives affect institutional ownership and prices. Their Benchmarking Intensity measures exposure to those incentives. IXI measures the benchmark allocation implemented in actual holdings. Our comparison of realized and fully attributed exposure holds the fund

universe fixed, separating the effect of counting implemented overlap from differences in fund coverage.

The paper also contributes to understanding differences in demand elasticity across stocks. Estimated stock demand is far less elastic than classical asset pricing models imply (Koijen and Yogo, 2019; Davis et al., 2025), and Gabaix and Koijen (2021) show why low elasticity amplifies flows. IXI reveals that elasticity varies with realized indexing ownership even within size groups and within firms. The ownership evidence connects this variation to both index ownership and the active investors who hold the remaining shares, complementing the investor composition evidence in Koijen et al. (2024).

The sources of indexing matter as well. Broad and factor or style indices supply most indexing capital and have the strongest elasticity associations per standard deviation of exposure. Sector and thematic exposure have smaller associations. IXI makes it possible to distinguish these sources of indexing in each stock’s ownership.

The findings also bear on the index effect literature. Classic index event studies show that demand curves for individual stocks slope down (Harris and Gurel, 1986; Shleifer, 1986; Scholes, 1972; Kaul et al., 2000). Recent work shows that benchmark demand continues to move prices (Pavlova and Sikorskaya, 2023). IXI shifts the object from event flows to the stock of realized indexing capital. Passive demand includes both the flow that arrives when a stock enters a benchmark and the persistent benchmark allocation held by index funds and active managers.

The measurement contribution also relates to work on the size and consequences of passive ownership. Chinco and Sammon (2024) show that passive ownership inferred from trading at index reconstitutions is about twice the share visible in declared index funds, and Sammon (2025) relates passive ownership to price informativeness. IXI locates realized indexing stock by stock from holdings, including the benchmark overlap inside active funds. Jiang et al. (2025) study how passive flows favor the largest firms, Ben-David et al. (2021) the price effects of concentrated institutional ownership, Coles et al. (2022) the trading and price effects of index membership, and Appel et al. (2019) its governance consequences. We document how demand elasticity differs across stocks with different amounts of realized indexing.

These estimates carry a practical implication for empirical work that uses demand elasticity. A single market elasticity can summarize aggregate price impact, but questions about individual stocks require a measure of how their demand differs. Realized indexing varies across stocks and is associated with differences in both their owners and their demand elasticity. Measuring where indexing capital is invested therefore matters for understanding how individual stock prices

respond to demand. Section 2 sets out the framework, Section 3 the data and construction of IXI, and Section 4 the results.

2 Framework

Passive ownership affects prices through the demand of heterogeneous investors. We study this link in the characteristics-based demand system of [Koijen and Yogo \(2019\)](#). Quarterly holdings identify each investor’s response to prices, characteristics, and demand shocks; market clearing aggregates those responses into stock-level demand elasticity.

2.1 Indexing Inclusion Ratio (IXI) as a measure of passive ownership

The demand system requires a stock-level measure of where indexing capital is actually invested. Declared index-fund holdings miss capital that follows benchmark weights inside nominally active funds. A realized-indexing measure must therefore include both declared index funds and the benchmark-overlapping positions of active funds.

We construct the Indexing Inclusion Ratio (IXI) as a holdings-based measure of realized passive capital allocation at the stock level. Benchmarking Intensity (BMI) ([Pavlova and Sikorskaya, 2023](#)) attributes benchmarked capital to index constituents to measure the incentives created by benchmark contracts. IXI instead asks where indexing capital is realized in fund positions and counts only the portion of each portfolio that overlaps its benchmark, stock by stock. For stock n at time t :

$$IXI_t(n) = \frac{\sum_{j=1}^J A_{j,t} \cdot \min\{w_{j,t}(n), w_{h(j),t}(n)\}}{ME_t(n)} \quad (1)$$

where $A_{j,t}$ is the assets under management of fund j , $w_{j,t}(n)$ is the fund’s portfolio weight in stock n , $w_{h(j),t}(n)$ is the stock’s weight in the fund’s benchmark $h(j)$, and $ME_t(n)$ is the market capitalization of stock n . The component-wise minimum is the stock-level counterpart of Active Share: summed across stocks it recovers exactly the fraction of the portfolio that tracks the benchmark,

$$\sum_{n=1}^N \min\{w_{j,t}(n), w_{h(j),t}(n)\} = 1 - \frac{1}{2} \sum_{n=1}^N |w_{j,t}(n) - w_{h(j),t}(n)| = 1 - \text{ActiveShare}_{j,t}, \quad (2)$$

with Active Share calculated following [Cremers and Petajisto \(2009\)](#). Each fund therefore con-

tributes its Active-Share-adjusted assets, $A_{j,t}(1 - \text{ActiveShare}_{j,t})$, allocated across exactly the positions it holds in common with its benchmark. A pure index fund with zero Active Share contributes its full AUM at index weights; a fund with 40% Active Share contributes 60% of its assets, placed only on its benchmark-overlapping holdings; and a benchmark constituent the fund does not hold receives nothing. In practice, declared index funds enter through their realized holdings directly, and each active-fund contribution is also capped at the fund’s realized dollar position in the stock (Appendix B). The benchmark $h(j)$ is itself assigned from realized holdings rather than taken from the prospectus. Each year the fund is matched to the benchmark whose weights overlap most with its portfolio, with the declared benchmark retained for index funds that track it closely and a hysteresis rule preventing mechanical year-to-year switching (Appendix B). The assignment matters because labels mislead. Roughly 45 percent of active fund assets sit in funds whose holdings track a different benchmark from the one their prospectus names.

This position rule captures gradual convergence toward benchmark weights inside nominally active funds while preserving the distinction between a benchmark contract and the capital realized in each stock. Section 3.2 gives the full construction and comparison with attributed indexing measures.

Two scope limitations apply. First, IXI is a measure of realized passive ownership *within the fund sector*. It does not capture passive-like allocations by non-fund institutional investors such as pension funds, insurance companies, and sovereign wealth funds, and therefore understates the total stock of indexing capital.¹ Second, the Active Share adjustment captures only the realized overlap between fund portfolios and their assigned benchmarks; it cannot distinguish between strategic closet indexing and coincidental benchmark similarity. The estimates concern this observed fund-sector overlap; incomplete coverage alone does not order the price effects of unobserved indexing capital.

2.2 Demand-based asset pricing

The demand-based asset pricing model of [Kojien and Yogo \(2019\)](#) maps observed holdings into investor-specific demand curves and stock-level elasticity. The framework builds on the revealed-preference approach of [Berk and van Binsbergen \(2016\)](#); [Kojien and Yogo \(2019\)](#) provide the full derivation.

Notation. Consider I heterogeneous investors and $N + 1$ assets, where $n = 0$ denotes the

¹Appendix D estimates that non-fund passive-equivalent capital adds approximately 15% to the IXI numerator by 2023, with a rank correlation of 0.979 between fund-based IXI and the enriched measure.

outside asset. Investor i has AUM $A_{i,t}$ and allocates across assets in its investment universe with portfolio weights $w_{i,t}(n)$, where $\sum_{n=0}^N w_{i,t}(n) = 1$. Each asset has market capitalization $ME_t(n)$ and observable characteristics $x_t(n)$, which include the standard [Kojen and Yogo \(2019\)](#) set (log book equity, profitability, investment, market beta) plus IXI. Market clearing requires:

$$ME_t(n) = \sum_{i=1}^I w_{i,t}(n) A_{i,t} \quad (3)$$

Empirical specification of demand curves. [Kojen and Yogo \(2019\)](#) establish the link between classic mean-variance portfolio theory, factor models, and empirical demand curves. For investor i , the optimal portfolio weight for stock n at time t satisfies

$$w_{i,t}(n) = \frac{\delta_{i,t}(n) U_{i,t}(n)}{1 + \sum_{m=1}^N \delta_{i,t}(m) U_{i,t}(m)} \quad (4)$$

where

$$\ln \delta_{i,t}(n) = \beta_{0,i,t} me_t(n) + \beta'_{1,i,t} x_t(n)$$

where $me_t(n) = \ln ME_t(n)$ and $\beta_{0,i,t} me_t(n)$ measures the response of demand to prices. A sufficient condition for the demand system to have a unique equilibrium solution is $\beta_{0,i,t}(n) < 1$. The secondary term, $\beta'_{1,i,t} x_t(n)$, measures how investors tilt their demand in response to each characteristic. This enables the model to identify, for example, growth versus value investors. The final term, $U_{i,t}(n)$ is latent demand. It measures the component of demand that is not well explained by the observed prices and characteristics.

Model estimation. The demand curve implies

$$\frac{w_{i,t}(n)}{w_{i,t}(0)} = \delta_{i,t}(n) \cdot U_{i,t}(n) = \exp\left(\beta_{0,i,t} me_t(n) + \beta'_{1,i,t} x_t(n)\right) \cdot U_{i,t}(n) \quad (5)$$

where $w_{i,t}(0)$ is the weight on the outside asset and $U_{i,t}(n)$ is latent demand. Estimation targets the nonlinear moment condition:

$$\mathbb{E} \left[\left(\frac{w_{i,t}(n)}{w_{i,t}(0)} \cdot \exp\left(-\beta_{0,i,t} me_t(n) - \beta'_{1,i,t} x_t(n)\right) - 1 \right) \cdot Z_t(n) \right] = 0 \quad (6)$$

where $Z_t(n)$ is a vector of instruments (described in Sections 3.6 and 3.5). This exponential formulation, adopted from [Kojen et al. \(2024\)](#), avoids the Jensen's inequality bias inherent in the log-linear approximation used in [Kojen and Yogo \(2019\)](#) and accommodates the multiplicative structure of the demand model directly. The system is exactly identified (each characteristic

is either self-instrumented or has a dedicated instrument), so the GMM weighting matrix does not affect point estimates. Only investors with strictly positive holdings enter the estimation; the outside asset absorbs all positions outside the investor’s universe, including stocks with missing characteristics, the bottom 10% by NYSE market capitalization, and any unmatched CRSP–Compustat securities.

Because latent demand is correlated with prices and many investors hold few stocks, we follow the two-step procedure of [Koijen et al. \(2024\)](#). First, investors are pooled by institution type and AUM quantile, and group-level coefficients are estimated via nonlinear IV-GMM. Second, individual investor coefficients are estimated with a ridge penalty ($\lambda = 120$, $\xi = 0.7$, following the cross-validation in [Koijen et al. \(2024\)](#); Appendix F confirms insensitivity to these choices) that shrinks toward the group estimates, balancing bias against variance. Investors with at least 2,000 holdings are estimated via unrestricted GMM.

We also cap the price coefficient at $\hat{\beta}_0 \leq 0.99$ to ensure downward-sloping own-price demand. Stock elasticity aggregates investor responses using ownership and portfolio weights, as defined below.² The cross-sectional IXI–elasticity slope, the paper’s main finding, is insensitive to where the cap is set, moving only from -0.021 to -0.022 as the cap tightens from 0.90 to 0.99 (Table 30, Appendix F); the implied mean elasticity is similarly stable, between 0.39 and 0.36. We impose the constraint throughout because $\hat{\beta}_0 > 1$ would distort any level-dependent aggregation.

2.3 Demand elasticity

Demand elasticity varies across investors. Define investor i ’s vector of log share holdings as $\mathbf{q}_i = \log(A_i \mathbf{w}_i) - \mathbf{p}$. The investor’s demand elasticity is

$$-\frac{\partial \mathbf{q}_i}{\partial \mathbf{p}'} = \mathbf{I} - \beta_{0,i} \text{diag}(\mathbf{w}_i)^{-1} \mathbf{G}_i \quad (7)$$

Aggregate log share demand is $\mathbf{q} = \log(\sum_i A_i \mathbf{w}_i) - \mathbf{p}$. Its elasticity is

$$-\frac{\partial \mathbf{q}}{\partial \mathbf{p}'} = \mathbf{I} - \sum_{i=1}^I \beta_{0,i} A_i \mathbf{H}^{-1} \mathbf{G}_i \quad (8)$$

where:

$$\begin{aligned} \mathbf{H} &:= \text{diag}(\sum_i A_i \mathbf{w}_i) = \sum_i A_i \text{diag}(\mathbf{w}_i) \\ \mathbf{G}_i &:= \text{diag}(\mathbf{w}_i) - \mathbf{w}_i \mathbf{w}_i' \end{aligned} \quad (9)$$

²The estimator imposes the bound during estimation rather than truncating an unconstrained estimate afterwards. Across the 19,007 individual and ridge investor-years, $\hat{\beta}_0$ sits at the cap for 14.9%, mostly among concentrated portfolios where GMM noise generates extreme estimates. The 11.1% with $\hat{\beta}_0 < 0$ (elasticity above one) are economically permissible and left uncapped; these are the coefficients outside $(0, 1)$ reported in Section 4.2.

In this setting, demand elasticity depends on the market-capitalization coefficient $\beta_{0,i}$, which contains the investor's price response. Including IXI in equation 5 separates passive indexing from that response and changes the estimated $\beta_{0,i}$, especially for investors with heavily indexed portfolios (Section 4.2).

2.4 Passive ownership and elasticity: a mechanical benchmark

Passive ownership mechanically lowers demand elasticity even before imposing the demand system. The result follows from the identity for share demand, the definition of price elasticity, and the approximation that float-weighted benchmark weights move approximately one-for-one with prices while the active residual follows its own weight elasticity.

For investor i , dollar demand for stock n at time t is $A_{i,t}W_{i,n,t}$, where $A_{i,t}$ is total AUM and $W_{i,n,t} \in (0, 1)$ is the portfolio weight. Share demand is $Q_{i,n,t} = A_{i,t}W_{i,n,t}/P_{n,t}$. Taking logs, $q_{i,n,t} = a_{i,t} + w_{i,n,t} - p_{n,t}$, and the own-price elasticity of share demand is

$$\epsilon_{i,n,t} \equiv -\frac{\partial q_{i,n,t}}{\partial p_{n,t}} = 1 - \underbrace{\frac{\partial a_{i,t}}{\partial p_{n,t}}}_{\approx W_{i,n,t-1}} - \underbrace{\frac{\partial w_{i,n,t}}{\partial p_{n,t}}}_{\equiv \eta_{i,n,t}}, \quad (10)$$

where the wealth effect $\partial a_{i,t}/\partial p_{n,t} \approx W_{i,n,t-1}$ is small for any individual stock in a diversified portfolio and is absorbed into the active-elasticity term below (Davis, 2025).

Decompose the portfolio weight into a passive component tracking benchmark indices h and an active residual:

$$W_{i,n,t} = \sum_h \lambda_{i,h,t} W_{h,n,t} + (1 - \bar{\lambda}_{i,t}) W_{i,n,t}^{\text{act}}, \quad (11)$$

where $\lambda_{i,h,t}$ is the fraction of investor i 's AUM that passively tracks benchmark h , $W_{h,n,t}$ is the benchmark weight of stock n in index h , $W_{i,n,t}^{\text{act}}$ is the active residual weight, and $\bar{\lambda}_{i,t} \equiv \sum_h \lambda_{i,h,t}$. Define the stock-specific passive share of investor i 's position in stock n as

$$\phi_{i,n,t} \equiv \frac{\sum_h \lambda_{i,h,t} W_{h,n,t}}{W_{i,n,t}} \in [0, 1]. \quad (12)$$

This is the fraction of investor i 's holding of stock n that comes from benchmark indexing. It varies across stocks for the same investor: a stock that appears in many of investor i 's tracked benchmarks will have a higher $\phi_{i,n,t}$ than a stock that appears in none.

For float-weighted benchmarks, $W_{h,n,t}$ is approximately proportional to $P_{n,t}$, so the passive

weight response $\partial \log W_{h,n,t} / \partial p_{n,t}$ is approximately one.³ Define $\eta_{i,n,t}^{\text{act}} \equiv \partial \log W_{i,n,t}^{\text{act}} / \partial p_{n,t} < 0$: the active weight response, which is negative when active investors tilt away from stocks whose prices have risen. Differentiating the log weight and using the definition of $\phi_{i,n,t}$:

$$\eta_{i,n,t} \approx \phi_{i,n,t} + (1 - \phi_{i,n,t}) \eta_{i,n,t}^{\text{act}}. \quad (13)$$

Substituting into (10) and defining $\epsilon_{i,n,t}^{\text{act}} \equiv 1 - W_{i,n,t-1} - \eta_{i,n,t}^{\text{act}}$ as the elasticity that would obtain if the investor held only the active portfolio:

$$\epsilon_{i,n,t} \approx \epsilon_{i,n,t}^{\text{act}} - \phi_{i,n,t} (1 - \eta_{i,n,t}^{\text{act}}). \quad (14)$$

Since active investors tilt away from rising stocks ($\eta_{i,n,t}^{\text{act}} < 0$), we have $1 - \eta_{i,n,t}^{\text{act}} > 1$, and

$$\frac{\partial \epsilon_{i,n,t}}{\partial \phi_{i,n,t}} = -(1 - \eta_{i,n,t}^{\text{act}}) < 0. \quad (15)$$

Holding the active response fixed, investor-level demand elasticity for stock n is strictly decreasing in the stock-specific passive share $\phi_{i,n,t}$. As a larger fraction of investor i 's position in stock n is benchmarked, the investor absorbs more price movements passively, mechanically muting the demand response. No structural demand system is required for this result.

The identity also delivers a magnitude before any estimation. Aggregating $\phi_{i,n,t}$ to the market level, the value-weighted pure-passive share of U.S. equity rose from 2.6% in 2001–2003 to 18.2% in 2021–2023. Three-year window averages replace single-year endpoints because fund coverage in the first sample years is incomplete. Substituting these endpoints into equation (14) implies a relative decline in aggregate elasticity of about 16%, and this magnitude is essentially invariant to the assumed active response: across calibrations of η^{act} and the active elasticity that span the plausible range, the implied relative decline stays near 16%, because it is governed by the change in the passive share rather than by the level of active price sensitivity. This calibration implies a decline relative to its initial elasticity level. It is not the fraction of the observed elasticity decline explained by the mechanical channel.

This is a no-strategic-response benchmark: active investors' behavior (η^{act}) is held fixed. In practice active investors may adjust to the changing composition of the market, and if that adjustment is partially offsetting, as [Haddad et al. \(2025\)](#) find, the equilibrium decline is smaller than the pure mechanical prediction. The cross-sectional decomposition in Section 4.4 decom-

³The exact expression is $1 - W_{h,n,t}$. The approximation is accurate whenever stock n is a small fraction of the benchmark; for a stock that is 5% of an index, the error is 5 percentage points on the passive-weight response.

poses the estimated gradient while holding each investor’s price coefficient fixed: splitting the estimated elasticity into the active term ϵ^{act} and the passive-share term $\phi(1 - \eta^{\text{act}})$ of equation (14), the active-holder gradient is about half the total gradient, with the remaining difference reflecting the passive ownership mix. The mechanical derivation gives the direction and a benchmark magnitude; the demand system in Section 4 estimates investor-year price coefficients and their aggregation across stocks. The separate within-investor test in Section 4.4 allows price responsiveness to vary with a stock’s passive ownership.

3 Data

The demand system, the price instrument, and the elasticity regressions date holdings at the month a fund’s report becomes public. Three exhibits that date holdings to index events, the S&P 500 additions, the Tesla case, and the index-class decomposition, use report-month timing instead; their notes say so.

The estimation sample covers 2001–2023 at quarterly frequency. We combine three data sources (Appendix A). Investor stock holdings come from FactSet 13F reports; fund-level holdings, assets, and benchmark metadata come from FactSet; firm characteristics and short interest come from CRSP-Compustat (common stocks on NYSE, AMEX, and NASDAQ with share codes 10, 11, 12, and 18). IXI is computed from the holdings of all benchmarked ETFs and open-ended mutual funds, both index and active. Each fund is assigned to the benchmark its portfolio actually tracks, and its contribution to each stock is the component-wise minimum of holding and benchmark weight from Section 2, so only realized indexing enters the measure. Following Koijen and Yogo (2019), investors are classified into six groups from FactSet: investment advisors (including mutual fund managers), hedge funds, private banking, long-term investors (insurance companies and pension funds), brokers, and a residual household category.⁴ Because large asset managers (e.g., Vanguard, BlackRock) file 13F reports through subsidiary entities that may contain both index and active funds, the standard entity-level passive classification substantially understates the true passive capital share. We therefore construct a fund-based passive classification by linking each 13F entity to its ultimate parent through FactSet’s corporate structure database, identifying all funds under that parent, and computing the share of fund AUM managed by index funds (Appendix E, Section E.1).

⁴The household category is computed as residual ownership not accounted for by 13F institutions. This approach may overestimate household ownership due to confidential treatment requests and non-reporting by smaller institutions.

3.1 Characteristics

Dividends, profitability, investment, and book equity come from the merged CRSP-Compustat databases, constructed following [Kojien and Yogo \(2019\)](#). Investment is the annual log growth rate of assets, dividends-to-book is annual dividends per share times shares outstanding over book equity, and profitability is operating profits over book equity. Market beta is from a 60-month rolling regression of monthly excess returns on the market. All characteristics except IXI and dividends are winsorized at the 2.5th and 97.5th percentiles, dividends and IXI at the 97.5th. Table 1 summarizes them and their cross-sectional correlations.

Table 1. Characteristics summary statistics

Statistic	N	Mean	St. Dev.	Min	Pctl(25)	Median	Pctl(75)	Max
Market beta	371,810	1.19	0.79	-0.38	0.62	1.08	1.62	4.07
Investment	393,861	0.101	0.309	-0.862	-0.033	0.054	0.175	2.328
Book equity	394,254	1,996.15	9,312.48	0.00	69.45	246.31	967.26	303,082.00
Profitability	382,866	0.09	0.44	-3.15	0.02	0.17	0.28	1.18
Dividends to book equity	383,406	0.025	0.047	0.000	0.000	0.000	0.033	0.315
IXI	394,373	0.08	0.08	0.00	0.01	0.05	0.12	0.39
IXI ^{pass}	394,373	0.06	0.07	0.00	0.01	0.03	0.09	0.34
Market cap	413,452	5,054.30	31,113.36	0.11	117.05	489.00	2,126.23	3,035,216.96

Note: This table reports quarterly summary statistics of stock characteristics. The panel retains the last security-level observation in each calendar quarter. Market capitalization and book equity are in \$ millions; market capitalization equals price times shares outstanding divided by 10^6 , and book equity comes from Compustat. Dividends-to-book equity is computed as trailing-12-month split-adjusted dividends in dollars divided by book equity in dollars. IXI is the Active-Share-adjusted fund-sector measure; IXI^{pass} includes only self-declared index funds. The IXI rows are computed on the fund-only measure, with holdings dated by public availability, over CRSP-matched stock-quarters in 2001–2023; the characteristic rows are CRSP-Compustat objects that do not depend on the holdings construction and cover 2000–2023. The IXI maxima reflect winsorization at the 97.5th percentile within month.

3.2 IXI construction

Equations (1)–(2) are applied to U.S.-domiciled equity funds. We estimate monthly benchmark weights, assign funds to benchmarks using portfolio overlap, and cap each stock contribution at its reported position. Holdings become available under a 45-day disclosure convention, which places a month-end report into the measure two months later. A position is carried forward only until the fund’s first subsequent report that omits the security. Reports more than twelve months old account for about 0.1 percent of the resulting indexing dollars. Declared index funds and the benchmark overlap of active funds enter the baseline; non-fund institutions enter a separate extension.

The fund universe contains 18,908 funds with assigned benchmarks and 460 indices. The monthly measure covers January 2002 through December 2023 and contains 1,098,008 stock-months. The demand-estimation panel covers 2001–2023 under its quarterly mapping. Table 24

summarizes the fund universe. Appendix B describes the position and disclosure rules.

Table 2. Properties of IXI including the non-fund extension

	Full Sample	2001–2006	2007–2015	2016–2023	2022–2023
<i>Panel A: Descriptive Statistics</i>					
Avg IXI, %	8.1	3.2	7.5	13.7	14.2
Value-weighted avg IXI, %	19.2	10.0	15.7	23.9	26.0
Median IXI, %	5.0	1.5	6.3	11.7	10.9
SD of IXI, %	8.8	3.9	6.6	11.1	12.4
No. of distinct stocks	11,777	7,681	6,488	6,069	4,731
<i>Panel B: Composition of Aggregate IXI (%)</i>					
Pure passive funds	61.1	32.1	50.0	68.7	72.4
Benchmarked active funds	34.6	61.2	44.5	27.7	24.4
Other passive 13F institutions	4.3	6.8	5.5	3.6	3.2

This table reports an extended IXI measure that adds passive-equivalent holdings of non-fund 13F institutions to the fund-only measure used in the main analysis. The fund component combines declared index-fund holdings with the realized benchmark overlap of active funds, measured stock by stock as the smaller of the fund and benchmark weights. Summed across a fund’s normalized positions, this overlap equals one minus Active Share before position caps. Panel A reports the pooled cross-sectional distribution of IXI over stock-months in each subperiod, in percentage points; the value-weighted average weights stock-months by CRSP market capitalization. Panel B decomposes the aggregate IXI dollar numerator, summed over stock-months in each subperiod, into the contribution of pure passive funds (self-declared index funds), the index-overlapping portion of benchmarked active funds, and passive 13F institutions outside the fund sample; each entry is the component’s share of total IXI dollars. Fund holdings enter under the public-availability convention, which places month-end reports into IXI two months later. The non-fund component follows the benchmark-allocation method in Appendix D. Sample: CRSP-matched U.S. common stocks, monthly, 2001–2023.

Figure 1 plots the evolution of IXI including the non-fund extension. The average fund-only IXI across its stock-months is 8.2 percent, of which 6.3 percentage points come from declared index funds and 1.9 from active-fund overlap. These are unweighted stock-month means, not market-wide passive ownership shares. Table 2 reports the extended measure on the CRSP-matched stock-month sample, so its 8.1 percent average is computed on a different set of stock-months and is not nested in the fund-only figure.

IXI can rise when active funds move closer to benchmark weights, even without growth in fund assets. We separate changes in passive-equivalent AUM into changes in the assets of continuing funds, fund entry and exit, within-fund Active Share drift, and their interaction. In the weighted average of annual decompositions over 2001–2024, changes in continuing funds’ AUM contribute 96.5 percent, entry 4.4 percent, exits –3.0 percent, and the interaction 0.8 percent.⁵ Within-fund Active Share drift contributes only 1.3 percent and is negative in 2001–2009, at –1.7 percent. Growth in fund scale therefore outweighs changes in benchmark overlap within existing funds.

⁵Annual component shares are weighted by the absolute annual change in total passive-equivalent AUM.

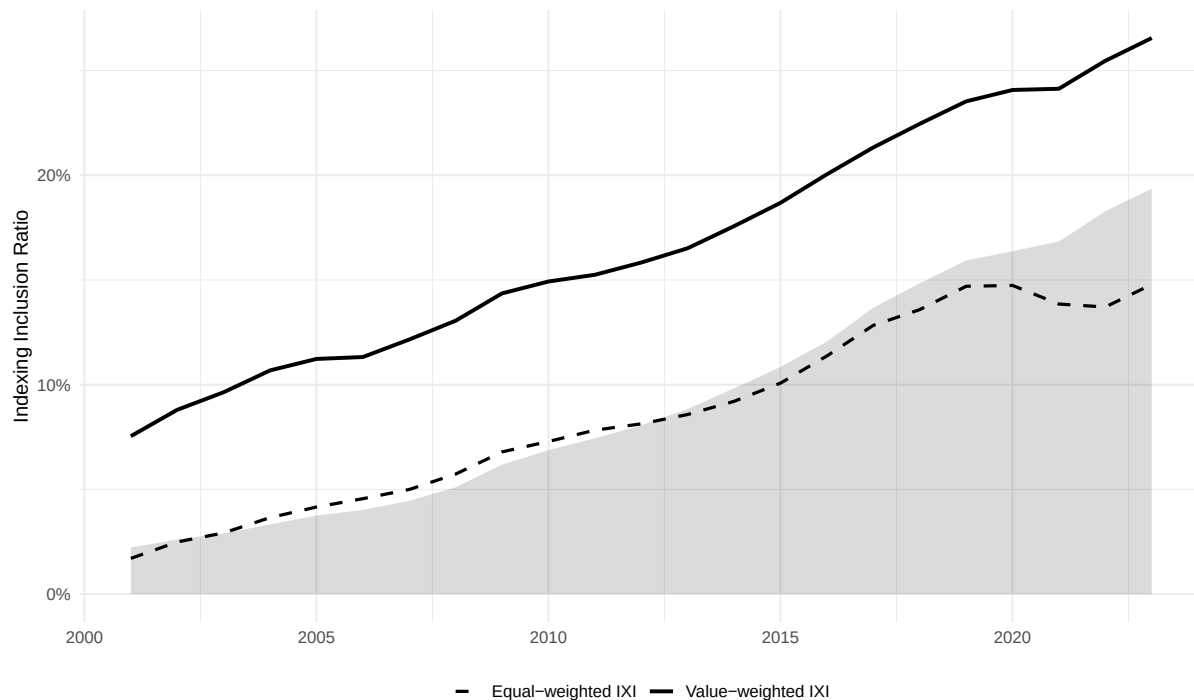


Figure 1. Evolution of IXI including the non-fund extension

Annual mean extended IXI across stocks, 2001–2023. Solid: value-weighted. Dashed: equal-weighted. Shaded area: the value-weighted contribution of declared index funds (pure passive); the distance between the shaded area and the solid line is the realized indexing inside nominally active funds plus the residual 13F branch.

High-IXI stocks are larger, more profitable, and pay higher dividends, consistent with the large-cap tilt of index benchmarks. Within every size quintile, however, the high-minus-low IXI spread remains approximately 18 percentage points, so IXI captures variation beyond market capitalization (Table 25, Appendix B).

Tesla illustrates how the fund component of IXI records discrete index assignments. Its Russell 3000 inclusion in 2011, Russell 1000 and NASDAQ-100 inclusions in 2013, and S&P 500 inclusion in 2020 each produce a visible jump in realized indexing in the inclusion month (Figure 2). Between events, declared index funds carry a growing share as benchmark trackers accumulate the stock.

IXI tilt differs across investor types (Figure 3). Hedge funds persistently underweight indexed stocks by roughly 1 to 3 percentage points. Brokers, private banks, and investment advisers remain near zero throughout, reflecting offsetting passive and active subsidiaries.

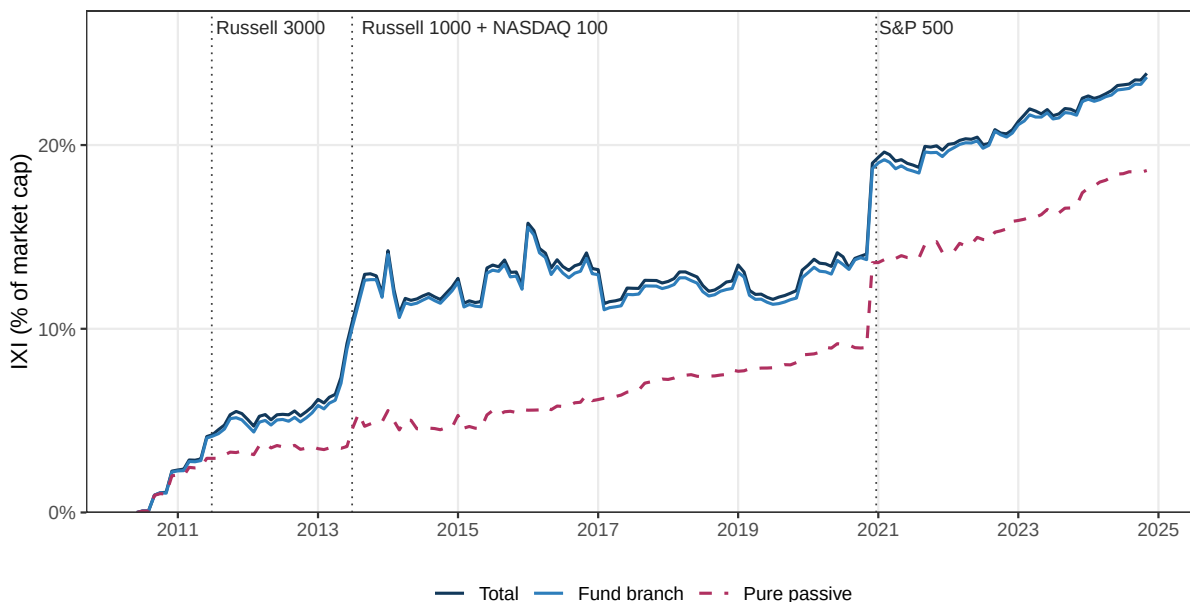


Figure 2. Evolution of Tesla IXI

Monthly IXI for Tesla as a share of market capitalization. Dark solid: extended IXI, including non-fund 13F institutions. Light solid: the fund-only measure used in the main analysis. Dashed: declared index-fund ownership. Dotted vertical lines mark index inclusion months. Holdings are dated at the report month.

3.3 Realized and attributed indexing

Benchmark exposure and realized indexing distinguish a manager’s incentives from their implementation in portfolios. Benchmarking Intensity in [Pavlova and Sikorskaya \(2023\)](#) assigns benchmarked capital at index weights; their empirical design allows partial implementation and instruments changes in actual ownership. On a common fund universe, we construct a full-benchmark attribution and compare it with the overlap each fund holds. About two thirds of attributed active-fund indexing lies outside realized overlap, between 62 and 69 percent across years (Figure 4). The remainder includes unheld constituents and the uncovered portion of underweight positions. Funds with Active Share below 20 percent realize about 90 percent of attributed indexing, while funds above 60 percent realize about one fifth.

For example, a fund with assets of \$100 and a benchmark weight of 10 percent in a stock has \$10 of attributed exposure. If its position is worth \$4, realized overlap is \$4 and the uncovered benchmark allocation is \$6. If it holds no position, the entire \$10 remains attributed exposure. These are measured exposures; the fund’s response to a change in the benchmark is an empirical question.

Exposure that funds do not implement does not move prices. The price design of Section 4.6

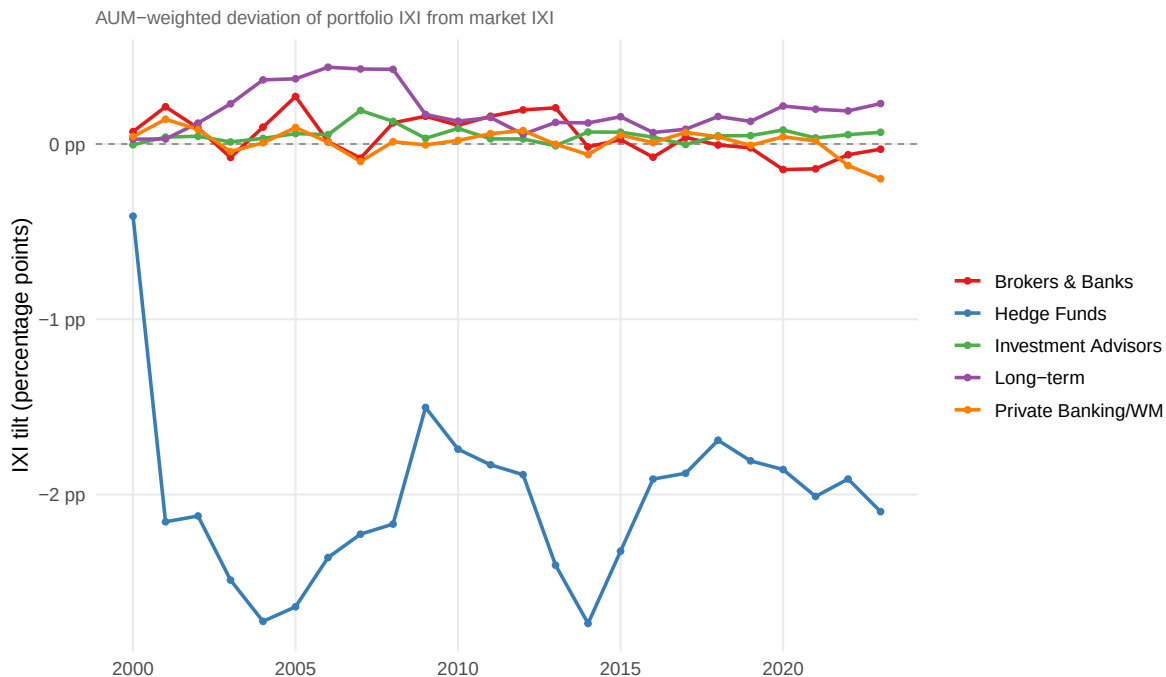


Figure 3. IXI tilt by investor type

AUM-weighted mean IXI tilt by FactSet investor type, 2001–2023. IXI tilt is portfolio-weighted IXI minus market-cap-weighted IXI. Positive (negative) values indicate overweighting (underweighting) of stocks with high IXI. The figure covers 11,134 of the 13,504 filing entities in the holdings universe.

instruments monthly changes in realized index-fund ownership, observed with the disclosure lag, with the equal-book shifter and relates them to returns over the exposure-change month and the preceding month. Adding the attributed-only component of the instrument tests whether unheld exposure carries a price response of its own. Its coefficient is 0.004 (standard error 0.015). If unheld exposure moved prices in the same proportion as held capital, the coefficient would be 0.078. The data reject that restriction at the one percent level, including the uncertainty in its estimated ingredients, while zero lies inside the confidence interval (Table 3). The price response to indexing demand belongs to the capital that reaches portfolios; a measure that counts unimplemented exposure spreads that response over dollars that do not carry it.⁶

The realized part of active portfolios also behaves like indexing. When a benchmark deletes a stock, the overlap positions of active funds move with the prescribed cut, while the same funds’

⁶The realized regressor is the one-month change in declared index ownership observed at $t + 2$. The attributed regressor is the cumulative change in total attributed indexing from $t - 1$ to $t + 2$. The restriction therefore compares these particular responses and timing conventions, not a universal per-dollar price effect of all unheld positions. The table is estimated on the stock-months where the attributed shifter is defined, so its realized coefficient and the estimate in Table 21 are the same specification on slightly different samples.

deviation positions do not (Table 15 in Section 4.3). The capital IXI counts inside active funds is the capital that follows the benchmark.

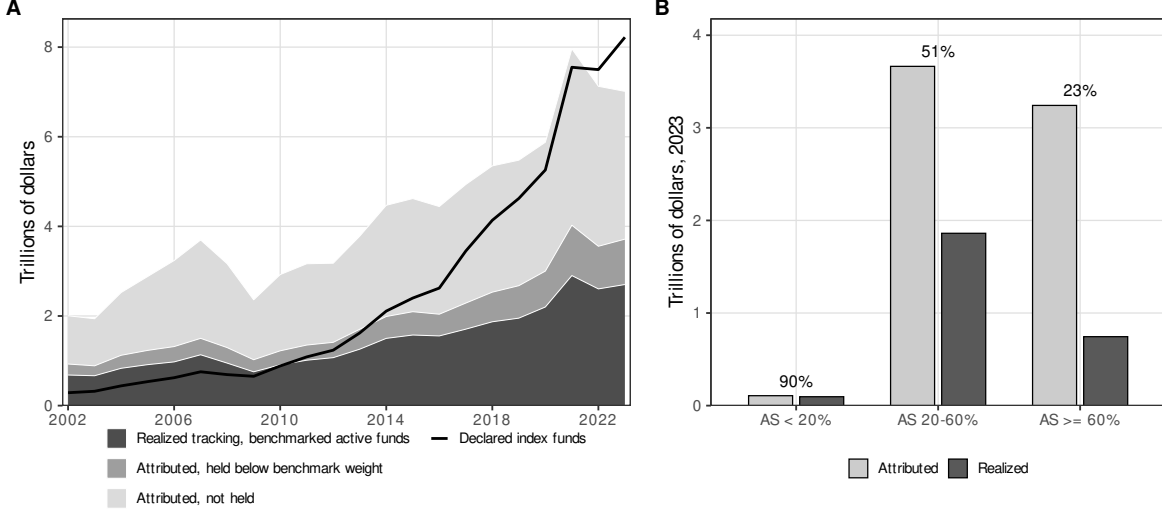


Figure 4. Attributed and realized indexing in benchmarked active funds

Panel A reports annual means of monthly aggregate indexing dollars, 2002–2023. The attributed remainder separates unheld constituents from uncovered benchmark weights in held positions. Declared index ownership is shown for scale. Panel B groups active funds by Active Share in 2023. Attribution allocates fund assets at benchmark weights; realized indexing uses observed overlap, subject to position caps. Holdings windows end when a later fund report omits the security.

3.4 Empirical estimation

The demand system is estimated for each investor i and year t using the exponential specification from equation (5). Two sources of endogeneity preclude the direct use of observed characteristics. First, latent demand $U_{i,t}(n)$ is correlated with asset prices through the cross-correlation of demand shocks across investors and through the price impact of large institutional investors such as Vanguard and BlackRock. Second, IXI contains market capitalization in its denominator (equation 1), creating a mechanical correlation with prices. We therefore construct instruments for both market capitalization and IXI, described in Sections 3.5 and 3.6, respectively.

Following Kojen et al. (2024), the market capitalization instrument is divided by the book value of equity to be consistent with the other characteristics. The demand equation for each investor i and year t is:

$$\frac{w_{i,t}(n)}{w_{i,t}(0)} = \exp\left(\alpha_{i,t} + \beta_{0,i,t} \widehat{m\epsilon}_t(n) + \beta_{1,i,t} \widehat{IXI}_t^{inst}(n) + \beta'_{2,i,t} x_t(n)\right) \cdot U_{i,t}(n) \quad (16)$$

Table 3. Price response to realized and attributed indexing

<i>Price impact of arriving passive flow, monthly panel, 2002 to 2022</i>			
	Estimate	Per SD (pp)	First-stage F
Attributed-only shifter, γ	0.0039 (0.0154)	0.023 (0.091)	50.5
Implied by realized impact only	0.0000	0.000	
Implied by constant-scaled attribution, $c\pi^*$	0.0777	0.460	
Contrast, $\gamma - c\pi^*$	-0.0739*** (0.0229)	-0.438 (0.136)	
p -value for $\gamma = c\pi^*$	0.0014		
Realized IV, β	8.809*** (1.869)	1.412	50.5
Attributed IV, c	1.312*** (0.222)		105.9
Attribution loading, π^*	0.0592*** (0.0087)		50.5
Realized IV without the shifter, β	8.978*** (1.557)	1.439	53.6
Observations	647,545		

Notes: The monthly panel includes stock and month fixed effects and lagged size, book-to-market, momentum, turnover, realized variance, and market covariance controls. The outcome is the cumulative log return over months $t - 1$ and t , the exposure-change month and its preceding month. The endogenous variable is the realized change in the pure-passive component of IXI measured at $t + 2$, allowing for the two-month disclosure convention, instrumented by z_t , the change in log equal-book index exposure with Active-Share-adjusted assets. The attributed-only shifter is $z_t^{\text{raw}} - z_t$, where z^{raw} uses full benchmarked assets under management, and it enters as a regressor.

Under the realized-only restriction, its coefficient γ is zero. Under the specified constant-scaled attribution restriction, it equals $c\pi^*$, with c the response of the same outcome to the total attributed change from $t - 1$ to $t + 2$ instrumented by z^{raw} and π^* the loading of the attributed change on the shifter in the same fit. The contrast carries a delta-method standard error that includes the estimation uncertainty of c and π^* . Per-standard-deviation magnitudes are in percentage points of the two-month return, per one standard deviation of the shifter for the first four rows and per one standard deviation of the fitted pure-passive change for the two realized coefficients. First-stage F statistics are cluster-robust Wald statistics. Standard errors are two-way clustered by stock and month.

***, **, and * denote significance at the 1%, 5%, and 10% levels. Standard errors are in parentheses.

where $\widehat{me}_t(n)$ is the instrumented log market-to-book equity, $\widehat{IXI}_t^{inst}(n)$ is the instrumented IXI from a first-stage projection (Section 3.6), and $x_t(n)$ includes log book equity, profitability, investment, dividends-to-book, and market beta.⁷ The coefficient $\beta_{1,i,t}$ on IXI captures the portfolio tilt of investor i toward more heavily indexed stocks: a negative β_1 indicates underweighting of stocks with high IXI relative to the benchmark, while a positive β_1 indicates overweighting.

The sample focuses on stocks in the top 90% of NYSE market capitalization, following [Kojien and Yogo \(2019\)](#), to avoid bias from smaller firms with incomplete data or missing IXI scores. The outside asset comprises the remaining 10% of firms along with any holdings that have missing characteristics or no match in the CRSP–Compustat universe. The demand system is estimated using the two-step ridge GMM procedure described in Section 2: investors with at least 2,000 strictly positive holdings are estimated individually via the full nonlinear GMM; smaller investors are pooled by institution type and AUM quantile, with a minimum of 500 positive holdings per estimation group. The estimation universe comprises 1,207 institutional estimation units, 734 large investors estimated individually and 473 synthetic pools of smaller entities, plus the household and short-interest sectors. Institution types are sourced from FactSet and include: Broker, Private Banking, Investment Advisor (including mutual funds), Long-term (pensions, endowments), and Hedge Funds. The household sector is constructed as a residual by subtracting aggregate institutional holdings from each stock’s market capitalization; in the rare cases where institutional holdings exceed market capitalization, all institutional positions are proportionally scaled back.

3.5 Market capitalization instrument

Because observed market capitalization reflects equilibrium prices that are jointly determined with latent demand, $me_t(n) = \ln ME_t(n)$ is endogenous in the demand equation. Following [Kojien and Yogo \(2019\)](#) and [Kojien et al. \(2024\)](#), we construct a “leave-one-out” instrument that replaces market capitalization with a measure derived from other investors’ holdings. For each investor i and stock n , the instrument is:

$$\widehat{me}_{i,t}(n) = \log \left(\sum_{j \neq i} A_{j,t} \cdot \frac{\mathbb{I}_{j,t}(n)}{1 + \sum_{m=1}^N \mathbb{I}_{j,t}(m)} \right) \quad (17)$$

⁷All right-hand-side characteristics, including $\widehat{me}_t(n)$, $\widehat{IXI}_t^{inst}(n)$, and $x_t(n)$, are measured at the end of quarter $t - 1$ (lagged one quarter) to ensure predetermination relative to the demand observation at t , following [Kojien and Yogo \(2019\)](#). The time subscript t on these variables denotes the demand observation period, not the measurement date.

where $A_{j,t}$ is investor j 's assets under management, $\mathbb{I}_{j,t}(n)$ is an indicator equal to one if stock n is in investor j 's investment universe (defined as stocks currently held or held in any of the previous 11 quarters), and the summation excludes investor i to avoid a mechanical link between the instrument and the investor's own demand. The denominator $1 + \sum_m \mathbb{I}_{j,t}(m)$ assigns equal weight to all stocks within investor j 's universe, ensuring that the instrument reflects the *breadth* of institutional interest in the stock rather than its market price.

To instrument log market-to-book equity, we subtract $\log BE_t(n)$ from this log instrument. Equivalently, the counterfactual market capitalization is divided by book equity before taking logs.

3.6 IXI instrument

Raw IXI is correlated with prices through market capitalization in its denominator and cap-weighted index weights in its numerator. We construct an equalized instrument that removes both sources of price-based variation while retaining cross-sectional variation from index membership and the capital tracking each index.

The instrument is defined as:

$$\widehat{ixi}_t(n) = \ln \left(\frac{\sum_{h=1}^H \tilde{A}_{h,t} \cdot w_{h,t}^{eq}(n)}{BE_t(n)} \right) \quad (18)$$

where $w_{h,t}^{eq}(n) = 1/N_{h,t}$ is the equal weight across all $N_{h,t}$ constituents of index h , $\tilde{A}_{h,t}$ is the Active-Share-adjusted assets tracking index h as in equation (2), and $BE_t(n)$ is the book value of equity. The instrument addresses both endogeneity channels: replacing market capitalization with book equity in the denominator eliminates the direct price link, while replacing cap-weighted index weights with equal weights removes the indirect correlation between index weights and market prices. The resulting measure, which we denote $IXI^{eq,full}$ in levels (so that $\widehat{ixi}_t(n) = \ln IXI_t^{eq,full}(n)$), reflects only the *extensive margin* of index inclusion, namely how many indices include a stock and how much aggregate capital tracks those indices, purged of any size-based variation within each index.

The construction parallels the market capitalization instrument in [Kojien and Yogo \(2019\)](#). Because index membership is not exogenous to market capitalization, the fully equalized construction captures only index *breadth* (how many indices include the stock) rather than within-index weights. The instrument is lagged one quarter to ensure predetermination.

3.6.1 Exclusion restriction and first-stage estimation

Because raw IXI is endogenous in the demand equation (it contains market capitalization in the denominator), we treat it analogously to how log market capitalization is treated in [Koijen and Yogo \(2019\)](#): the raw variable enters as a characteristic in the demand equation, but is instrumented using its equalized counterpart. Formally, the endogenous variable $\ln IXI_{t-1}(n)$ is projected onto $\widehat{ixi}_{t-1}(n)$ and controls via a first-stage OLS regression within each estimation group:⁸

$$\ln IXI_{t-1}(n) = \gamma_0 + \gamma_1 \widehat{ixi}_{t-1}(n) + \gamma'_2 x_{t-1}(n) + \eta_t(n) \quad (19)$$

where $x_{t-1}(n)$ includes log book equity, profitability, investment, dividends-to-book, and market beta. The fitted values $\widehat{IXI}_t^{inst}(n) = \hat{\gamma}_0 + \hat{\gamma}_1 \widehat{ixi}_{t-1}(n) + \hat{\gamma}'_2 x_{t-1}(n)$ then replace raw IXI in the demand equation as a pre-determined, exogenous characteristic.

At the stock-year level, the equalized instrument is significantly related to log IXI in 20 of 23 years (Table 34), with the exceptions in 2010 to 2012, and the partial R^2 of the equalized instrument for realized IXI, conditional on stock characteristics, is 0.04 in 2001 and 0.03–0.05 in recent years. The conditional first-stage coefficient is positive through 2008, near zero in 2010 to 2012, and negative thereafter. The demand system is estimated year by year, so the sign change does not weaken identification within a year, but it does mean that the instrument’s relation to realized IXI reversed over the sample. The two measures share index exposure, with price-based weighting removed from the instrument. Its role is to address mechanical price dependence, conditional on the exclusion restriction. We report the first stage by year rather than pooled because the instrument’s conditional relation to IXI shifts over the sample as index breadth and market capitalization decouple, so a pooled statistic averages across regimes. The Hausman comparison shows that instrumenting changes the estimates. The instrumented and raw coefficients differ investor by investor (paired $t = -23$ across 18,854 investor-years), their medians have opposite signs (-0.44 against $+0.02$), and the equal-weighted by-year raw path is indistinguishable from zero while the instrumented path is large and negative. The AUM-weighted means are close (0.10 against 0.11), so the correction operates on the distribution of investor coefficients, most visibly among smaller investors, rather than on the capital-weighted mean. These stock-level diagnostics do not establish identification in every investor-level equation. Exclusion also re-

⁸The log transformation requires $IXI > 0$. Stocks not included in any tracked benchmark ($IXI = 0$) are excluded from the IXI first stage; their demand is estimated using the base model characteristics only. Approximately 10% of investor-stock-quarter observations have zero or missing IXI, predominantly among smaller stocks near the bottom of the top-90%-NYSE-capitalization threshold.

quires the equalized measure to shift demand through realized passive ownership, conditional on controls, rather than through benchmark salience, institutional visibility, or index selection.

Two selection concerns motivate additional checks of the exclusion restriction. The first is institutional visibility. Stocks in more indices may attract more analyst coverage and broader institutional ownership, independently affecting demand elasticity. Appendix G addresses it by controlling for analyst coverage, bid-ask spread, trading volume, and turnover, and IXI retains 85% of its coefficient under the most stringent year $\times$ size-quintile specification. The second is index committee screening. S&P, Russell, and other committees screen for profitability, earnings quality, and float, creating selection on characteristics that may independently affect elasticity. The demand equation controls for profitability, dividends, and beta, and the double sort by IXI and profitability confirms the IXI–elasticity gradient within every profitability quintile. Instrument strength and external validation provide further evidence. The stock-level first-stage relation is statistically significant outside 2010 to 2012 (Appendix G), and the S&P 500 matched DiD provides independent validation from a different source of identifying variation.

The equalized instrument isolates variation in realized passive ownership from index breadth and benchmarked capital, purged of mechanical price-based variation. The demand-system estimates remain conditional on the exclusion restriction. The index-assignment event studies provide complementary evidence from a different source of variation.

4 Results

Realized passive ownership sharply ranks the cross-section of demand elasticity. High-IXI stocks are less elastic within size groups and within the same firm, and their active holders are also less price-sensitive. The evidence therefore points to ownership composition, the mix of holders and the sorting of active holders, as the main source of the gradient, with a within-investor response running in the opposite direction. The estimates are conditional on the exclusion restriction and the demand system’s substitution structure, so the relative gradients carry more weight than the absolute elasticity levels.

4.1 Demand estimation

We estimate the demand equation (16) annually from 2001 through 2023 using the fund-only IXI measure. All estimated equations converge. The investor aggregation uses 19,007 individual and ridge investor-year estimates across 1,207 institutional estimation units. AUM-weighted means

describe the allocation of capital; unweighted means and medians describe the distribution of investor-year coefficients. Table 4 distinguishes these statistics.

4.1.1 IXI demand coefficient over time

The AUM-weighted IXI demand coefficient is 0.11. The unweighted mean is -0.80 and the median is -0.44 (Table 4). The sign difference reflects the distribution of capital across investors: positive IXI coefficients receive more weight in the capital-weighted statistic. A negative coefficient for the typical investor therefore coexists with a positive aggregate tilt.

4.1.2 Heterogeneity across investor types

Because FactSet administrative types bundle passive and active funds under a single 13F entity, we use the fund-based passive classification of Section 3, the share of the parent company’s fund AUM in index funds, with entities lacking linked funds classified active (Appendix E).

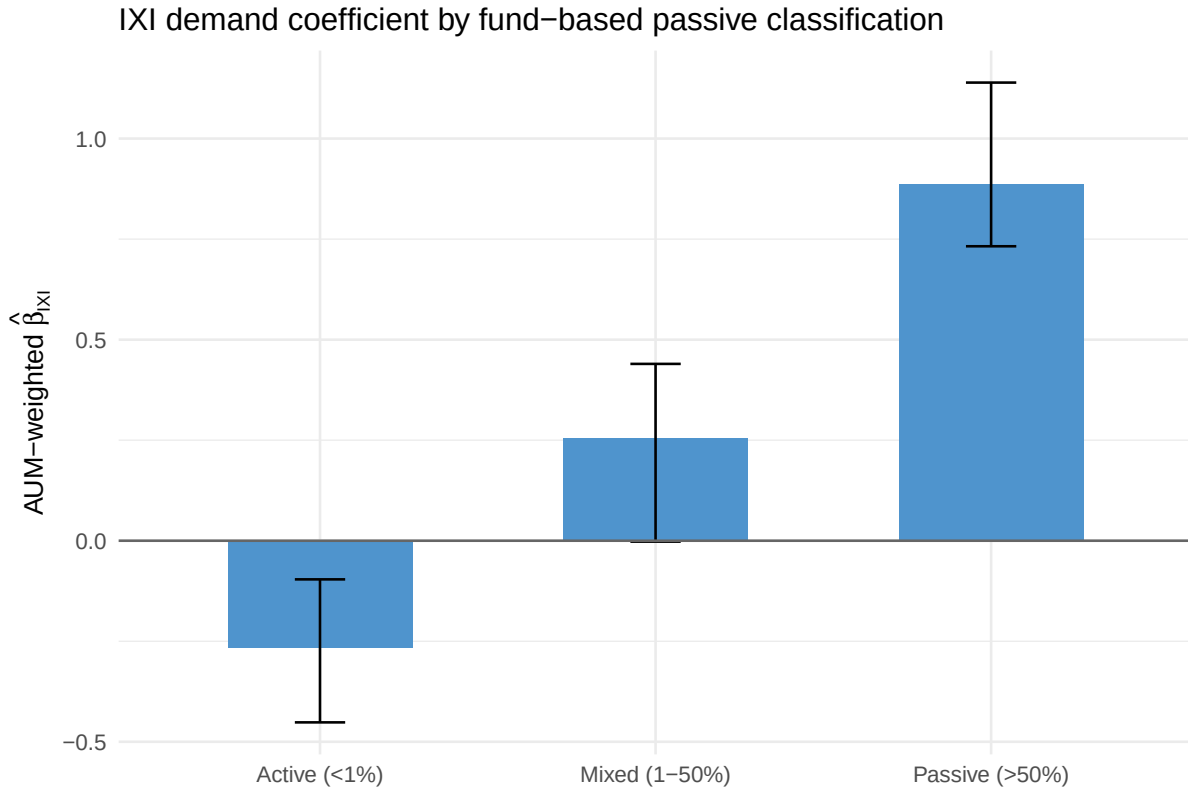


Figure 5. IXI demand coefficient by fund-based passive classification

AUM-weighted mean IXI demand coefficient ($\hat{\beta}_{IXI}$) by fund-based passive classification, with 95% confidence intervals. Passive: entities with $> 50\%$ of parent-company fund AUM in index funds. Active: entities with $< 1\%$ passive fund AUM (including entities with no linked funds). Mixed: 1–50%. Sample: 2001–2023.

The AUM-weighted IXI coefficient rises with investor passivity (Figure 5). Predominantly passive entities have a coefficient of 0.89, purely active entities -0.27 , and mixed entities 0.25. These opposing tilts produce an aggregate coefficient near zero. IXI therefore acts as a *sorting variable* for which stocks attract price-insensitive capital, not as a uniform demand shifter.

Table 4. Weighting and the distribution of demand coefficients

Statistic	IXI coefficient	Price coefficient
AUM-weighted mean	0.110	0.798
Unweighted mean	-0.796	0.450
Unweighted median	-0.439	
Investor-years	19,007	19,007

Notes: Individual and ridge investor-year estimates in the demand system with fund-only IXI, 2001–2023. Group estimates used only as shrinkage targets are excluded. The AUM-weighted mean describes the allocation of capital; the unweighted mean and median weight each investor-year equally. The IXI coefficient is the coefficient on instrumented log IXI, not a standardized percentage demand response. The price coefficient is β_0 and differs from stock-level aggregate elasticity.

4.1.3 Price sensitivity (β_0)

Including IXI changes the allocation of variation between passive ownership and the price coefficient. The demand system yields an AUM-weighted price coefficient of 0.798. Comparisons with a model estimated without IXI are useful for assessing the information added by the characteristic, provided the construction and estimation samples are held fixed. The external price comparison in Section 4.6 asks whether the resulting stock ranking predicts responses to a common tracker-demand change.

4.1.4 Panel regression: IXI as a demand characteristic

A pooled 13F regression provides a complementary estimate of IXI’s role relative to other characteristics:

$$\ln \frac{w_{i,t}(n)}{w_{i,t}(0)} = \beta_0 \widehat{m\epsilon}_t(n) + \beta_1 \text{ixi}_t(n) + \beta_2' x_t(n) + \alpha_{i,t} + \epsilon_{i,t}(n) \quad (20)$$

where $\alpha_{i,t}$ denotes investor-by-quarter fixed effects, observations are weighted by AUM, standard errors are three-way clustered by investor, stock, and quarter, log market-to-book is instrumented, and all variables are standardized within quarter. The estimation sample covers 53.7 million holdings of 1,207 investors in 8,700 stocks over 2001–2023.

Table 5. Demand panel estimation results

	<i>Dependent variable: $\ln(w_{i,t}(n)/w_{i,t}(0))$</i>				
	All 13F	2001–2012	2013–2023	Active (< 1%)	Passive (> 50%)
Log IXI	0.308*** (0.037)	0.276*** (0.035)	0.318*** (0.043)	0.136*** (0.024)	0.388*** (0.051)
Log market-to-book (IV)	1.200*** (0.036)	1.088*** (0.082)	1.230*** (0.036)	0.963*** (0.065)	1.225*** (0.051)
Investor $\times$ Quarter FE	Yes	Yes	Yes	Yes	Yes
AUM-weighted	Yes	Yes	Yes	Yes	Yes
Observations	53,703,036	23,110,945	30,592,091	39,294,300	5,261,413

Note: Estimates of equation (20). The dependent variable is the log ratio of the portfolio weight on stock n to the outside-asset weight. Log market-to-book is instrumented with the book-equity-based counterfactual market-equity instrument; characteristics (log book equity, profitability, investment, dividends-to-book, beta) are included in all columns and standardized within quarter together with log IXI. Observations are weighted by investor AUM; standard errors (in parentheses) are three-way clustered by investor, stock, and quarter. Columns (4)–(5) split by the fund-based passive classification (entities with no linked funds classified active). Sample: 2001–2023, on the fund-only IXI measure, with holdings dated by public availability. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

The IXI coefficient is 0.31 and stable across subperiods, at 0.28 in 2001–2012 and 0.32 in 2013–2023 (Table 5). It rises from 0.14 for purely active entities to 0.39 for predominantly passive ones, a threefold gradient in the capital-weighted tilt toward heavily indexed stocks.⁹ The interaction between IXI and the entity’s passive fund-AUM fraction yields the same ordering. Alternative specifications appear in Appendix I.

4.1.5 Demand decomposition and IXI share

IXI’s share of explained demand rises from 9.4 percent in 2001–2006 to 34.5 percent in 2016–2023, while the shares of price and book equity decline (Table 6). By the end of the sample, IXI explains more than one-third of the variation attributable to observable characteristics. Including IXI also reduces the dispersion of latent demand, especially among investment advisers and brokers. Appendix D reports the corresponding stock-level measure of IXI price pressure.

4.2 Demand elasticity

The aggregated price elasticity of demand for each stock follows from equation (8). The AUM-weighted average of the price elasticity for stock n is the n th diagonal entry:

⁹In this AUM-weighted pooled regression even the active group’s coefficient is positive, because the weighting emphasizes the largest active managers, whose holdings overlap heavily with indices. Equal-weighted, the active group’s pooled coefficient is near zero. The investor-level coefficients, which estimate each entity separately, show the typical active investor tilting away from stocks with high IXI (Figure 5). The capital-weighted and investor-level estimates therefore describe different margins.

Table 6. Demand variance decomposition by characteristic

	Price	Log BE	Profit.	Invest.	Div/BE	Beta	IXI
2001–2006	24.1%	56.3%	3.3%	2.3%	2.7%	1.9%	9.4%
2007–2015	22.6%	50.6%	3.2%	2.1%	2.0%	1.7%	17.8%
2016–2023	18.8%	40.4%	3.5%	1.4%	0.3%	1.2%	34.5%
Full sample	21.7%	48.5%	3.3%	1.9%	1.6%	1.6%	21.4%

Notes: Each cell reports the share of cross-sectional demand variance explained by a characteristic, computed as $|\hat{\beta}_k| \times \text{SD}(x_k) / \sum_j |\hat{\beta}_j| \times \text{SD}(x_j)$ following [Kojien and Yogo \(2019\)](#), averaged within each subperiod. Characteristic standard deviations are the pooled standard deviations of the estimation sample. IXI’s share rises from 9.4% in 2001–2006 to 34.5% in 2016–2023, while the shares of price and book equity decline. IXI is the fund-only measure, with holdings dated by public availability.

$$\text{Elas}_n = 1 - \frac{\sum_i \beta_{0,i} A_i w_i(n) (1 - w_i(n))}{\sum_i A_i w_i(n)} \quad (21)$$

where $\beta_{0,i}$ is the price coefficient from the demand system. The stock-year panel has an equal-weighted mean elasticity of 0.358. This is a mean across stocks, distinct from the AUM-weighted mean of investor coefficients and from a market-capitalization-weighted market elasticity.

The market-capitalization-weighted elasticity path declines over the sample (Figure 6). The investor estimates impose an upper price-coefficient cap of 0.99 and allow negative coefficients; 11.1 percent of the 19,007 investor-year coefficients lie outside $(0, 1)$. Absolute stock elasticity levels are therefore sensitive to estimation choices. The IXI regressions in Table 7 report the cross-sectional and within-firm relationships alongside the cap-sensitivity exercises in Appendix F.

Price sensitivity also differs sharply across investor types. Long-term investors and private banks have the highest β_0 values, while hedge funds have the lowest (Figure 13, Appendix F). The ordering is consistent with the buy-and-hold mandates and benchmark constraints of pensions and insurers and the more active strategies of hedge funds.

4.2.1 Size-dependent effects

Larger stocks have lower estimated elasticity on average. Figure 7 plots the annual paths by size quintile, and Table 11 reports the sort. The association is consistent with passive demand being concentrated in large stocks, as in [Jiang et al. \(2025\)](#), but size and realized indexing contain distinct information.

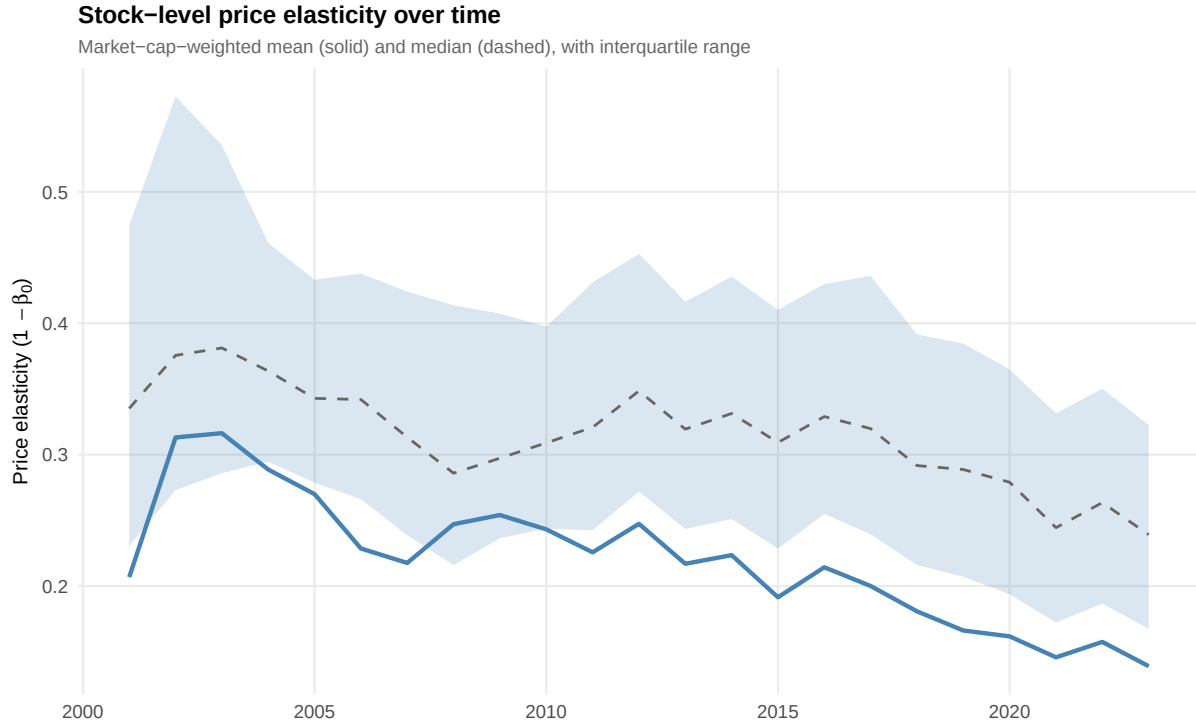


Figure 6. Stock-level price elasticity over time

Market-cap-weighted mean (solid) and median (dashed) of stock-level aggregated price elasticity, with interquartile range shaded. Sample: 2001–2023.

4.2.2 IXI versus size: identification tests

The central identification challenge is separating IXI from firm size. Stock-level elasticity is also generated by the estimated demand system, so analytic standard errors can understate sampling uncertainty. We address both issues with flexible size controls, within-firm specifications, a block bootstrap that recomputes elasticity, and an elasticity measure estimated without IXI. Appendices I and F provide the full inference and construction details.

Table 7. Realized indexing and elasticity with size and firm controls

	Year effects	Size controls	Firm and year effects
Log IXI	-0.0528*** (0.0028)	-0.0236*** (0.0028)	-0.0266*** (0.0032)
Observations	77,751	77,751	76,460

Notes: Stock-year regressions on the demand-system elasticity, 2001–2023. All columns include year effects; the second and third include log market capitalization and log book equity, and the third includes firm effects. Standard errors are clustered by stock and year, conditional on the estimated elasticity. Stars denote the 1, 5, and 10 percent levels.

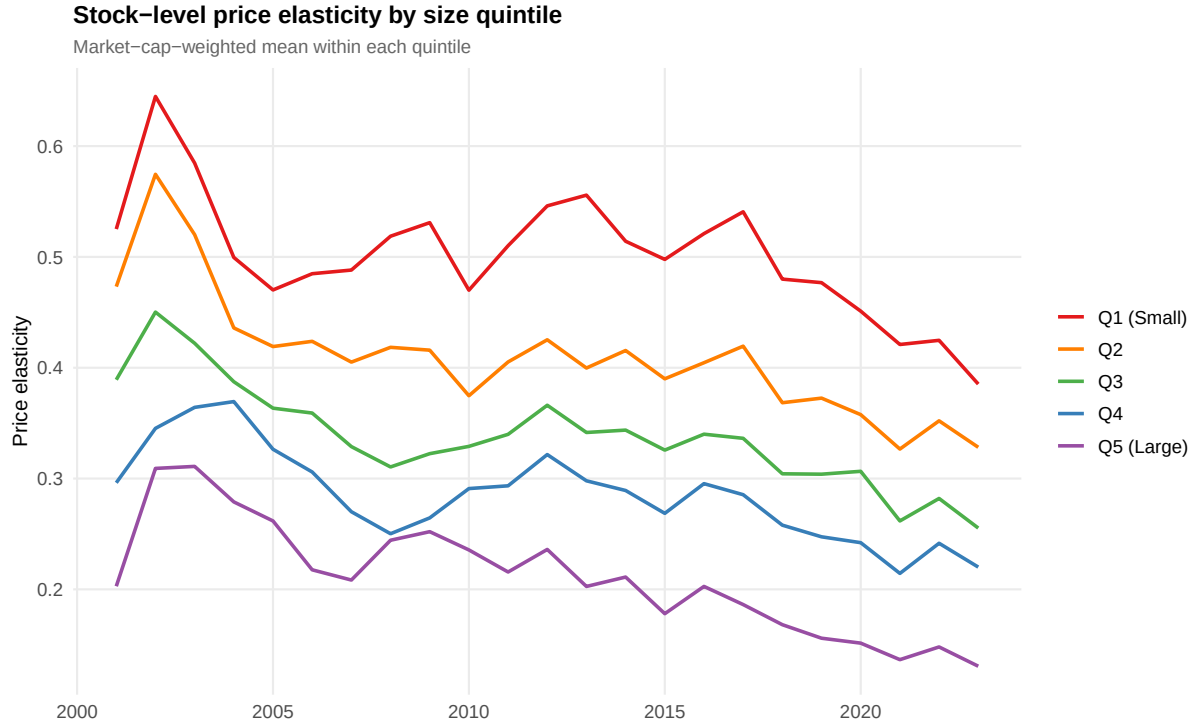


Figure 7. Stock-level price elasticity by size quintile

Market-cap-weighted mean stock-level elasticity by size quintile (Q1 = smallest, Q5 = largest), plotted annually. Sample: 2001–2023.

Table 8. IXI versus flexible size controls

This table reports the coefficient on $\log(\text{IXI})$ in regressions of stock-level aggregate price elasticity on $\log(\text{IXI})$, flexible size controls, and $\log(\text{BE})$, with year fixed effects (rows 1–9) or year + firm fixed effects (rows 10–11). Standard errors are double-clustered by stock and year. The final column reports the coefficient as a percentage of the baseline estimate. Sample: 77,751 stock-years (76,460 with firm fixed effects), 2001–2023, on the fund-only IXI measure, with holdings dated by public availability.

Specification	Size control	Firm FE	$\hat{\gamma}_{\text{IXI}}$	t -stat	N	% of baseline
Baseline	log ME	No	-0.0236***	-8.34	77,751	100%
Size ²	Polynomial (2)	No	-0.0229***	-8.75	77,751	97%
Size ³	Polynomial (3)	No	-0.0245***	-8.74	77,751	104%
Size ⁴	Polynomial (4)	No	-0.0237***	-8.33	77,751	101%
NS (5 knots)	Spline (5 df)	No	-0.0227***	-8.02	77,751	96%
NS (10 knots)	Spline (10 df)	No	-0.0226***	-7.96	77,751	96%
Quintile $\times$ Year FE	120 FE	No	-0.0231***	-9.55	77,751	98%
Decile $\times$ Year FE	240 FE	No	-0.0228***	-8.94	77,751	97%
Ventile $\times$ Year FE	480 FE	No	-0.0225***	-8.69	77,751	96%
Firm FE	log ME	Yes	-0.0266***	-8.21	76,460	113%
Firm FE + Quintile $\times$ Year FE	120 FE	Yes	-0.0297***	-11.35	76,460	126%

The elasticity regression gives a coefficient of -0.024 on $\log \text{IXI}$ after controlling for market capitalization, book equity, and year effects, and -0.027 with firm and year effects (Table 7).

Table 8 reports a wider set of size specifications. The gradient appears in several tables under different control sets and samples: with log market capitalization and year effects alone it is -0.022 , adding log book equity gives the -0.024 baseline, firm effects give -0.027 , and the smaller stock-year panel of Table 10 gives -0.017 . These are the same object under different controls and samples. The estimates establish that the negative relation persists within stocks over time.

Table 9. IXI-elasticity relationship within size quintiles

Regressions of stock-level price elasticity on $\log(\text{IXI})$, $\log(\text{ME})$, and $\log(\text{BE})$ with year fixed effects, estimated separately within each size quintile. Standard errors are double-clustered by stock and year. Q1 = smallest, Q5 = largest. Sample: 77,751 stock-years (76,460 with firm fixed effects), 2001–2023, on the fund-only IXI measure, with holdings dated by public availability.

	Q1 (Small)	Q2	Q3	Q4	Q5 (Large)
$\hat{\gamma}_{\text{IXI}}$	-0.0228*** (0.0042)	-0.0200*** (0.0040)	-0.0270*** (0.0050)	-0.0253*** (0.0044)	-0.0232*** (0.0037)
t -statistic	[-5.41]	[-4.98]	[-5.40]	[-5.76]	[-6.29]
N	15,561	15,546	15,546	15,546	15,552
Within R^2	0.016	0.034	0.046	0.068	0.076

The IXI coefficient is negative in every size quintile, ranging from -0.020 to -0.027 , with the largest estimate in the middle quintile and no monotone pattern across size groups (Table 9). The block bootstrap widens standard errors but preserves inference for the baseline, size-controlled, and within-firm specifications (Appendix I). Using elasticity from a demand model estimated without IXI produces the same sign and larger magnitudes in every size quintile (Appendix F). These comparisons show that the negative gradient survives flexible size controls and estimation of elasticity without IXI.

The Shapley-Owen decomposition in Appendix I attributes between 34% and 57% of the explained cross-sectional variation in elasticity to IXI in every sample year. IXI absorbs much of the variation otherwise attributed to book equity. This pattern is consistent with larger stocks attracting more price-insensitive capital through greater index exposure.

4.2.3 IXI and stock-level elasticity

To quantify how IXI maps into the cross-section of stock-level elasticity, we estimate:

$$\text{Elas}_{n,t} = \alpha + \gamma \log(\text{IXI}_{n,t}) + \delta' X_{n,t} + \mu_t + \epsilon_{n,t} \quad (22)$$

where $\text{Elas}_{n,t}$ is the aggregated stock-level price elasticity from equation (8), computed using

the investor-level coefficients from the IXI demand model. Because this elasticity is recovered from the estimated demand system, these regressions summarize how passive ownership maps into the model-implied elasticity distribution. The event-study evidence from S&P 500 additions (Section 4.5) provides complementary validation from outside the model.

We also estimate a first-difference specification following [Haddad et al. \(2025\)](#):

$$\Delta \log(\text{Elas}_{\text{agg},n,t}) = \gamma \Delta \log(\text{IXI}_{n,t}) + \delta' X_{n,t} + \mu_t + \epsilon_{n,t} \quad (23)$$

Table 10. Stock-level elasticity and passive ownership

	Levels			First differences		
	(1)	(2)	(3)	(4)	(5)	(6)
<i>Panel A: Dependent variable</i>						
		$\text{Elas}_{n,t}$			$\Delta \log(\text{Elas}_{n,t})$	
$\log(\text{IXI})$	−0.046*** (0.003)	−0.017*** (0.002)	−0.013*** (0.004)			
$\Delta \log(\text{IXI})$				−0.049*** (0.004)	−0.050*** (0.004)	−0.046*** (0.004)
$\log(\text{ME})$		−0.024*** (0.001)	−0.015*** (0.002)			
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Stock FE					Yes	
MC-weighted			Yes			
Controls						Yes
N	74,880	74,880	74,880	66,159	65,271	66,159
R^2	0.224	0.282	0.547	0.060	0.010	0.062

Notes: This table reports the relationship between stock-level price elasticity and passive ownership (IXI). Columns (1)–(3) regress the level of aggregated elasticity on $\log(\text{IXI})$ with year fixed effects; column (3) weights by market capitalization following [Haddad et al. \(2025\)](#). Columns (4)–(6) regress the annual log change in elasticity on the annual change in $\log(\text{IXI})$. Controls in column (6) include lagged log market equity and change in log market equity. Standard errors are two-way clustered by stock and year in columns (1)–(3) and clustered by stock in columns (4)–(6). Sample: 2001–2023. IXI is the fund-only measure, with holdings dated by public availability. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

In the level specification, the coefficient on $\log(\text{IXI})$ is −0.046 with year fixed effects, −0.017 after controlling for log market equity, and −0.013 under market-capitalization weighting (Table 10). Size absorbs much of the level relation, so the within-stock and within-firm evidence carries the interpretation. In first differences, the coefficient remains near −0.050 with stock fixed effects and lagged size controls. A 10 percent increase in a stock’s IXI is therefore associated with roughly a 0.5 percent decline in its aggregate price elasticity. A single-log specification provides a compact average magnitude: doubling IXI is associated with a decline in elasticity of

about 0.018 within firms over the sample. The estimate summarizes the average gradient and does not impose a saturation or steepening shape.

4.2.4 Cross-sectional incidence and persistence

IXI turns the aggregate decline in elasticity into a persistent stock-level ranking.

Stocks in the top IXI quintile have market-capitalization-weighted elasticity of 0.206, against 0.273 in the bottom quintile, a gap of about 25 percent (Table 11). The quintiles are formed within year, and the reported means pool stock-years. The profile is not monotonic: the fourth quintile is less elastic than the fifth. The continuous negative association survives size controls and firm effects.

Table 11. Realized indexing and stock demand elasticity

	Low IXI	2	3	4	High IXI
All stocks	0.273	0.262	0.205	0.186	0.206
Size quintile 1	0.516	0.467	0.437	0.389	0.335
Size quintile 2	0.466	0.408	0.377	0.358	0.334
Size quintile 3	0.375	0.351	0.325	0.322	0.307
Size quintile 4	0.287	0.308	0.271	0.268	0.270
Size quintile 5	0.232	0.206	0.183	0.177	0.199

Notes: Market-capitalization-weighted means of stock-year elasticity, 2001–2023, using the fund-only holdings measure. IXI quintiles use within-year empirical quantile cutoffs. The size rows intersect these IXI quintiles with size quintiles. The full sample contains 77,751 stock-years. The high-minus-low proportional gap is 24.7 percent. The table is a descriptive sort; the within-firm relation is estimated separately.

The IXI ranking remains related to elasticity several years ahead. The Spearman correlation between within-year IXI and elasticity ranks is -0.44 both contemporaneously and three years later. In a rolling comparison that fits earlier years and evaluates the next year’s cross section, adding IXI to size improves fit in 17 of 18 years, with modest gains. The exercise uses each evaluation year’s observed characteristics and within-year means, so it assesses held-out cross-sectional fit rather than a forecast available before that year.¹⁰

4.3 Architecture of realized indexing

IXI spans several index classes and includes benchmark overlap inside active funds. Class-level estimates locate the elasticity association across index products; position-level evidence tests

¹⁰The mean gain in held-out R^2 is 0.017 over 2006–2023. Both models use the same stocks and year-demeaned elasticity; one includes log size alone and the other adds log IXI.

whether overlap inside active funds behaves like indexed capital.

4.3.1 Index classes

Index classes differ in their association with demand elasticity. We decompose IXI into broad cap-weighted, sector or industry, factor or style, and thematic or niche contributions, with separate residuals for unclassified fund capital and the nonfund branch. Broad and factor-or-style exposure carry the association, at -0.013 and -0.014 per standard deviation in the joint specification, and their equality is not rejected; sector and thematic exposure have smaller coefficients per standard deviation, and equality with the broad class is rejected for both (Table 12). Broad exposure also predicts lower elasticity when entered alone. The association therefore sits in the broad and style layers, which hold about 84 percent of indexing dollars, rather than in the narrower products.

Table 12. Index architecture and demand elasticity

Index class	Indexing dollars (%)	Joint level	With controls	First difference	p : equal to broad
Broad cap-weighted	45.55	-0.0134 (-4.71)	-0.0111 (-4.38)	-0.0091 (-4.74)	0.003
Sector/industry	8.14	-0.0032 (-2.75)	-0.0021 (-1.83)	-0.0026 (-3.57)	
Factor/style	38.01	-0.0144 (-8.23)	-0.0134 (-7.89)	-0.0057 (-4.45)	0.485
Thematic/niche	3.32	-0.0028 (-2.89)	-0.0021 (-2.25)	-0.0027 (-2.87)	0.000
Observations		76,460	75,350	67,252	
Firm fixed effects		Yes	Yes	No	
Year fixed effects		Yes	Yes	Yes	

Notes. The dependent variable is stock-level demand elasticity. The indexing-dollar share is each class's share of the extended measure, including the nonfund branch, over the sample; the balance sits in the unclassified fund and nonfund residuals. The primary IXI measure uses the fund branch only. Class components are standardized to mean zero and unit variance within year and enter jointly with the unclassified fund contribution, the nonfund 13F contribution, and log market equity. The controlled specification also includes book-to-market, return volatility, turnover, and industry-by-year fixed effects. The first-difference specification uses annual changes and year fixed effects. Parentheses contain t -statistics based on standard errors double-clustered by stock and year. The final column reports equality tests against the broad cap-weighted coefficient in the controlled specification. Broad cap-weighted exposure is negative and significant when entered separately with firm and year fixed effects (-0.262 , $t = -4.12$).

Index class contributions are dated at the report month, the contemporaneous timing convention, so a position enters the decomposition in the month it was held; the elasticity outcome is the demand model estimated with holdings dated by public availability.

The class decomposition also shows the reach of indexing beyond broad indices. Broad cap-weighted indices account for 45.5 percent of indexing dollars and factor or style indices for

38.0 percent in this extended ownership measure (Table 12). The remainder includes sector and thematic indices, unclassified funds, and the nonfund extension. The negative elasticity association is therefore shared by broad and style exposure.

Outside broad indices, exposure comes through overlapping sector, style, and thematic products, many drawn from familiar broad parent universes. No single index becomes proportionally dominant.

4.3.2 Positions within active funds

The second decomposition splits IXI by position type. Declared passive capital enters as Pure Passive. For benchmarked active funds, the overlap between fund and benchmark weights is grouped descriptively into closet indexing (CI, Active Share below 20 percent), partial closet indexing (PCI, Active Share between 20 and 60 percent), and an active residual. The components use the same contribution rule and reproduce total IXI at every stock-month.

Table 13. IXI decomposition by fund type

	PP (%)	CI (%)	PCI (%)	Active (%)	AS branch (%)
<i>Panel A: Share of fund-based IXI</i>					
2001–2006	35.1	2.9	35.1	26.9	64.9
2007–2015	53.8	1.3	26.2	18.8	46.2
2016–2023	72.1	0.9	17.0	10.1	27.9
<i>Panel B: Composition of the Active Share branch</i>					
2001–2006	—	4.5	54.1	41.4	—
2007–2015	—	2.7	56.6	40.6	—
2016–2023	—	3.1	60.8	36.1	—
<i>Panel C: Average monthly dollar amount (USD trillions)</i>					
2001–2006	0.45	0.04	0.45	0.34	0.83
2007–2015	1.46	0.03	0.71	0.51	1.26
2016–2023	6.18	0.07	1.46	0.86	2.39

Note: Pure Passive (PP) contains declared index funds. Closet Indexing (CI), Partial Closet Indexing (PCI), and Active contain active funds with Active Share below 20%, between 20% and 60%, and at least 60%, respectively. Components are computed at the fund-stock-month level using the same allocation rule as IXI and sum to fund-based IXI. Panel A reports each component’s share of total fund-based IXI, Panel B its share within the Active Share branch, and Panel C its average monthly dollar amount. Components use fund holdings dated by public availability and sum to fund-only IXI in every stock-month. The sample is 2001–2023.

Every IXI component grows in dollar mass, but declared passive funds grow fastest (Table 13). Average monthly Pure Passive dollars rise from about \$0.4 trillion in 2001–2006 to \$6.2 trillion in 2016–2023, increasing their share of IXI from 35 to 72 percent. PCI dollars rise from \$0.4 trillion to \$1.5 trillion even as their share of total IXI falls. Within the benchmarked-active branch, however, PCI gains share at the expense of the fully active component. The CI and PCI cutoffs follow Cremers and Petajisto (2009) and are descriptive.

Benchmark overlap inside active funds also carries an elasticity association. Entered jointly with year effects, the declared-passive component enters at -0.031 and the closet and partial-closet overlap components at -0.019 and -0.007 , each negative and significant (Table 27, Appendix C). This is evidence that realized overlap inside active portfolios identifies inelastic ownership beyond a fund’s declared label. The association concerns model-estimated elasticity and does not itself establish mechanical trading.

Table 14. Position architecture inside active funds

Outcome or loading	Benchmark overlap	Active overweight	Difference
<i>Panel A: Turnover and persistence</i>			
Return-adjusted turnover	0.155	0.190	-0.036 (-46.87)
Stock-level persistence	0.807	0.642	0.165 (6.64)
<i>Panel B: Direct-flow pass-through</i>			
All flows	1.451 (2.56)	0.746 (6.98)	0.705 (1.30)
Inflows	1.710 (2.22)	0.603 (4.43)	1.107 (1.51)
Outflows	0.753 (7.47)	1.339 (12.55)	-0.586 (-4.58)

Notes. A position’s benchmark-overlap weight is the smaller of the fund and benchmark weights; active overweight is the positive residual. Panel A uses consecutive fund-quarter transitions with a stable benchmark, at least 5 percent of fund mass in each component, and at least 99 percent return coverage. Turnover is return-adjusted; its difference is paired within fund transition with fund-clustered inference. Persistence slopes come from stock-level current-on-lag component regressions with fund-transition effects and fund-and-quarter clustered inference. Panel B regresses position changes on direct CRSP fund flow interacted with lagged component weights, absorbing fund-by-quarter-transition and fund-by-stock fixed effects. Inference is clustered by economic fund and quarter. Parentheses contain t -statistics. The Panel A turnover difference becomes 0.0002 ($p = 0.832$) when the sample includes all transitions with both components positive; its AUM-weighted counterpart remains negative. The primary flow-loading difference is not significant, and outflows significantly reverse the predicted ordering. Fund benchmark assignments and weights follow Appendix B. The test uses holdings as reported, without carrying positions forward.

Benchmark overlap turns over less and persists longer than active overweight in the primary sample (Table 14). Return-adjusted turnover differs by -0.036 , and the persistence slopes differ

by 0.165. The turnover result is sample-sensitive: when all transitions with both components positive are included, the equal-transition difference is effectively zero, although the AUM-weighted difference remains negative.

Benchmark reconstitution prescribes the trade itself, and it prescribes it only for the tracked part of the portfolio. For active funds holding the same benchmark across consecutive quarters over 2011 to 2023, we measure each position’s response to the benchmark’s prescribed weight change at additions, deletions, and material reweights, net of buy-and-hold drift, within fund and event, splitting positions by pre-event overlap intensity into an overlap sleeve, where the benchmark-matched component is larger, and a deviation sleeve, where the active deviation is larger, so that classification never depends on the event itself. Deletions deliver the sharp contrast (Table 15). Overlap-dominant positions move with the prescribed cut, while the same funds’ deviation-dominant positions do not track it and lean slightly against, a within-fund difference in pass-through of 0.205 (standard error 0.031). Reweights of continuing constituents do not separate the sleeves, as expected, because a position held above benchmark weight still contains a benchmark-matched component that moves with the prescription. Additions cannot be scored on the overlap side, which does not exist before inclusion, and newly added names are not reliably bought through the active book.

Table 15. Position-level response to benchmark reconstitution inside active funds

	Overlap sleeve	Deviation sleeve	Difference
<i>Pass-through coefficient</i>			
Deletion	0.130*** (0.024)	-0.075*** (0.022)	0.205*** (0.031)
Reweight	0.062*** (0.016)	0.072*** (0.021)	-0.010 (0.025)
Addition		-0.029 (0.020)	

Note: Sample: active funds holding the same benchmark across consecutive quarters, 2011–2023. Events are the benchmark’s prescribed weight changes at the transition: additions and deletions at any magnitude and reweights of continuing constituents of at least 10 basis points. Each cell is the slope from regressing the fund’s change in a position’s weight, net of buy-and-hold drift, on the prescribed benchmark weight change, with fund-by-event fixed effects, equal weighted; standard errors in parentheses, clustered by fund. A position is in the overlap (deviation) sleeve if its pre-event overlap intensity is above (below) the within-transition median, so classification never depends on the event. The difference column comes from the joint interaction regression. The addition row has no overlap cell because a stock outside the benchmark has no overlap position before inclusion. Benchmark assignments and weights follow Appendix B. Observations: 127,998 and 180,615 (deletions), 618,407 and 979,525 (reweights), 285,604 (additions). * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

The within-fund evidence supports persistence of economically meaningful overlap and an association with benchmark deletion adjustments. It gives behavioral context to measured overlap without establishing full passive pass-through. A fund-flow test and a prediction comparison against plain position size, reported in Appendix H, do not sharpen the distinction.

4.4 Composition versus conduct

The broader point that investor composition matters for asset prices is established by [Koijen et al. \(2024\)](#). We therefore treat the decompositions below as corroboration of IXI’s stock-level ownership channel, not as a separate aggregate contribution. The mechanical benchmark of Section 2.4 gives the direction of the composition channel: capital committed to index weights does not respond to price, so a stock’s elasticity falls as that capital’s share of its float rises. What the data must establish is how much of the IXI gradient remains on the active side and whether the aggregate time series points in the same direction. Active investors could raise their own price sensitivity where indexing crowds in, unwinding the compositional effect, as the strategic response in [Haddad et al. \(2025\)](#) allows; or the measured gradient could reflect which stocks passive capital selects rather than whom it displaces.

Using the demand system’s investor-level price coefficients, we recompute each stock’s model-implied elasticity using all holders, holders below 50 percent passive fund AUM, and holders below 1 percent. The active-holder measure combines active investors’ price coefficients with the identities of the active investors who hold each stock; it is not a same-investor conduct experiment. Coefficients are measured in elasticity levels per log point of IXI, and the low-to-high IXI spread spans several log points.

The active side is flatter in IXI than total elasticity, by about half. Within the same firm, total elasticity falls by 0.026 per log point of IXI, while the active holder component falls by 0.012, and the strict active component by 0.010 (Table 16). Active holders are therefore less price sensitive in high IXI stocks, and the active side accounts for about half of the gradient. The rest is the ownership mix, since high IXI stocks are held more by investors whose demand follows benchmark weights. The S&P 500 addition shock points in the same direction. In simple matched additions, total and active holder elasticity fall by about the same amount (-0.022 and -0.019). A stacked matched event study reproduces the common post event decline and has a flat IXI pretrend, although pre-event differences remain in the elasticity leg.¹¹ Firm fixed effects

¹¹The stacked matched version compares each added stock to a never-added control matched on pre event size, IXI, elasticity level, and recent elasticity change, with cohorts stacked to avoid already-treated comparisons. Total and active holder elasticity fall together after addition, and the pre event path of realized IXI is flat. The active

absorb persistent differences across stocks, while changes in the identities and weights of their holders remain part of the composition measured here.¹²

Table 16. Composition versus active behavior in the cross-section

	Total elasticity	Active holders	Active holders (strict)
<i>Coefficient on log(IXI)</i>			
Year FE	-0.0218*** (0.0030)	-0.0107*** (0.0031)	-0.0086*** (0.0029)
Firm + year FE	-0.0258*** (0.0032)	-0.0124*** (0.0032)	-0.0104*** (0.0031)

Note: Each cell is the coefficient on log(IXI) from a regression of a stock-year elasticity measure on log(IXI) and log(ME), double-clustered by stock and year. “Total elasticity” aggregates the demand-system price coefficients over all holders of the stock; “Active holders” restricts the aggregation to entities below 50% passive fund AUM, and “strict” to entities below 1%. The active holder columns recompute elasticity within the active holder set, so they capture the active side of ownership rather than a pure same investor conduct experiment. The active holder gradient is about half the total gradient, so the ownership mix accounts for about half of the cross-sectional decline of elasticity in IXI and the sorting of active holders for the rest. IXI is the fund-only IXI measure, so a stock’s value reflects index membership already public at the time. Sample: 2001–2023. Standard errors double-clustered by stock and year with small-sample p-values. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

Ownership sorting provides a second composition measure. Because the demand system estimates an investor-year price coefficient, its ownership-weighted average varies across stocks with the identities and weights of their holders. The active holders of high-IXI stocks have higher average price coefficients. Regressing the ownership-weighted mean price coefficient of each stock’s active holders on IXI, within firm and year, gives a value-weighted slope of 0.138 and an equal-weighted slope of 0.387, both significant at the one percent level (Table 17). Active ownership reallocates toward less price-sensitive holders as indexing rises. The same sorting appears in price coefficients from the base model estimated without IXI, so it is not created by conditioning on passive ownership.

Classifying active holders by the passive share of their parent’s fund complex refines the sorting with one boundary. Among classified holders, the value-weighted slope for genuinely active holders is -0.114 , so the largest genuinely active managers of heavily indexed stocks

holder elasticity pretrend is not fully flat in this stacked exercise, so it is treated as validation of the ownership channel rather than as the main identification design; in the primary matched design of Section 4.5 the joint test does not reject zero elasticity pre-event coefficients ($F = 0.19$, $p = 0.83$).

¹²A cross-investor analogue of the Haddad et al. (2025) strategic-response parameter, which compares investors rather than stocks, is uninformative in this setting. It is driven by the sorting of elastic investors into elastic portfolios and an instrument that cannot be excluded from an investor’s own price sensitivity, so it does not identify the within-stock object. Appendix H reports it.

Table 17. Active-holder sorting across the IXI cross-section

	Slope on IXI	
<i>Mean price coefficient of the stock's active holders</i>		
All active holders, value-weighted	0.138***	(0.020)
All active holders, equal-weighted	0.387***	(0.021)
Genuinely active holders, value-weighted	-0.114***	(0.044)
Genuinely active holders, equal-weighted	0.317***	(0.032)
Closet-range holders, value-weighted	-0.022***	(0.006)

Note: Each row reports the coefficient on IXI from a stock-year regression of the ownership-weighted mean demand-system price coefficient of the stock's active holders on IXI, with firm and year fixed effects; standard errors in parentheses, clustered by firm. A higher price coefficient means less price-sensitive demand, so a positive slope says the active holders of heavily indexed stocks are less elastic. Value-weighted regressions weight stock-years by market capitalization. The genuinely active and closet-range rows classify active holders by the passive share of the parent's fund complex (below and above 10%); the classification covers about 55% of active ownership dollars, and these rows are computed on the classified holders. The value-weighted all-active slope has a two-way firm-and-year clustered t of 4.10. IXI is the fund-only IXI measure, so a stock's value reflects index membership already public at the time. Sample: 2001–2023; 64,882 stock-years (64,768 and 64,834 for the classified subsets). * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

carry somewhat lower price coefficients, a tilt toward more price-sensitive ownership. Equal-weighted the same slope is +0.317, so the typical genuinely active holder of those stocks is less price-sensitive, and holders in the closet-indexing range carry a small negative value-weighted slope (−0.022). The classification covers about half of active ownership dollars, and much of the positive value-weighted slope sits among the unclassified remainder. The net pattern remains reallocation toward less price-sensitive ownership.

The offset mechanism also has a within-investor implication that the holdings panel can test. In [Haddad et al. \(2025\)](#), the same investor becomes more price-elastic in a stock when the other capital in that stock becomes less elastic, so an active investor's price coefficient should be lower in stocks with higher passive ownership. Table 18 adds the interaction of instrumented log market-to-book with log IXI to the holdings-panel regression of Table 5, within investor and quarter, for the active fund complexes that can be classified from their linked funds. The answer depends on how IXI is treated. With realized IXI as a regressor, the interaction is positive (0.29, standard error 0.10): the same complex's price coefficient is higher in heavily indexed stocks. Instrumenting IXI with the equalized allocation, as the demand estimation does, reverses the sign (−0.14, standard error 0.05, first-stage F of 166), and the same instrumented interaction is not statistically significant for predominantly passive complexes or for all investors together. Under the maintained instrument assumptions, active complexes

are therefore more price-elastic in stocks whose index exposure is higher, by about 0.25 in the price coefficient between the tenth and ninetieth percentiles of IXI, the direction of the strategic substitution HHL estimate. The sign change makes the treatment of IXI material to the interpretation. We use the instrumented specification, while the appendix reports a curvature check whose negative interaction is imprecisely estimated. The test identifies the direction of a within-investor response, not its structural magnitude. The composition results of this section hold each investor’s price coefficient fixed within the year, so they measure where passive capital sits and who holds those stocks; they do not incorporate this response.

Table 18. Within-investor conduct: price coefficients and passive ownership across stocks

Investor group IXI treatment	<i>Dependent variable: $\ln(w_{i,t}(n)/w_{i,t}(0))$</i>			
	(1)	(2)	(3)	(4)
	Active complexes Realized	Active complexes Instrumented	All 13F Instrumented	Passive complexes Instrumented
Log market-to-book (IV), β_0	1.297*** (0.100)	1.021*** (0.089)	1.022*** (0.062)	1.182*** (0.077)
Log market-to-book $\times$ Log IXI (IV)	0.293*** (0.096)	−0.141** (0.055)	−0.036 (0.035)	−0.004 (0.043)
Log IXI	0.200*** (0.034)	0.265*** (0.093)	0.464*** (0.089)	0.413*** (0.131)
Reduced-form interaction		−0.125*** (0.017)	−0.043** (0.020)	
First-stage F , log market-to-book	1,089	756	565	692
First-stage F , interaction	16.4	166	99	172
First-stage F , log IXI level		279	546	399
Investor $\times$ Quarter FE	Yes	Yes	Yes	Yes
AUM-weighted	Yes	Yes	Yes	Yes
Investors	252	252	1,207	109
Observations	8,585,676	8,304,741	52,081,322	5,099,989
Implied $\Delta\beta_0$, p90 vs. p10 log IXI	0.55	−0.25	−0.07	−0.01

Note: Estimates of equation (20) extended with the interaction of log market-to-book and lagged log IXI. The dependent variable is the log ratio of the portfolio weight on stock n to the outside-asset weight; characteristics (log book equity, profitability, investment, dividends-to-book, beta) are included and standardized within quarter together with log IXI. Log market-to-book is instrumented with the book-equity-based counterfactual market-equity instrument. In column (1) realized lagged log IXI enters as a regressor and the interaction is instrumented by the product of the market-equity instrument and realized log IXI. In columns (2) to (4) realized log IXI is treated as endogenous, as in the demand estimation, and instrumented by the equalized (equal-index-weight, book-scaled) log IXI; the interaction is instrumented by the product of the market-equity instrument and the equalized measure. Active complexes are 13F filers with linked funds and less than 1 percent of fund assets in index funds; passive complexes have more than 50 percent. Observations are weighted by investor AUM; standard errors (in parentheses) are three-way clustered by investor, stock, and quarter. [Haddad et al. \(2025\)](#) predict a negative interaction for active investors: the same investor should be more price-elastic where the other capital in the stock is less elastic. Predominantly passive complexes provide a comparison group with a larger share of assets tied to index weights. The last row multiplies the interaction by the gap between the 90th and 10th percentiles of standardized log IXI. ***, **, *: significance at 1, 5, and 10 percent.

The supporting base-model decomposition addresses the aggregate time series. Did the two-decade decline in measured price sensitivity come from capital reallocation toward passive

entities, or did active investors themselves become less price-elastic? Following the approach suggested by [Davis et al. \(2026\)](#), we classify each 13F entity by the share of its parent company’s fund AUM in index funds and decompose the change in the aggregate AUM-weighted price coefficient between 2001–2003 and 2021–2023 into a between-group (composition) and within-group (behavioral) component. The decomposition is computed on the base model estimated without IXI, so that the price coefficient measures raw price responsiveness without separately conditioning on passive ownership. Its investor-year coefficient averages across stocks and does not identify the stock-specific strategic response estimated by [Haddad et al. \(2025\)](#).

Table 19. Composition versus behavioral change in the aggregate price coefficient

	Total $\Delta\bar{\beta}_0$	Composition	Behavioral
Base model (no IXI) bootstrap s.e.	0.0659	0.0652 (99%) (0.0184)	0.0007 (0.0283)
Model including IXI	0.1293	0.0413 (32%)	0.0880

Note: Oaxaca-Blinder decomposition of the change in the AUM-weighted aggregate price coefficient between 2001–2003 and 2021–2023 into between-group (composition) and within-group (behavioral) components. Groups by fund-based passive classification (passive > 50% of parent fund AUM in index funds, active < 1%, mixed between; entities with no linked funds classified active). Bootstrap standard errors from 500 entity-level resamples. The base-model row decomposes the price coefficient estimated without IXI, an investor-level average that does not separately identify the stock-specific strategic response in [Haddad et al. \(2025\)](#); the second row decomposes the coefficient from the model that includes IXI, where conditioning on passive ownership shifts part of the change into the within-group component. Estimates use the fund-only IXI measure, 2001–2023, with holdings dated by public availability.

In this decomposition, composition accounts for almost all of the change. Capital reallocation from active to passive entities accounts for 99% of the aggregate change (+0.065, entity-bootstrap s.e. 0.018), and the within-group behavioral component is near zero (+0.001, s.e. 0.028; Table 19). The change in average price responsiveness within these groups is imprecisely estimated. It need not track the stock-specific response in the holdings interaction test. The split also holds without shrinkage. Restricted to entities estimated individually, with no pooling and no ridge, composition still accounts for 75 to 85 percent of the change and the behavioral component remains statistically zero.¹³¹⁴

¹³On the 741 entities estimated individually in the base model (the IXI model estimates 734 individually), composition is +0.052 of a +0.070 total (bootstrap s.e. 0.014) and the behavioral component is +0.017 (s.e. 0.020); on the strictest cut, entities estimated by unrestricted GMM with no ridge, composition is 85% and the behavioral component is +0.009 (s.e. 0.020).

¹⁴Conditioning changes the split. Decomposing the price coefficient from the model that includes IXI attributes a substantial positive component to within-group movement, because once stock-level passive indexing is a separate

4.4.1 Decomposing the decline in aggregate elasticity

The stock-level gradient also has a meaningful aggregate counterpart. The mechanical benchmark of Section 2.4 implies a relative decline of about a sixth from the change in the passive share alone. The decomposition holds other prices and estimated demand parameters fixed, isolating the partial-equilibrium contribution of passive ownership rather than a full general-equilibrium response.

The most direct quantification uses within-stock variation. Applying the first-difference estimate of Table 10 ($\gamma_{FD} = -0.049$) to the growth in cap-weighted realized IXI from the 2001–2003 average to the 2021–2023 average attributes 8.3% of the decline in cap-weighted elasticity to growth in realized passive ownership.¹⁵

The decomposition in levels following Haddad et al. (2025) equation (29) is complementary (Table 20 and Figure 8). Holding individual elasticities fixed, reallocation toward passive, low-elasticity investors accounts for 32% of the aggregate elasticity decline from the 2001–2003 average to the 2021–2023 average, and growth in realized indexing demand at the estimated slope accounts for a further 16%, a share of the observed decline that is distinct from the 16 percent relative decline of the mechanical benchmark. The two mechanical components leave about half of the realized decline as a residual that collects both active adjustment and all non-IXI forces. Because each investor’s price coefficient is fixed within the year, this decomposition holds conduct fixed. It is the no-response benchmark of Haddad et al. (2025), and the pass-through of the non-indexed share into stock elasticity is accordingly about one in this system (Appendix H, Section H.3). The within-investor response of Section 4.4 is not part of it. The residual also contains changes in investor-year price coefficients and other non-IXI forces; it does not separately identify strategic conduct. The passive share of AUM in the estimation universe rises from about 11% in 2001–2003 to about 33% in 2021–2023, the investor-side counterpart of the composition result above.

The ownership decomposition distinguishes declared passive funds from overlap inside active portfolios. Declared passive funds account for a growing share of indexing dollars, while partial closet indexing gains share within the active-fund branch (Table 13). These dollar shares describe the sources of measured indexing and are distinct from the contributions to the elasticity decline.

demand channel, the remaining active price coefficient drifts up late in the sample. The base-model decomposition avoids conditioning on IXI, but neither version identifies HHL’s strategic-response parameter. The conditional version is reported in Appendix E.

¹⁵Base and end are three-year averages, the convention of the composition decomposition in Section 4.4, so that no single year sets the comparison. The first estimation year is unusual (cap-weighted elasticity 0.21 in 2001 against 0.31 in 2002), and a single-year base moves the attribution between 6 and 15 percent.

Table 20. Decomposition of aggregate elasticity decline

	Year					
	2001	2005	2010	2015	2020	2023
<i>Panel A: Key variables</i>						
Aggregate elasticity	0.210	0.271	0.244	0.192	0.162	0.139
Mean IXI	0.077	0.105	0.147	0.187	0.244	0.268
Passive share	9.8%	14.5%	17.6%	24.2%	31.8%	33.6%
<i>Panel B: Cumulative change from the 2001–2003 base</i>						
Total change	-0.0702	-0.0095	-0.0362	-0.0883	-0.1182	-0.1412
Extensive margin	0.0031	-0.0061	-0.0121	-0.0251	-0.0400	-0.0434
IXI channel	0.0034	-0.0030	-0.0108	-0.0146	-0.0202	-0.0215
Residual	-0.0767	-0.0004	-0.0132	-0.0486	-0.0581	-0.0763
<i>Panel C: Cumulative contribution as share of total 2001–2003 to 2021–2023 change</i>						
Extensive margin	-2%	5%	9%	19%	30%	33%
IXI channel	-3%	2%	8%	11%	15%	16%
Residual	58%	0%	10%	37%	44%	58%
2001–2003 to 2021–2023 window	Extensive margin 32%, IXI channel 16%, residual 52%					

Notes: This table decomposes the change in market-cap-weighted aggregate stock-level price elasticity following [Haddad et al. \(2025\)](#) equation (29). *Extensive margin*: change attributable to the growing share of passive (low-elasticity) investors, holding individual elasticities at their 2001–2003 average values. *IXI channel*: change attributable to the growth of the Indexing Inclusion Ratio, computed as $\hat{\gamma} \times \Delta \log(\text{IXI})$ where $\hat{\gamma} = -0.017$ from Table 10 column (2). *Residual*: the remaining change, including movements in investor-year price coefficients, composition among active holders, and other non-IXI forces. It does not separately identify a strategic response. Panel C reports each channel’s cumulative contribution through year t as a percentage of the total 2001–2003 to 2021–2023 change in aggregate elasticity, so entries answer how much of the eventual decline the channel had delivered by year t ; early-year entries can be small or negative because aggregate elasticity briefly rose before declining. The base is the 2001–2003 average and the end point the 2021–2023 average, rather than single years, so that no single unusual year sets either end of the comparison; annual entries are measured against the base-window averages, and the reported full-sample shares use the end-window average, so the final annual column need not equal them. IXI is the fund-only measure, with holdings dated by public availability. The IXI channel captures approximately 16% of the total elasticity decline over the full sample.

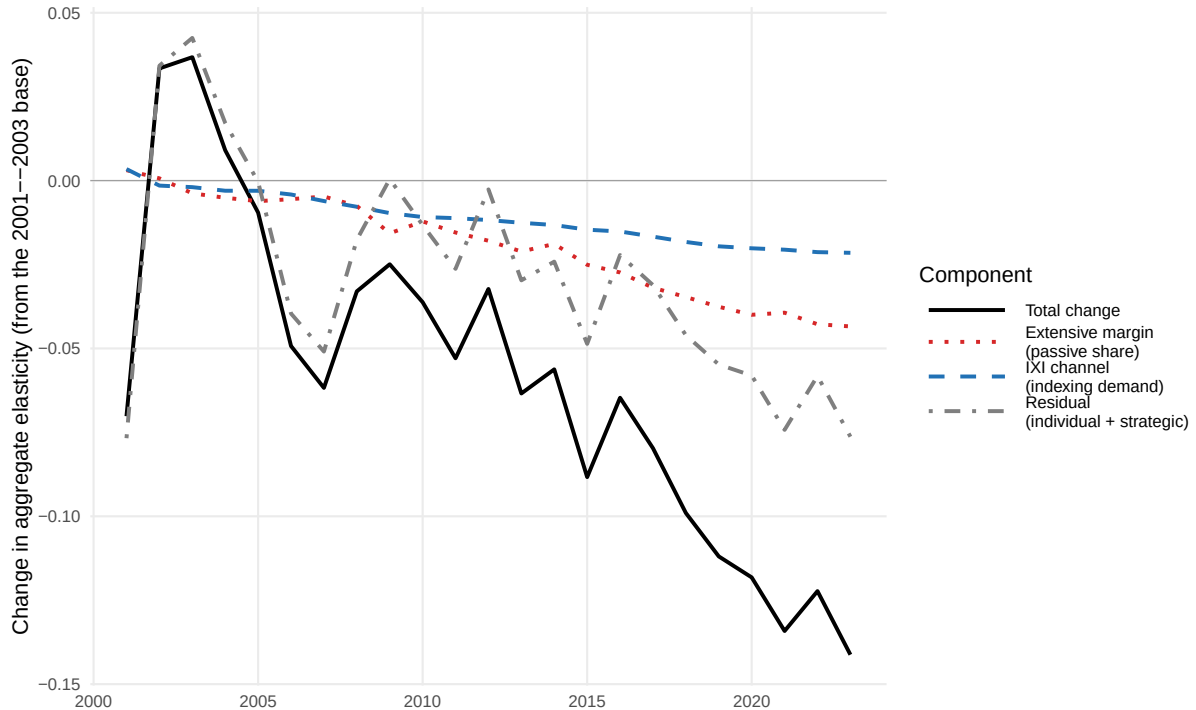


Figure 8. Decomposition of aggregate elasticity change

Cumulative change in market-cap-weighted aggregate stock-level price elasticity, decomposed following [Haddad et al. \(2025\)](#) equation (29) into investor composition (the passive share), the IXI channel (IXI growth at the estimated slope), and residual changes (active-side adjustment and non-IXI forces). Sample: 2001–2023; cumulative changes are measured from the 2001–2003 base average, and the reported shares compare the 2021–2023 average with it.

4.5 Event-study evidence: S&P 500 additions

S&P 500 additions provide a separate source of variation in realized indexing. Added stocks attract index-fund demand, and we compare their ownership and model-implied elasticity with those of matched non-added stocks. The design relies on parallel trends conditional on the matching variables; it does not use a discontinuity in index eligibility.

Each addition (2002–2022) is matched to a control stock from the same year with similar size (± 0.5 log market equity) and the closest pre-event IXI, yielding 163 matched pairs. Figure 9 traces the dynamic difference-in-differences coefficients in event time. IXI rises by 1.3 percentage points in the addition year and 1.7 percentage points one year after, and the new level is stable through year three; a joint test does not reject zero pre-event coefficients (years -3 and -2 : $F = 1.52$, $p = 0.22$). Model-implied elasticity declines by 1.1 percentage points in the addition year, 1.9 points the year after, and 2.5 points by year three; the corresponding pre-event test also does not reject ($F = 0.19$, $p = 0.83$). Holdings in this exhibit are dated at the report month, so

the IXI response is contemporaneous with inclusion; elasticity comes from the annual demand system.

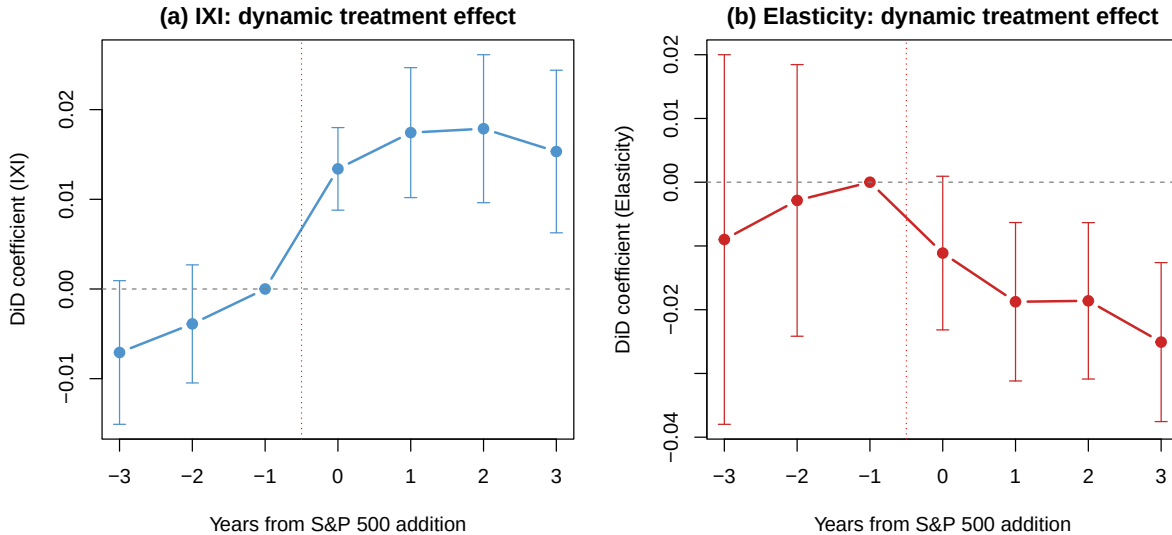


Figure 9. S&P 500 additions: dynamic treatment effects

Event-time difference-in-differences coefficients for IXI (left) and model-implied elasticity (right), relative to event year -1 , with 95% confidence intervals clustered by event. 163 additions (2002–2022), each matched to a same-year control of similar size and closest pre-event IXI.

A placebo permutation gauges whether matching on size alone could produce these estimates. In each of 500 iterations, pseudo-event stocks are drawn from the same years and size range as the actual additions (with no actual addition) and run through the identical matching and difference-in-differences procedure. No placebo draw produces an estimate as extreme as the actual one for either variable: the placebo distributions are centered at zero, the actual elasticity estimate lies 4.7 placebo standard deviations below the placebo mean, and the actual IXI estimate lies far outside the entire placebo range. Size-based selection does not reproduce the result.

4.6 Price consequences of low elasticity

Passive demand should move prices most where the remaining demand curve is least elastic. Monthly index-exposure changes measure the average response; Russell reconstitution tests its relation to the stock's estimated elasticity.

The monthly design relates the cumulative log return in months $t - 1$ and t to the change in declared index-fund ownership observed at $t + 2$, instrumented by the equal-book index-exposure change at t . The two-month disclosure lag aligns reported positions with the exposure change. Including the preceding return month allows for announcements before implementation.

The specification includes stock and month effects and lagged size, book-to-market, momentum, turnover, realized variance, and market covariance. A percentage point of instrumented ownership is associated with an 8.8 percentage point cumulative log-return response, with a first-stage F of 54 (Table 21, Panel A). The implementation-month estimate alone is 5.5.

We find no statistically significant return response two months before the exposure change. This timing check supports a response concentrated near the exposure change. The monthly instrument also varies outside discrete membership events, so the two-month window does not establish announcement dates for every observation. A causal interpretation requires index exposure to affect returns through the instrumented demand channel conditional on the included controls.¹⁶

Russell reconstitution tests whether a common tracker-demand change has a larger price response at stocks ranked as less elastic. The predicted ownership change combines pre-event ownership in the departing tracker with the destination tracker’s median ownership among its incumbents in the prior June. The event’s destination assignment determines the direction of the change. The dose thus combines pre-event holdings inputs with the event assignment. We interact it with the inverse-elasticity rank computed from the preceding year’s stock elasticities and measure abnormal returns from the first trading day after the preliminary list through implementation.

The interaction using the IXI model’s ranking is positive, but its precision depends on the inference method (Table 21, Panel B). The coefficient is 1.14, with a company-and-year clustered standard error of 0.54 and a year sign-flip p -value of 0.115. The corresponding interaction from a demand model estimated without IXI is 1.54, with a clustered standard error of 0.59 and a sign-flip p -value of 0.060. Both comparisons use the same 2,803 stock-events and ownership-change measure. Inference enumerates all sign reversals of the twelve year-level score contributions.

The joint comparison does not establish that including IXI improves the explanation of Russell price responses (Table 22). When both rankings enter, the interaction coefficients are 0.37 for the IXI model and 1.36 for the model without IXI. Neither coefficient is precisely estimated, and equality is not rejected ($p = 0.56$). The rankings use corrected demand estimates, with each model retaining its valid investor estimates. Appendix H reports the tracker holdings and event timing.

¹⁶An active fund’s measured overlap can change immediately when its benchmark changes, even while its reported shares remain fixed. The monthly first stage is therefore based on subsequent declared index-fund ownership, not contemporaneous changes in total overlap. Disclosure timing identifies when positions enter the data, not their exact trade dates.

Table 21. Passive demand and stock price responses

	(1)	(2)
<i>Panel A. Monthly changes in realized indexing</i>		
	Arriving flow	
Two-month impact	8.82***	
	(1.48)	
One-month impact	5.46***	
	(1.03)	
Response two months before the change	−1.03	
	(0.89)	
First-stage coefficient	0.00281***	
	(0.00038)	
First-stage F -statistic	54.0	
Observations	642,141	
<i>Panel B. Russell reconstitution</i>		
	IXI model	Model without IXI
Tracker dose $\times$ inverse elasticity rank	1.145*	1.543**
	(0.535)	(0.587)
Year sign-flip p -value	0.1147	0.0596
Observations	2,803	2,803
Event years	12	12

Notes: Panel A reports IV coefficients in percentage points of log return per percentage point of declared index-fund ownership. The endogenous variable is the ownership-share change observed at $t + 2$, instrumented by the equal-book exposure change at t . The two-month outcome is the sum of log returns at $t - 1$ and t ; the one-month outcome is the return at t . The $t - 2$ row is an earlier-return diagnostic. These windows allow for announcement effects before implementation without imposing event-specific announcement dates on the whole monthly panel. All specifications include stock and month effects and lagged size, book-to-market, momentum, turnover, realized variance, and market covariance. Standard errors are clustered by stock and month. Panel B uses abnormal returns from the first trading day after the preliminary Russell list through implementation. The dose combines pre-event holdings in the departing tracker, the destination tracker's prior-June incumbent median, and the event destination assignment. Elasticity ranks use the preceding calendar year and corrected demand estimates. Column (1) uses the model including IXI; column (2) uses the model without IXI. Each model retains its valid investor estimates. Both columns include year effects, dose and rank main effects, capitalization, local rank slopes, banding, prior membership, beta, spread, and turnover. Standard errors are clustered by company and year. Sign-flip p -values enumerate all twelve year-level score signs. One, two, and three stars denote 10, 5, and 1 percent significance under clustered inference.

Table 22. Demand-model rankings and Russell price responses

	IXI ranking	No-IXI ranking	Both rankings
Dose $\times$ IXI-model rank	1.145* (0.535)		0.367 (0.826)
Dose $\times$ no-IXI-model rank		1.543** (0.587)	1.356 (0.903)
IXI interaction sign-flip p	0.1147		0.6665
No-IXI interaction sign-flip p		0.0596	0.3232
Equal interaction coefficients, p			0.559
Observations	2,803	2,803	2,803
Event years	12	12	12

Notes: The outcome and tracker dose follow Table 21, Panel B. Rankings use corrected demand estimates, with each model retaining its valid investor estimates. Each rank uses the preceding calendar year’s mean quarterly elasticity and is centered within event year and prior index group. The no-IXI model omits indexing from demand estimation; it supplies a separate model estimate rather than an observed elasticity. Regressions use the same stock-events and common dose. The joint column includes both rank main effects and their dose interactions. Standard errors are clustered by company and year. The equality test uses the joint covariance and a t_{11} reference distribution. Sign-flip inference enumerates all twelve year-level score signs; stars use clustered inference at the 1, 5, and 10 percent levels. This is a conditional explanatory comparison, not an out-of-sample forecast-loss test.

4.7 A valuation wedge

The price response could reflect information about subsequent cash flows. We assess this possibility by following the equity claim actually delivered after the exposure change. At horizons of five, ten, and fifteen years, the claim includes distributions and terminal market value, discounted with an estimated stochastic discount factor. The implementation-month change in log market equity decomposes into a realized fundamental component and a valuation wedge. All three outcomes use the same instrumented change in declared index ownership, controls, and observations within each horizon, with formation dates restricted so that each claim window is complete within the sample. The decomposition concerns the implementation month, whereas the headline return estimate in Table 21 spans that month and the preceding month.

The wedge accounts for most of the implementation-month valuation response (Table 23, Panel A). At ten years, the price coefficient is 7.60 and the fundamental coefficient is 1.42, leaving a wedge of 6.19 before the log correction. The corrected wedge share is 88 percent at ten years and 99 percent at fifteen years. Revaluing the claim paths under 2,000 bootstrap discount-factor draws gives lower bounds of 70, 74, and 85 percent at the three horizons. These bounds describe discount-factor uncertainty; the table also reports clustered sampling errors. A combined diagnostic rejects a fundamental response half as large as the price response at each horizon and one fifth as large at fifteen years. The evidence bounds the fundamental response

rather than establishing that payouts never change.

The attribution restriction and the valuation decomposition address different questions. The former asks whether the attributed-only shifter adds the response implied by a specified pricing restriction. The latter asks how much of the implementation-month valuation response is matched by the subsequently delivered claim. Neither exercise assigns a causal share of the total wedge to indexing inside active funds. Appendix J reports supplementary return evidence around earnings announcements.

Declared index ownership supports a separate ten-year decomposition (Table 23, Panel B). Indexing inside active funds represents about 19 percent of IXI for the average stock-month with positive IXI. This is an average ownership-component share, not a share of the aggregate wedge. The instrument has essentially no first stage for the active-fund component at the corresponding disclosure date, so this design does not identify its separate price effect.

5 Conclusion

Realized indexing links fund ownership to stock demand elasticity. IXI measures declared index holdings and benchmark overlap inside active portfolios. Stocks in the highest IXI quintile have about 25 percent lower estimated elasticity than stocks in the lowest quintile, and a negative relation remains within firms. Holding each fund’s indexing total fixed, however, allocating it to actual overlap adds no inelasticity advantage over allocating it at benchmark weights. The useful distinction is the amount of benchmark indexing implemented by each fund.

Indexing shocks raise prices with little corresponding increase in subsequent claim value. In the monthly design, this value explains only a small part of the implementation-month price response. At a ten-year valuation horizon, the log-corrected wedge accounts for 88 percent under the maintained instrument and discount-factor assumptions. The contribution of indexing inside active funds to that price response remains unidentified.

The composition evidence describes where passive capital sits and which investors hold the remaining shares, holding investor price coefficients fixed. The separate within-investor test finds a response in the direction of Haddad et al. (2025) among active fund complexes. Ownership composition and investor behavior can therefore move elasticity in opposing directions. Measuring implemented indexing makes the first channel observable; incorporating the second into stock-level elasticity is the next step.

Table 23. Indexing demand and the valuation wedge

<i>Panel A. Price, realized fundamentals, and the wedge by horizon</i>			
	Five years	Ten years	Fifteen years
Price response	7.24*** (1.29)	7.60*** (1.60)	9.27*** (2.32)
Realized fundamental	1.41 (0.89)	1.42*** (0.53)	0.53 (0.52)
Valuation wedge	5.83*** (1.39)	6.19*** (1.41)	8.74*** (2.25)
Wedge share (log corrected)	83%	88%	99%
Bootstrap 95% lower bound	70%	74%	85%
First-stage F -statistic	52.2	37.5	25.4
Observations	593,060	441,268	286,949
<i>Panel B. Ten-year wedge by component of the arriving indexing flow</i>			
	Declared index flow		
Price response	7.53*** (1.60)		
Realized fundamental	1.31** (0.51)		
Valuation wedge	6.22*** (1.42)		
Wedge share	83%		
Mean share of stock-month IXI	81%		
First-stage F -statistic	37.3		
Observations	439,188		

Notes: Panel A decomposes the implementation-month change in log market equity into a realized fundamental component and a valuation wedge. The fundamental is the change in log discounted equity-claim value, including distributions and terminal value, over five, ten, or fifteen years. Within each horizon, the three regressions use identical observations, controls, and instrumented ownership changes, so their coefficients satisfy the decomposition identity before rounding. The endogenous variable is the declared index-fund ownership-share change observed at $t + 2$, instrumented by the equal-book exposure change at t . The price outcome covers month t , whereas Table 21's headline return spans $t - 1$ and t . Completed claim windows restrict formation dates to 2020, 2015, and 2010. Standard errors are clustered by stock and month. The log correction and recentered lower bounds use 2,000 bootstrap discount-factor draws to revalue the realized claim paths; they describe discount-factor uncertainty separately from clustered regression uncertainty.

Panel B uses the ten-year observations with both ownership components observed. The declared-index component has a first-stage F of 37.3. The active-fund component's change at $t + 2$ has a first-stage F of 0.005 against the instrument at t , so its separate price effect is not identified. The reported 81 percent component share is the mean declared share of IXI across stock-months with positive IXI, not the declared share of aggregate indexing dollars. The complementary active-fund share is 19 percent. Panel B's wedge share is the uncorrected coefficient ratio. Stars denote clustered significance at the 1, 5, and 10 percent levels.

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Appendices

Appendix A Data and sample construction

This appendix describes the data sources, sample construction, and key variable definitions underlying the analysis. Summary statistics for all characteristics appear in Table 1; IXI properties by subperiod are reported in Table 2.

Table 24. Fund universe summary statistics by fund type

Category	Statistic	Full Sample	2001–2006	2007–2012	2013–2019	2020–2021	2022–2023
All Funds	N Funds	18,908	3,857	7,286	12,335	12,927	16,442
	Total AUM (\$B)	6930.6	2376.6	3824.0	8450.6	14874.9	16648.2
	Mean AUM (\$M)	495.0	653.5	543.0	721.8	1160.0	1022.3
	Median AUM (\$M)	27.6	54.6	31.0	34.8	58.9	38.5
	Unique Benchmarks	460	79	166	301	336	450
Passive ETF	N Funds	2,956	187	772	1,766	2,067	2,832
	Total AUM (\$B)	2123.5	306.1	734.6	2579.1	5542.1	6728.9
	Mean AUM (\$M)	919.3	1752.5	987.2	1505.1	2689.8	2383.6
	Median AUM (\$M)	45.0	135.3	53.2	53.2	103.1	58.1
	Unique Benchmarks	442	68	157	286	317	431
Passive OEF	N Funds	1,207	287	483	770	722	930
	Total AUM (\$B)	628.3	151.7	269.1	778.3	1480.4	1759.1
	Mean AUM (\$M)	817.8	561.7	598.5	1115.0	2088.4	1926.3
	Median AUM (\$M)	54.3	43.9	34.4	63.7	145.3	90.1
	Unique Benchmarks	335	74	124	218	173	229
Active Benchmarked	N Funds	14,748	3,383	6,031	9,799	10,138	12,680
	Total AUM (\$B)	4178.8	1918.9	2820.3	5093.2	7852.4	8160.2
	Mean AUM (\$M)	383.6	600.5	481.7	549.8	782.0	651.9
	Median AUM (\$M)	24.1	53.0	28.6	30.7	50.3	34.3
	Unique Benchmarks	429	74	156	280	311	416

This table reports summary statistics for the fund universe used to construct IXI, broken down by fund type and time period. Passive ETF and Passive OEF are exchange-traded funds and open-end mutual funds classified as index funds. Active Benchmarked includes all non-index funds that receive a benchmark assignment. N Funds is the number of unique funds observed during the period; type rows can sum to slightly more than the total because a fund that changes type is counted in each. Total AUM is the average annual assets under management in billions USD. Mean and Median AUM are cross-sectional statistics of fund-level average AUM in millions USD. Unique Benchmarks counts distinct benchmarks assigned by the portfolio-overlap procedure of Appendix B, not prospectus labels, so the count is the one the construction uses. AUM is computed from FactSet holdings. Sample: 2001–2023.

Holdings data

Fund-level holdings are drawn from FactSet Ownership (formerly LionShares), which provides monthly position-level data for both ETFs and open-end mutual funds. The raw holdings extract begins in January 2000 and runs through December 2023; the measure and the estimation samples begin in 2001. It encompasses all U.S.-domiciled equity funds with identifiable benchmark mandates. After applying the tiered benchmark weight estimation described in Appendix B, the final sample includes 460 distinct benchmark indices contributing to Active Share estimation and 394,373 stock-quarter observations.

Institutional holdings

Institutional investor holdings for the demand system come from SEC 13F filings as compiled by FactSet Ownership. The 13F universe captures all institutional investment managers exercising

discretion over at least \$100 million in qualifying equity securities. The holdings universe covers 13,504 filing entities; pooling smaller filers for estimation (Section 3.4) yields 1,207 institutional estimation units, 734 estimated individually and 473 pooled, plus the household and short-interest sectors, and 19,007 individually estimated investor-years.

Stock characteristics

Stock-level characteristics are constructed from CRSP and Compustat via WRDS. Market capitalization uses CRSP month-end price times shares outstanding. Book equity follows the standard Fama–French definition from Compustat (stockholders’ equity plus deferred taxes minus preferred stock). Profitability, investment, dividends-to-book equity, and market beta are winsorized at the 2.5th and 97.5th percentiles each quarter to limit the influence of outliers.

IXI construction

The Indexing Inclusion Ratio is the share of each stock’s market capitalization held by indexing capital after adjusting benchmarked active funds for Active Share. Appendix B describes benchmark weight estimation, fund-to-benchmark assignment, aggregation, and sample filters. We use two variants: IXI (realized indexing) and IXI_{pass} (declared index funds only). Attributed indexing on the same fund universe, the object comparable to BMI, is constructed separately in Section 3.3.

Appendix B IXI construction details

Benchmark weight estimation

A critical implementation choice concerns how to estimate index weights $w_{h,t}(n)$. Published index constituent lists, while available for major indices, may not reflect actual investable weights due to float adjustments, capping rules, and timing differences between index reconstitutions and fund rebalancing. We therefore employ a holdings-based approach with a tiered structure.

When a physical replication ETF tracking index h exists, we use its actual holdings as the benchmark weights. Physical ETFs must hold index constituents to minimize tracking error, making their portfolios precise proxies for implementable index composition. This approach has the additional advantage of capturing the weights that passive investors actually hold, including any deviations from published index weights due to corporate actions, index methodology changes, or rebalancing timing.

When no physical ETF exists for a given benchmark, which occurs more frequently in the early sample and for less popular indices, we aggregate the holdings of all declared index funds tracking benchmark h to construct proxy weights. The inclusion of open-end mutual funds is particularly important for coverage prior to the rapid growth of ETFs following the 2008 financial crisis, as many indices had only mutual fund trackers in earlier years.

This tiered approach to benchmark weight estimation gives broad index coverage while prioritizing the most accurate weight proxies when available. The benchmark universe contains more than 600 indices spanning the major U.S. index families (S&P, Russell, CRSP total market, style, and sector indices), of which 460 receive fund assignments in the sample window. Differences from the available BMI file also reflect its fund universe and sample dates.

Benchmark assignment

Each fund is assigned to a benchmark from its realized portfolio rather than from its prospectus label. For every non-index fund and calendar year, the assignment selects the benchmark whose weights maximize the overlap score $\sum_n \min\{w_j(n), w_h(n)\}$ over the benchmark universe. A five percentage point score-gap hysteresis rule prevents mechanical year-to-year switching. The benchmark is updated when its overlap with the fund’s current portfolio collapses, which accommodates funds that migrate across styles. For index products whose declared benchmark overlaps their portfolio by at least 0.85, we retain the declared benchmark rather than switch to an incidentally similar neighboring index.

Per-stock allocation

The unit of construction is the fund-stock-month. Declared index funds contribute their realized holdings subject to position caps. Active funds contribute $A_{j,t} \min\{w_j(n), w_h(n)\}$, also capped at the reported position. An unheld or off-benchmark constituent contributes zero. Before additional dollar caps and sample restrictions, summing overlap across the normalized fund and benchmark portfolios gives the Active-Share-adjusted fund total. Non-fund 13F enrichment is a separate extension.

Aggregation strategy

IXI is constructed and used throughout the paper at the individual-security level, following [Kojen and Yogo \(2019\)](#). For stocks with multiple share classes, each security retains its own IXI value, reflecting passive ownership of that share class rather than a firm-level aggregate.

Aggregation is value weighted at the benchmark level. We sum indexing dollars across funds assigned to a benchmark and divide by the benchmark’s market capitalization, rather than averaging fund-level ratios. This treatment gives large and small positions their appropriate economic weights and follows standard holdings-based ownership measures ([Appel et al., 2019](#); [Cremers and Petajisto, 2009](#)).

IXI cross-sectional properties

Table 25 reports firm characteristics by IXI quintile within size quintiles. Stocks with high IXI are larger, more profitable, and pay higher dividends, consistent with the large-cap tilt of index benchmarks. Within every size quintile, the high-minus-low IXI spread remains approximately 18 percentage points ($t > 11$), so IXI captures meaningful variation beyond market capitalization.

Data quality procedures

Fund holdings are reported at different frequencies. Between reports we carry forward split-adjusted shares and revalue them at the current price. The public-availability convention admits a month-end report two months later. A position’s window ends immediately before the availability date of the first later fund report that omits the security, including an omission without an explicit zero record. This prevents an exited position from remaining in measured overlap indefinitely. Table 26 reports the disclosure-frequency summary.

We also compute IXI using both FactSet and CRSP market capitalization. When both denominators produce admissible values below 0.98, we use the source with the smaller mean

Table 25. Portfolio characteristics by IXI and size quintiles

<i>Panel A: Single Sort on IXI Quintiles</i>						
Characteristic	Low	2	3	4	High	H–L
IXI (%)	0.49	3.00	7.58	13.01	18.94	18.45*** [14.36]
Log(ME)	3.891	4.938	6.239	7.681	7.842	3.951*** [86.48]
Log(BE)	3.233	4.232	5.347	6.715	6.906	3.673*** [150.57]
Profitability	-0.085	-0.027	0.117	0.229	0.255	0.340*** [13.68]
Investment	0.094	0.097	0.129	0.111	0.108	0.014 [1.16]
Div/BE	0.013	0.017	0.025	0.036	0.035	0.022*** [17.36]
Beta	1.015	1.261	1.329	1.261	1.169	0.154*** [10.52]
<i>Panel B: Single Sort on Size Quintiles</i>						
Characteristic	Small	2	3	4	Large	L–S
IXI (%)	1.32	4.51	9.96	13.37	13.86	12.55*** [15.28]
Log(ME)	3.230	4.887	6.061	7.242	9.170	5.940*** [100.76]
Log(BE)	3.160	4.231	5.159	6.165	7.914	4.754*** [115.31]
Profitability	-0.121	0.023	0.124	0.206	0.305	0.426*** [18.09]
Investment	0.074	0.104	0.123	0.127	0.113	0.039*** [2.95]
Div/BE	0.009	0.017	0.021	0.028	0.050	0.041*** [24.45]
Beta	1.141	1.224	1.336	1.282	1.093	-0.048* [-1.78]
<i>Panel C: Double Sort (Size $\times$ IXI) – Mean IXI (%)</i>						
Size / IXI	Low	2	3	4	High	H–L
Small	0.47	2.45	6.56	12.07	19.77	19.29*** [11.28]
2	0.55	3.14	6.85	12.65	18.63	18.07*** [13.78]
3	0.52	3.37	7.64	12.67	19.06	18.54*** [13.18]
4	0.52	3.40	8.09	12.92	19.12	18.60*** [13.80]
Large	0.47	3.32	8.35	13.24	18.28	17.81*** [16.05]

Note: This table reports time-series averages of monthly portfolio means. Each month, stocks are sorted into quintiles by IXI (Panel A) and by market capitalization (Panel B). Panel C reports mean IXI (%) for portfolios double-sorted by size (rows) and IXI (columns). H–L (L–S) denotes the High minus Low (Large minus Small) spread. Stars denote statistical significance based on Newey–West t -statistics (lag 6) from the time-series of monthly spread values: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Holdings enter under the public-availability convention, which places month-end reports into IXI two months later. Sample: CRSP common stocks, 2001–2023.

Table 26. Reporting frequency over time

Year	% of reports in year				
	Irregular	Monthly	Quarterly	Semi-Annual	Yearly+/Gap
2000	2.6	0.1	5.1	88.8	3.3
2001	2.6	0.2	3.5	87.9	5.9
2002	2.2	0.0	2.5	88.6	6.6
2003	2.2	0.1	11.3	84.1	2.3
2004	1.2	1.1	35.5	60.9	1.4
2005	1.9	5.3	52.1	38.5	2.2
2006	1.3	7.4	53.5	35.7	2.1
2007	1.3	7.1	55.6	34.1	2.0
2008	2.3	8.5	57.9	29.4	1.9
2009	4.2	19.2	52.6	22.9	1.1
2010	7.5	60.7	19.6	11.3	0.9
2011	5.8	71.7	14.8	7.0	0.8
2012	6.9	73.5	13.1	5.5	1.0
2013	8.0	73.2	12.8	5.3	0.8
2014	6.0	76.2	12.5	4.4	0.9
2015	4.1	80.5	11.2	3.6	0.5
2016	5.1	80.3	10.5	3.6	0.5
2017	5.4	80.4	10.3	3.4	0.5
2018	16.8	68.2	10.2	3.9	0.9
2019	19.9	67.5	8.5	3.3	0.8
2020	22.1	66.3	8.1	2.9	0.7
2021	22.4	66.9	7.2	2.7	0.7
2022	19.8	68.7	7.7	2.8	1.0
2023	16.9	70.7	7.7	3.8	0.9

This table reports the annual distribution (in percent) of reporting-frequency classifications, excluding observations classified as *First Report*. Percentages are computed within year and may not sum to exactly 100 due to rounding. “Yearly+/Gap” groups reports with annual-or-lower frequency and/or gaps.

absolute month-to-month change for that stock. The rule limits jumps caused by denominator errors without suppressing persistent changes in tracking ownership.

Finally, we exclude observations with IXI at or above 0.98. Such values are inconsistent with the active, retail, and insider ownership present in nearly all stocks and typically reflect denominator or identifier errors.

Comparison with existing measures

BMI and IXI measure two related objects. BMI attributes benchmarked capital to index constituents to recover benchmark incentives. IXI measures the indexing capital realized in actual positions after adjusting for fund-level Active Share. The distinction is contractual exposure versus the residence of capital, not a claim that either object is universally preferable.

The price restriction of Section 3.3 uses changes in equal-book exposure rather than directly observed unheld-dollar purchases.

The measures also differ in index coverage. The available BMI file and our fund universe cover different sets of benchmarks, including differences in sector, factor, international, and thematic products. Broader coverage matters as indexing capital expands beyond traditional market-cap-weighted benchmarks. A stock can receive realized passive ownership through a sector ETF or factor fund outside the set of broad indices.

The measures separate on prices, where only realized capital carries the response.

Appendix C IXI decomposition

This appendix provides the construction details and supplementary regression evidence for the IXI decomposition summarized in Section 4.3. IXI is decomposed into four mutually exclusive and exhaustive components based on fund-level Active Share: (i) Pure Passive (declared index funds), (ii) Closet Indexing (CI, Active Share < 20%), (iii) Partial Closet Indexing (PCI, 20% ≤ Active Share < 60%), and (iv) the Active residual (Active Share ≥ 60%). By construction, IXI equals the sum of these four components at every stock-date.

Table 27. Stock-level elasticity and IXI components

	(1) Total IXI	(2) Passive + PCI	(3) PCI only	(4) PCI + size	(5) All components
log(IXI)	−0.072*** (0.005)				
log(IXI _{passive})		−0.046*** (0.006)			−0.031*** (0.006)
log(IXI _{CI})					−0.019*** (0.002)
log(IXI _{PCI})		−0.018*** (0.002)	−0.032*** (0.002)	−0.002 (0.002)	−0.007** (0.003)
log(Market Cap)				−0.033*** (0.002)	
Year FE	Yes	Yes	Yes	Yes	Yes
Observations	233,997	233,997	233,997	233,997	233,997
R^2	0.216	0.212	0.180	0.304	0.239
Adj. R^2	0.216	0.212	0.180	0.304	0.239

Notes: Dependent variable: stock-level aggregated price elasticity ($1 - \hat{\beta}_0$). IXI_{passive} is the pure index fund component (realized holdings). IXI_{CI} is the closet indexing component (Active Share < 20%). IXI_{PCI} is the partial closet indexing component (20% ≤ Active Share < 60%). All regressions include year fixed effects. Standard errors clustered by stock and year in parentheses. Components and elasticities come from the fund-only IXI measure and demand estimates, with holdings dated by public availability, 2001–2023. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 27 reports the full horse-race regressions for the components. The sharpest specification is column (5): declared passive, CI, and PCI components all remain negative and significant, and the R^2 rises from 0.216 in the total-IXI specification to 0.239 when the components are entered separately. The Active Share adjustment therefore adds economically meaningful cross-sectional information beyond declared passive holdings alone.

Appendix D IXI price pressure and 13F enrichment

This appendix presents the structural analysis of IXI-driven price pressure (D.1–D.2), summarized in Section 4.2, and the robustness check adding non-fund 13F institutional holdings to IXI (D.3).

D.1 Structural derivation

In the demand system of [Kojien and Yogo \(2019\)](#), the equilibrium price impact of a change in characteristic k for stock n is the n th diagonal element of:

$$\frac{\partial p}{\partial x_k} = \left(\mathbf{I} - \sum_i \beta_{0,i} A_i \mathbf{H}^{-1} \mathbf{G}_i \right)^{-1} \left(\sum_i \beta_{k,i} A_i \mathbf{H}^{-1} \mathbf{G}_i \right) \quad (24)$$

where $\mathbf{H} := \text{diag}(\sum_i A_i \mathbf{w}_i)$ and $\mathbf{G}_i := \text{diag}(\mathbf{w}_i) - \mathbf{w}_i \mathbf{w}_i'$. Assuming individual portfolio weights $w_i(n)$ are small, the pressure for stock n can be approximated as:

$$M_{n,n} \approx \frac{\sum_i s_i(n) \beta_{ki} (1 - w_i(n))}{1 - \sum_i s_i(n) \beta_{0i} (1 - w_i(n))} \quad (25)$$

where $s_i(n) = A_i w_i(n) / \sum_j A_j w_j(n)$ is investor i 's ownership share. Stocks held by larger, more price-inelastic investors with higher IXI coefficients experience greater institutional demand pressure.

For the IXI characteristic, equation (25) applies with k set to IXI, so the price impact of a change in a stock's IXI is approximately $M_{n,n}$ with $\beta_{k,i}$ the investor's IXI coefficient.

The AUM-weighted average of the IXI coefficients for stock n can be expressed as:

$$\frac{\sum_i \beta_{1,i} A_i w_i(n) (1 - w_i(n))}{\sum_i A_i w_i(n) - \sum_i \beta_{0,i} A_i w_i(n) (1 - w_i(n))} \quad (26)$$

For each stock n , the institutional pressure is the weighted average of IXI coefficients across its investors, adjusted for their price elasticity. Stocks held by more price-inelastic investors (higher $\beta_{0,i}$) with larger IXI coefficients experience greater institutional demand pressure.

D.2 Time-series and cross-sectional patterns

Figure 10 shows that IXI pressure has transitioned from negative in the early 2000s to strongly positive by 2023, with the median rising from -0.28 to $+0.98$ and the aggregate path from -0.43 to $+1.22$. The transition reflects the growing influence of passive capital on equilibrium prices; the pressure is concentrated among large-cap stocks, in line with the large-cap tilt of the dominant benchmarks. By investor type, investment advisors and “other” institutions, which together hold 95% of total AUM, contribute approximately 90% of aggregate IXI pressure, while long-term investors partially offset it, consistent with liability-matching mandates that tilt away from indexed stocks.

D.3 Non-fund 13F enrichment

IXI is constructed from mutual fund and ETF holdings, omitting passive-like demand from non-fund 13F filers such as pensions, insurance companies, and sovereign wealth funds. To

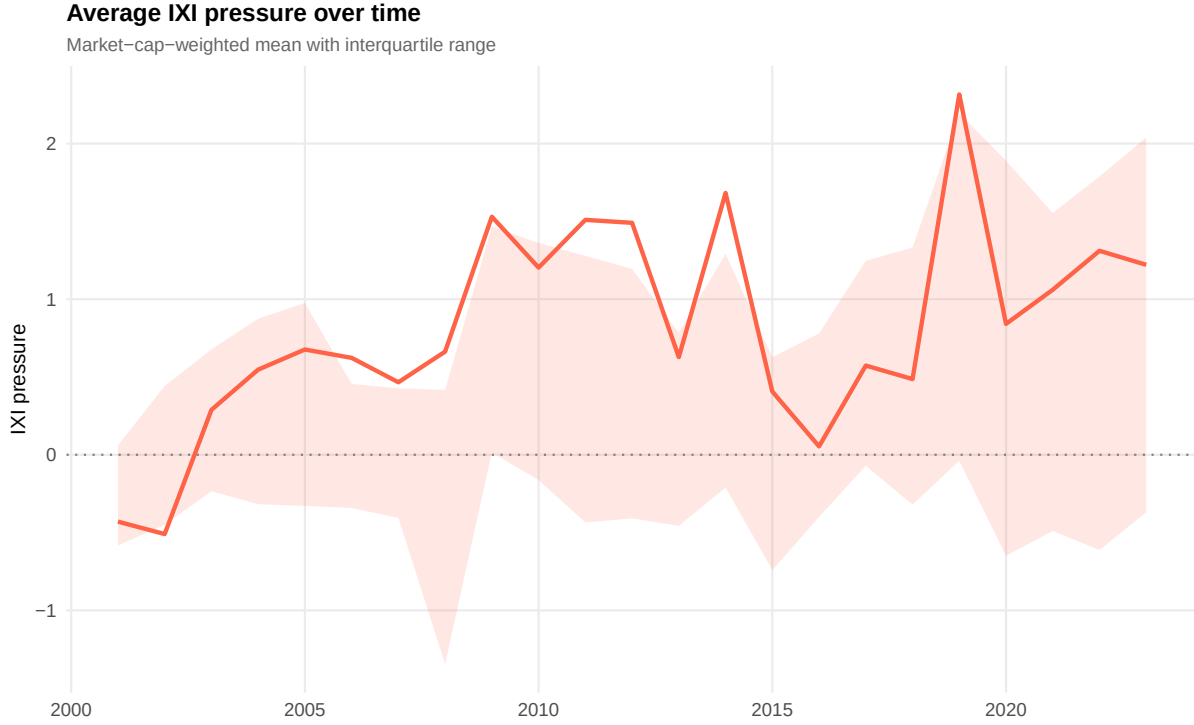


Figure 10. Average IXI pressure over time

Market-cap-weighted mean (solid) of stock-level IXI pressure, with interquartile range shaded. Values are win-sorized at the 1st and 99th percentiles. IXI pressure transitions from negative (2001) to strongly positive (2023), reflecting the growing influence of passive capital on equilibrium prices.

assess whether this gap matters, we decompose the portfolios of non-fund entities with at least 400 stock positions and no linked fund data (379 entities over the sample, 310 in 2023) into non-negative mixtures of 33 standard benchmark families using Sharpe (1992) style analysis applied to holdings, and compute the stock-level passive-equivalent demand from the fitted benchmark allocations.¹⁷ This yields \$1.7 trillion in passive-equivalent institutional AUM by 2023, representing 15% of the existing IXI numerator. Adding these holdings to IXI produces a rank correlation of 0.979 with 88.7% of stocks in the same quintile and 99.5% within one quintile (Table 28). The extension raises measured indexing while preserving most of the cross-sectional ranking. It addresses the coverage concern emphasized by [Chinco and Sammon \(2024\)](#), although its construction and magnitude differ from their estimate.

¹⁷The decomposition solves $\min \|w_e - \sum_h \alpha_{e,h} w_h\|^2$ subject to $\alpha_{e,h} \geq 0$ and $\sum_h \alpha_{e,h} \leq 1$, where w_e is the entity's portfolio weight vector, w_h is family h 's AUM-weighted benchmark weight vector, and $\alpha_{e,h}$ is entity e 's allocation to family h . Entity-level rankings are temporally stable (quarter-to-quarter Spearman correlation of 0.93).

Table 28. IXI enrichment from non-fund 13F institutional holdings

<i>Panel A: Passive-equivalent AUM from non-fund 13F entities</i>					
	2005	2010	2015	2020	2023
Entities decomposed	87	121	190	280	310
Benchmark families used	27	30	31	32	33
Passive-equiv. AUM (\$B)	377	352	439	1,006	1,706
Enrichment / IXI numerator (%)	26.0	17.8	11.3	11.8	14.6
<i>Panel B: IXI and enriched IXI, 2001–2023</i>					
Spearman rank correlation	0.979				
Same quintile (%)	88.7				
Same or adjacent quintile (%)	99.5				
Mean IXI (equal-weighted)	0.085				
Mean IXI ^{enriched} (equal-weighted)	0.102				
VW mean IXI	0.184				
VW mean IXI ^{enriched}	0.208				

Note: Non-fund 13F entities are institutional holders, including pensions, insurers, sovereign wealth funds, and investment advisers, not covered by the fund-level measure. For each entity with at least 400 stock positions and four quarters of data, we decompose its portfolio into a non-negative mixture of benchmark families: $w_e = \sum_h \hat{\alpha}_{e,h} w_h + \varepsilon_e$, subject to $\hat{\alpha}_{e,h} \geq 0$ and $\sum_h \hat{\alpha}_{e,h} \leq 1$. The passive-equivalent holding is $\hat{H}_{e,n} = \text{AUM}_e \times \sum_h \hat{\alpha}_{e,h} w_{h,n}$. Enriched IXI adds these holdings to the fund-based numerator. Panel A reports the scale of the addition at the last quarter of each year; Panel B compares the two measures over 1,053,729 stock-months. Fund holdings are dated by public availability. The non-fund component is estimated from the benchmark allocations of 13F portfolios.

Appendix E Decomposing aggregate price sensitivity

This appendix provides full methodological details for the decomposition of the aggregate elasticity decline into compositional and behavioral components, as summarized in Section 4.4. The approach follows the suggestion of Davis et al. (2026) to separate the mechanical reallocation of capital from active to passive investors from the behavioral change in the remaining active investors’ price sensitivity. Figure 11 plots the annual paths and the cumulative decomposition.

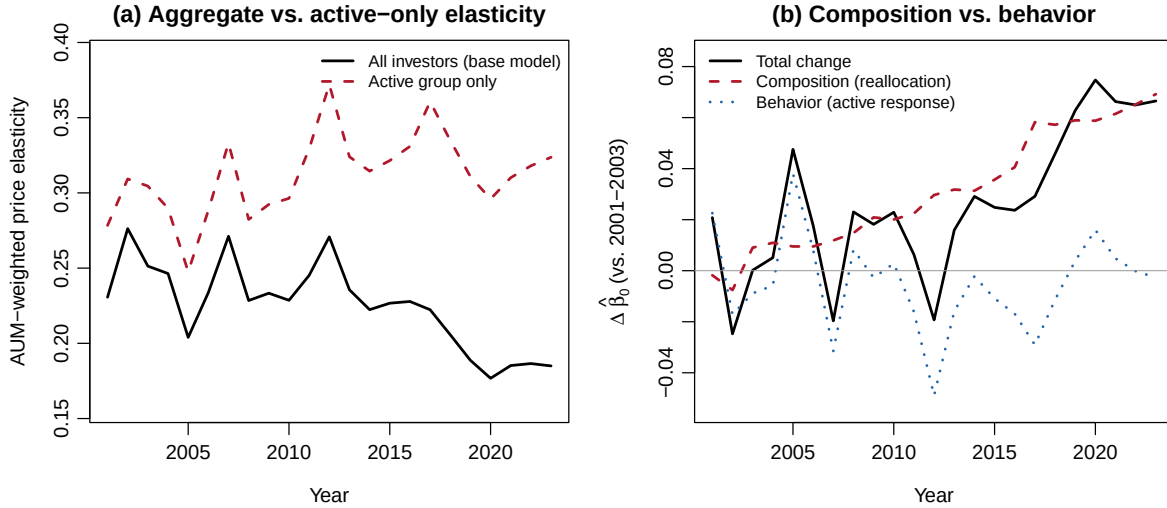


Figure 11. Decomposition of the aggregate elasticity decline

Panel (a) plots the AUM-weighted price elasticity from the base model for all investors (solid) and for the active group only (entities below 1% passive fund AUM, dashed), annually. Panel (b) plots the cumulative change in the AUM-weighted base-model price coefficient relative to its 2001–2003 level, decomposed year by year with the three-group Oaxaca formula of Section E.3 into the composition component (reallocation across groups, dashed) and the behavioral component (within-group change, dotted). By 2021–2023 the composition component accounts for 99% of the total change.

E.1 Entity-level passive classification

FactSet’s entity-level passive flag identifies only 61 of 13,504 entities as passive, capturing 0.1% of AUM in 2000 and 4.4% in 2023. This classification misses index funds operated alongside active funds within the same 13F filer. We instead construct a fund-based passive share by tracing each filer through FactSet’s corporate hierarchy:

1. **Entity** → **ultimate parent**. Each 13F filer is linked to its ultimate parent. For example, Vanguard Global Advisers LLC maps to The Vanguard Group, Inc.
2. **Parent** → **funds**. We identify subsidiaries under each parent and link them to their constituent funds, yielding 186,676 fund-entity pairs across 9,699 entities.
3. **Fund classification**. A fund is passive if FactSet classifies its style as “Index” or if the fund reports positive index-tracking AUM. The union identifies 20,292 passive funds. Both signals produce the same entity-level passive fractions.

4. **Entity-level passive fraction.** For each entity $\times$ year, the passive fraction is computed as:

$$\pi_{j,t}^{\text{pass}} = \frac{\sum_{f \in \text{passive}(j)} \text{AUM}_{f,t}}{\sum_{f \in \text{all}(j)} \text{AUM}_{f,t}} \quad (27)$$

where the sums run over all funds f under entity j 's ultimate parent and fund AUM is averaged within year.

The classification assigns passive shares of 99.6% to Vanguard and 90.7% to BlackRock in 2023. In the decomposition sample, the AUM-weighted passive fraction rises from about 11% in 2001–2003 to about 33% in 2021–2023. This share is below Morningstar's total passive fund share because the 13F panel covers institutional holdings and the fund data cover benchmarked funds.

E.2 Assigning demand-system coefficients to entities

The demand system estimates investor-level $\hat{\beta}_0$ either for a single large entity or for a pool of smaller entities grouped by FactSet investor type and AUM quantile, following [Koijen et al. \(2024\)](#). We assign the estimated coefficients back to entities using the same pooling rule:

- **Individual entities** (734 entities with average ≥ 500 holdings): the demand-system investor identifier is the FactSet entity identifier itself. These entities receive their own $\hat{\beta}_0$ estimate.
- **Pooled entities** (the remaining smaller entities with < 500 holdings): grouped by investor type and passive status, sorted by AUM, and accumulated into 473 pools targeting $\sim 2,000$ total positions. Each entity inherits the $\hat{\beta}_0$ of its assigned pool.

The mapping covers all 1,207 institutional investors in the demand system. Household and short-interest residuals are not 13F entities and therefore do not enter this exercise.

E.3 Oaxaca-Blinder decomposition

Entities are classified into three passive intensity groups based on their fund-based passive fraction: Active ($< 1\%$), Mixed (1–50%), and Passive ($> 50\%$). The aggregate AUM-weighted $\hat{\beta}_0$ change between 2001–2003 and 2021–2023 is decomposed as:

$$\underbrace{\bar{\beta}_{0,e} - \bar{\beta}_{0,s}}_{\text{Total}} = \underbrace{\sum_g \Delta\omega_g \cdot \frac{\bar{\beta}_{0,g,s} + \bar{\beta}_{0,g,e}}{2}}_{\text{Between (composition)}} + \underbrace{\sum_g \frac{\omega_{g,s} + \omega_{g,e}}{2} \cdot \Delta\bar{\beta}_{0,g}}_{\text{Within (behavioral)}} \quad (28)$$

where g indexes the three groups, $\omega_{g,t}$ is the AUM share, and bars denote AUM-weighted means within each group.

E.4 Annual results

Table 29 reports the full annual time series. The passive AUM fraction in the estimation universe grew from about 11% in 2001–2003 to about 33% in 2021–2023, roughly a tripling. Decomposed on the base-model coefficient, the active group's own $\hat{\beta}_0$ is essentially flat (0.71 versus 0.68) while

the passive share triples, so the aggregate elasticity decline is almost entirely a composition effect. The behavioral component of the decomposition is sensitive to whether the coefficient being decomposed conditions on IXI: once stock-level passive ownership enters as its own demand channel, the residual active coefficient drifts up late in the sample (the within-group component of the model-with-IXI decomposition); the base-model object is reported as primary here and in Section 4.4. This group decomposition does not identify the same-investor response across stocks studied by [Haddad et al. \(2025\)](#).

Table 29. Entity-level decomposition: annual detail

Year	Pass. frac.	$\hat{\beta}_0^{\text{base}}$	$\hat{\beta}_0^{\text{active}}$	Elasticity	Active elast.	AUM (\$T)
2001	0.098	0.769	0.721	0.231	0.279	8
2002	0.093	0.736	0.702	0.264	0.298	7
2003	0.137	0.777	0.730	0.223	0.270	7
2004	0.141	0.757	0.713	0.243	0.287	10
2005	0.141	0.798	0.755	0.202	0.245	11
2006	0.141	0.768	0.712	0.232	0.288	13
2007	0.141	0.731	0.668	0.269	0.332	15
2008	0.158	0.774	0.720	0.226	0.280	11
2009	0.190	0.773	0.713	0.227	0.287	9
2010	0.179	0.775	0.710	0.225	0.290	11
2011	0.192	0.761	0.680	0.239	0.320	13
2012	0.208	0.736	0.634	0.264	0.366	14
2013	0.223	0.766	0.678	0.234	0.322	17
2014	0.212	0.774	0.689	0.226	0.311	19
2015	0.243	0.773	0.678	0.227	0.322	20
2016	0.245	0.772	0.669	0.228	0.331	20
2017	0.281	0.778	0.639	0.222	0.361	24
2018	0.295	0.795	0.665	0.205	0.335	26
2019	0.307	0.811	0.686	0.189	0.314	28
2020	0.314	0.822	0.701	0.178	0.299	29
2021	0.317	0.814	0.690	0.186	0.310	41
2022	0.332	0.813	0.680	0.187	0.320	36
2023	0.336	0.815	0.676	0.185	0.324	40

Notes: AUM-weighted annual averages across 13F entities, on the base-model price coefficient estimated without IXI (the object comparable to [Haddad et al. \(2025\)](#)). “Pass. frac.” is the AUM-weighted entity-level passive fund AUM fraction. $\hat{\beta}_0^{\text{active}}$ is the AUM-weighted mean within the active group (entities below 1% passive fund AUM), and “Active elast.” is $1 - \hat{\beta}_0^{\text{active}}$. The active group’s own price sensitivity is roughly flat while the passive fraction triples, so the aggregate elasticity decline is almost entirely compositional. AUM is total holdings in the entity-level 13F panel. Estimates use the fund-only IXI measure, 2001–2023, with holdings dated by public availability.

Internet Appendix

This Internet Appendix provides supplementary figures, tables, and analyses referenced in the main text.

Appendix F Demand-system diagnostics

This appendix presents diagnostics and sensitivity checks for the Koijen-Yogo demand system estimation. Section F.1 reports the $\hat{\beta}_0$ cap sensitivity. Section F.2 documents robustness of the IXI coefficient to the ridge penalty, Section F.3 reports its subperiod path, and Section F.4 addresses base-model circularity. Sections F.5–F.7 report the full time-series and investor-type evolution of $\hat{\beta}_0$, the IXI demand coefficient, and latent demand.

F.1 β_0 cap sensitivity

Following Koijen and Yogo (2019) Assumption 2, the main specification imposes $\hat{\beta}_0 \leq 0.99$ during estimation to ensure downward-sloping demand and equilibrium uniqueness. Table 30 reports the sensitivity of the main finding to the cap value; because the estimator imposes the cap during estimation, the table varies the cap level rather than comparing to an uncapped run. The IXI–elasticity slope is virtually identical (-0.021 to -0.022) across cap values from 0.90 to 0.99, and the implied mean elasticity moves only from 0.39 to 0.36. The 0.99 cap is the least restrictive bound that excludes economically implausible upward-sloping demand, and the cross-sectional slope the paper relies on does not depend on where within this range it is set.

Table 30. β_0 cap sensitivity

Cap	IXI coefficient	t	Mean elasticity
0.90	-0.0210	-7.6	0.385
0.95	-0.0214	-7.4	0.368
0.99	-0.0215	-7.3	0.358

Note: Stock-level elasticity is recomputed after imposing each cap during investor-level estimation, then regressed on log IXI and log market equity with year fixed effects. Standard errors are double-clustered by stock and year. An uncapped estimate is not reported because $\beta_0 > 1$ implies upward-sloping demand. Estimates use the fund-only IXI measure, 2001–2023, with holdings dated by public availability.

F.2 Ridge-penalty sensitivity

The IXI coefficient is insensitive to the ridge penalty. Across 20 grid points the grid mean ranges from -1.378 to -1.428 , a maximum deviation from the baseline of 3.4% within the standard parameter range; the grid mean is computed on the sensitivity sample and is not the full-sample mean of Table 4. Table 31 reports the full grid.

F.3 Subsample stability

The AUM-weighted IXI coefficient is positive in every subperiod: $+0.20$ before 2013, $+0.07$ after, and $+0.10$ when the crisis years are excluded (Table 32).

Table 31. Ridge Penalty Sensitivity: Mean b_{IXI}

λ	$\xi = 0.3$	$\xi = 0.5$	$\xi = 0.7$	$\xi = 0.9$
30	-1.380	-1.382	-1.391	-1.428
60	-1.379	-1.380	-1.385	-1.404
120	-1.379	-1.379	-1.382	-1.391
240	-1.378	-1.379	-1.380	-1.385
480	-1.378	-1.378	-1.379	-1.381

Notes: Mean b_{IXI} from Step 2 IV-Ridge estimation of the Kojen-Yogo demand system, averaged over 2005, 2010, 2015, and 2020. Bold cell is the baseline specification ($\lambda = 120$, $\xi = 0.7$) from Kojen & Yogo (2019) cross-validation. 200 randomly sampled ridge-estimated investors per year. Estimates use the fund-only IXI measure on the 2001–2023 sample, with the equalized instrument dated one quarter before the demand observation.

Table 32. Subsample stability of the IXI coefficient

Period	AUM-wt $\hat{\beta}_{IXI}$	Median	AUM-wt $\hat{\beta}_0$	SD	N
Full sample (2001–2023)	0.110	−0.439	0.798	4.83	19,007
Pre-2010	0.167	−0.155	0.740	2.01	6,577
Post-2010	0.095	−0.788	0.814	5.76	12,430
Pre-2013	0.202	−0.211	0.743	2.72	8,988
Post-2013	0.071	−0.836	0.822	6.10	10,019
Excl. crisis (no 08–09)	0.104	−0.491	0.801	4.97	17,450

Note: The table reports estimates from the primary specification using the equalized-IXI instrument. Means are AUM weighted following Kojen and Yogo (2019); SD is the unweighted cross-sectional standard deviation. The AUM-weighted IXI coefficient stays positive in every subsample, between 0.071 and 0.202, while the median is negative because many small investors have negative ridge estimates. Estimates use the fund-only IXI measure, 2001–2023, with holdings dated by public availability.

Table 33. Base-model elasticity as the dependent variable

Sample	IXI coefficient	t	N
All stocks	−0.0413***	−10.7	77,751
Size Q1	−0.0419***	−7.4	15,561
Size Q2	−0.0426***	−9.2	15,546
Size Q3	−0.0436***	−7.5	15,546
Size Q4	−0.0337***	−7.3	15,546
Size Q5	−0.0296***	−7.1	15,552

Note: The dependent variable is stock-level elasticity from the demand system estimated *without* IXI; regressors are log IXI and log ME with year fixed effects, double-clustered by stock and year. The IXI gradient is present, with the same sign and larger magnitude, when IXI plays no role in the estimation. Estimates use the fund-only IXI measure, 2001–2023, with holdings dated by public availability.

F.4 Base-model elasticity robustness

Table 33 addresses whether IXI’s explanatory power is mechanically inflated by its inclusion in the demand estimation. The table reports the stock-level gradient when elasticity is computed from the base model estimated without IXI: -0.041 ($t = -10.7$) on all stocks and between -0.030 and -0.044 within every size quintile, all significant at the 1% level. The gradient is steeper than with the IXI model’s elasticity (Table 7), so conditioning on IXI in estimation does not produce the relation.

F.5 Price sensitivity (β_0) over time and across investors

Figure 12 compares the AUM-weighted $\hat{\beta}_0$ from the demand system with IXI and from the base model without it, and Figure 14 reports the corresponding investor-level elasticity.

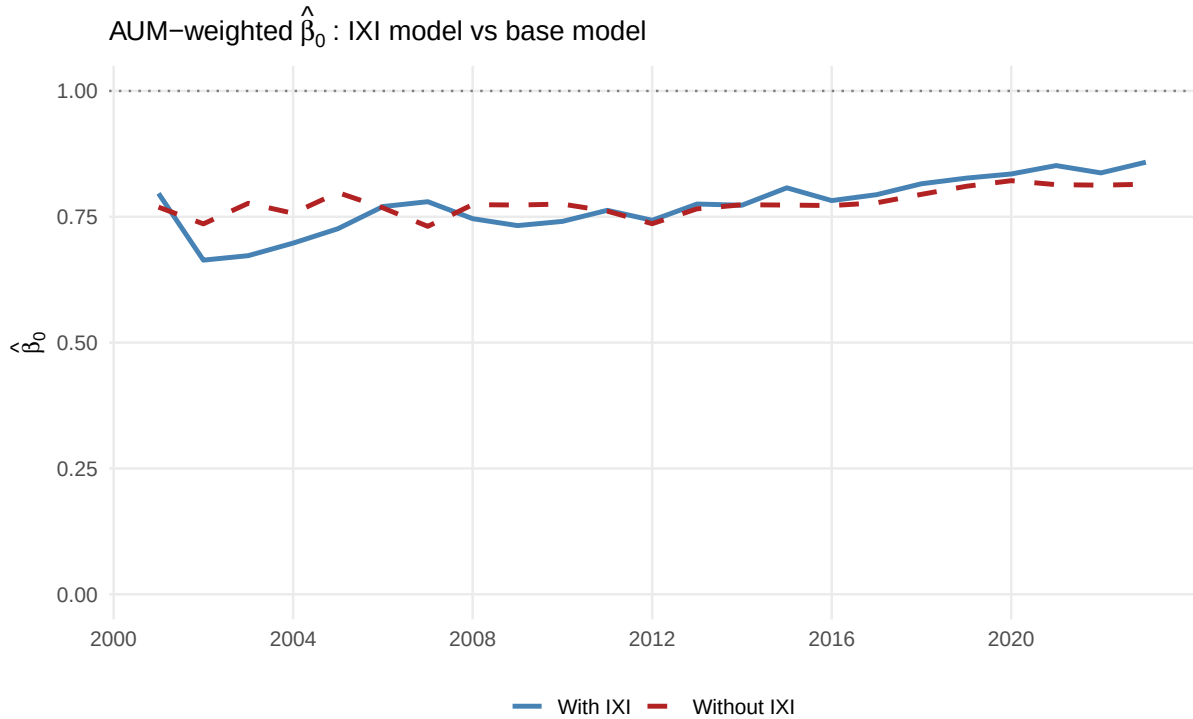


Figure 12. Price sensitivity: IXI model versus base model

AUM-weighted $\hat{\beta}_0$ from the demand system with IXI (solid) and the base model without IXI (dashed), 2001–2023. Omitting IXI attributes part of the passive-tracking channel to price sensitivity, lowering measured $\hat{\beta}_0$.

F.6 IXI demand-coefficient heterogeneity

Figure 15 plots the AUM-weighted IXI demand coefficient by year, and Figure 16 reports it by FactSet investor type.

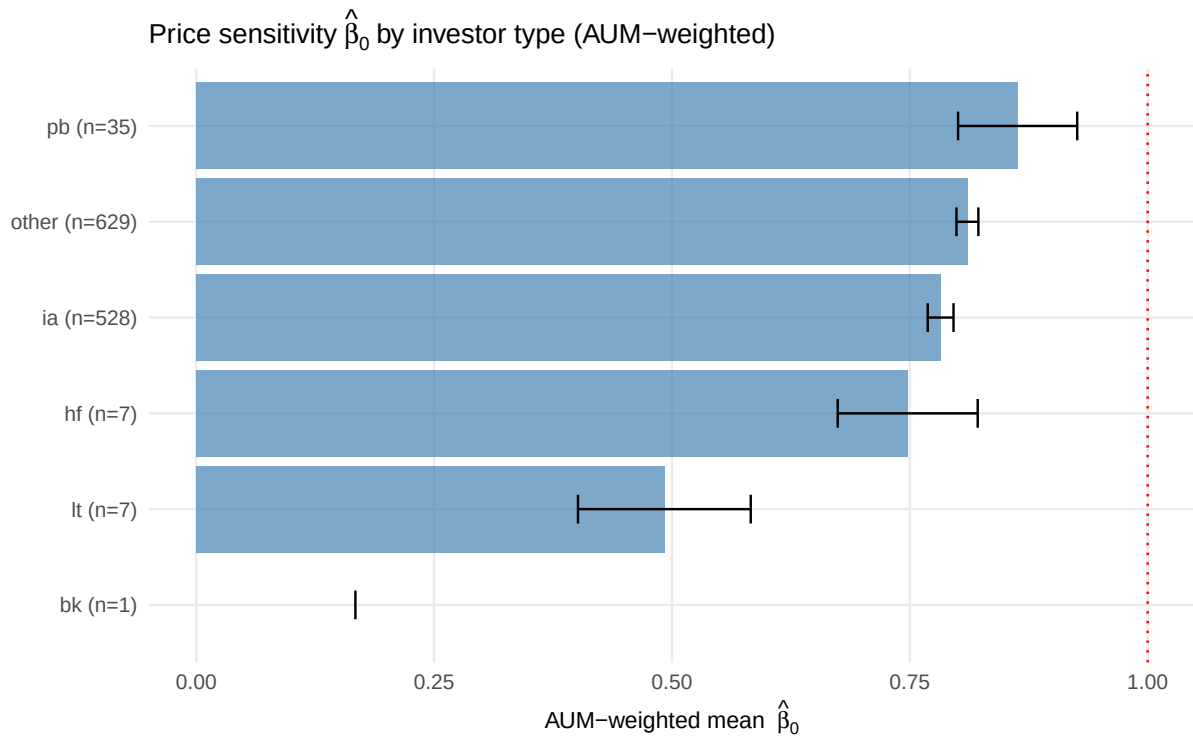


Figure 13. Price sensitivity (β_0) by investor type

AUM-weighted mean β_0 by investor type.

F.7 Latent demand and model fit

Figure 17 plots the dispersion of log latent demand by year, and Figure 18 the fit of observed against fitted log demand.

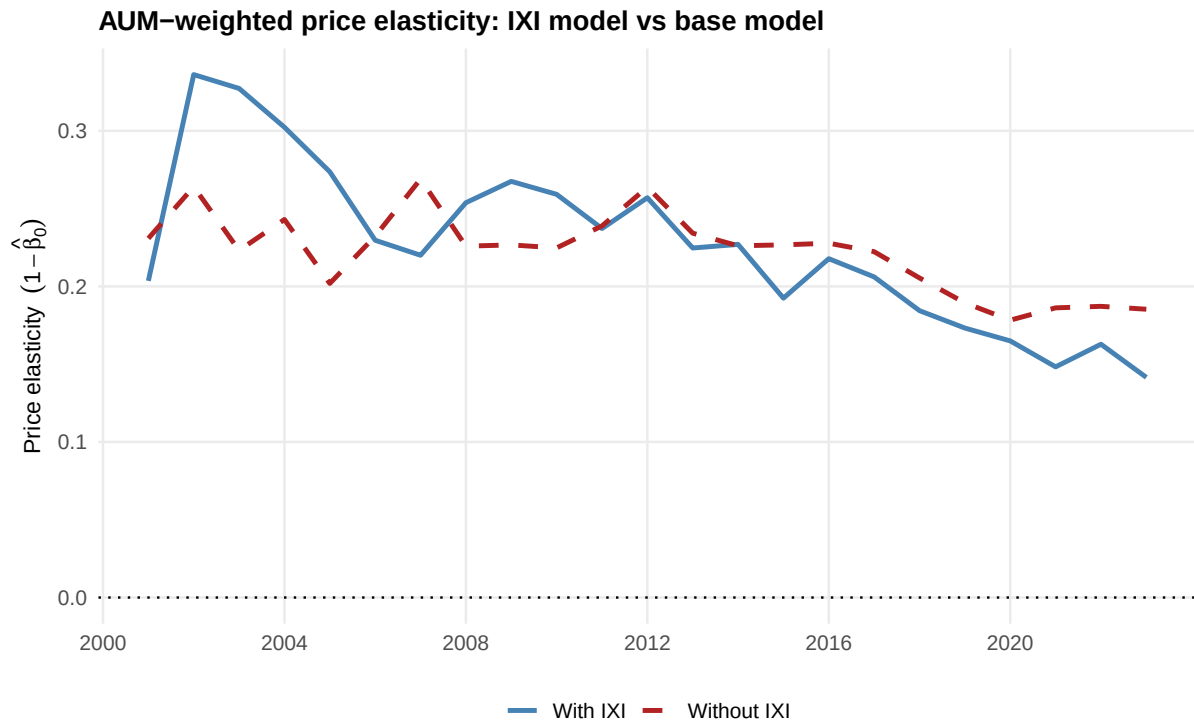


Figure 14. Price elasticity with and without IXI in the demand system

AUM-weighted investor-level price elasticity ($1 - \beta_0$) from two specifications: with IXI included (blue) and without IXI (red). Omitting IXI yields lower β_0 and higher measured elasticity. The AUM-weighted investor-level elasticity is 0.212 (no IXI) vs. 0.202 (with IXI), a 5% reduction.

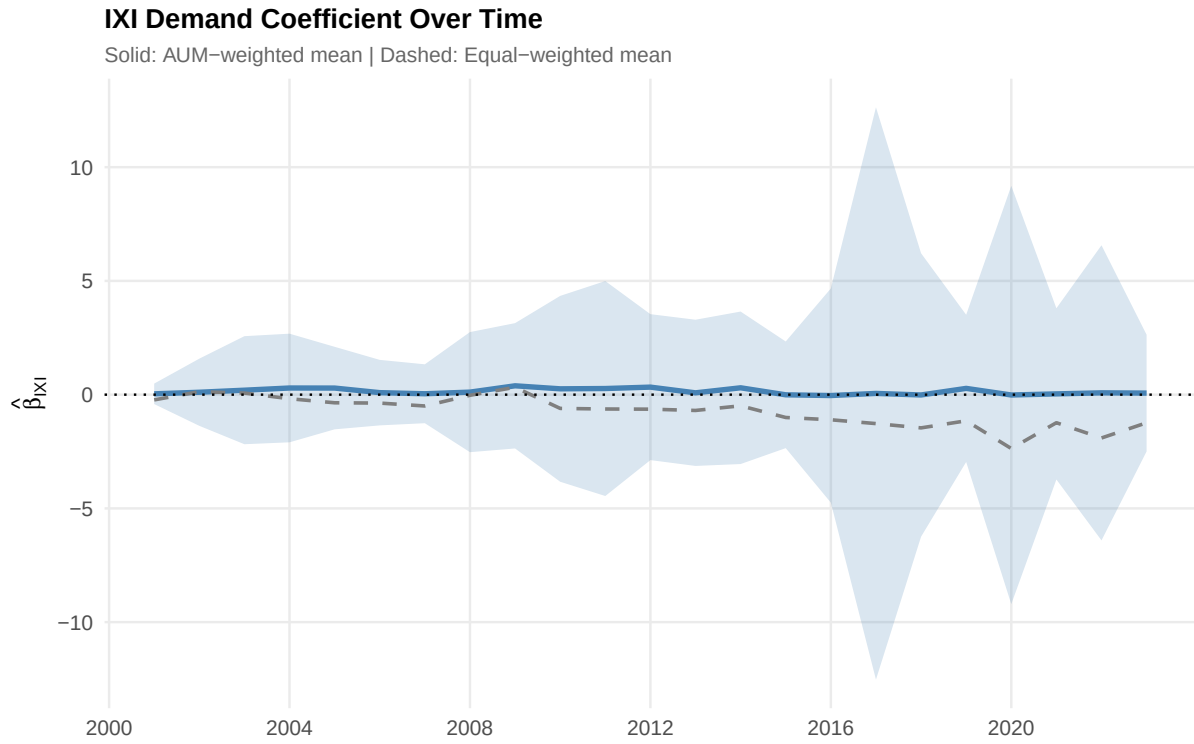


Figure 15. IXI demand coefficient over time

AUM-weighted average IXI demand coefficient ($\beta_{1,i,t}$) from equation (16), 2001–2023. The AUM-weighted mean is approximately +0.04 in 2001 and +0.07 in 2023, reflecting aggregate near-neutrality. The shaded area shows one standard deviation across investors.

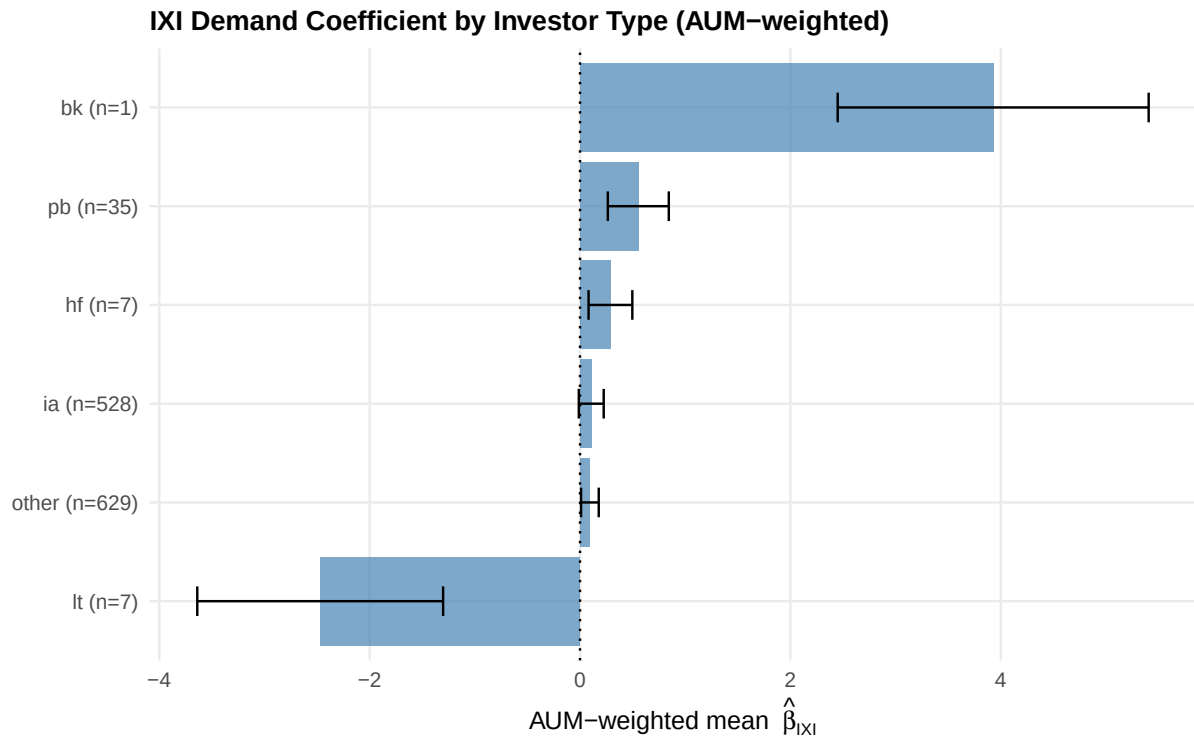


Figure 16. IXI demand coefficient by FactSet investor type

AUM-weighted mean IXI demand coefficient ($\hat{\beta}_{IXI}$) by FactSet investor type, with 95% confidence intervals. Hedge funds ($n = 7$ investors) and banks ($n = 1$) have AUM-weighted means that reflect a handful of entities. See Figure 5 for the fund-based classification used in the main text.

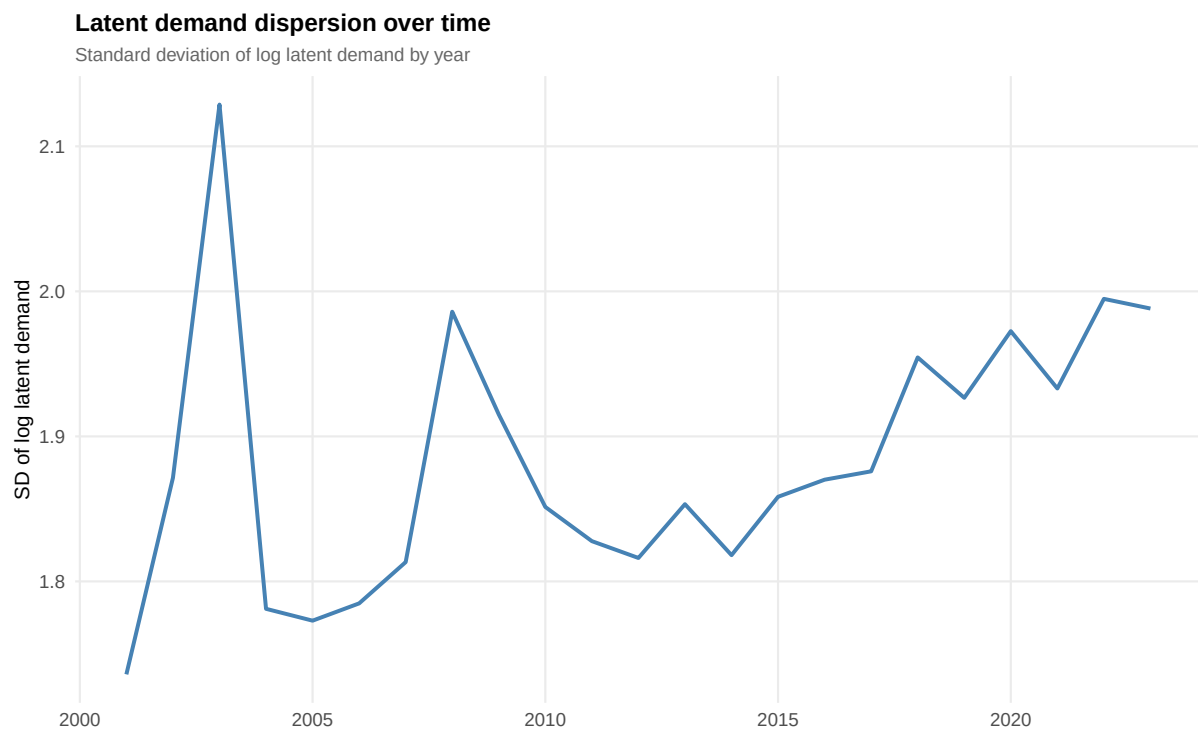


Figure 17. Latent demand dispersion over time

Standard deviation of log latent demand by year in the demand system that includes IXI.

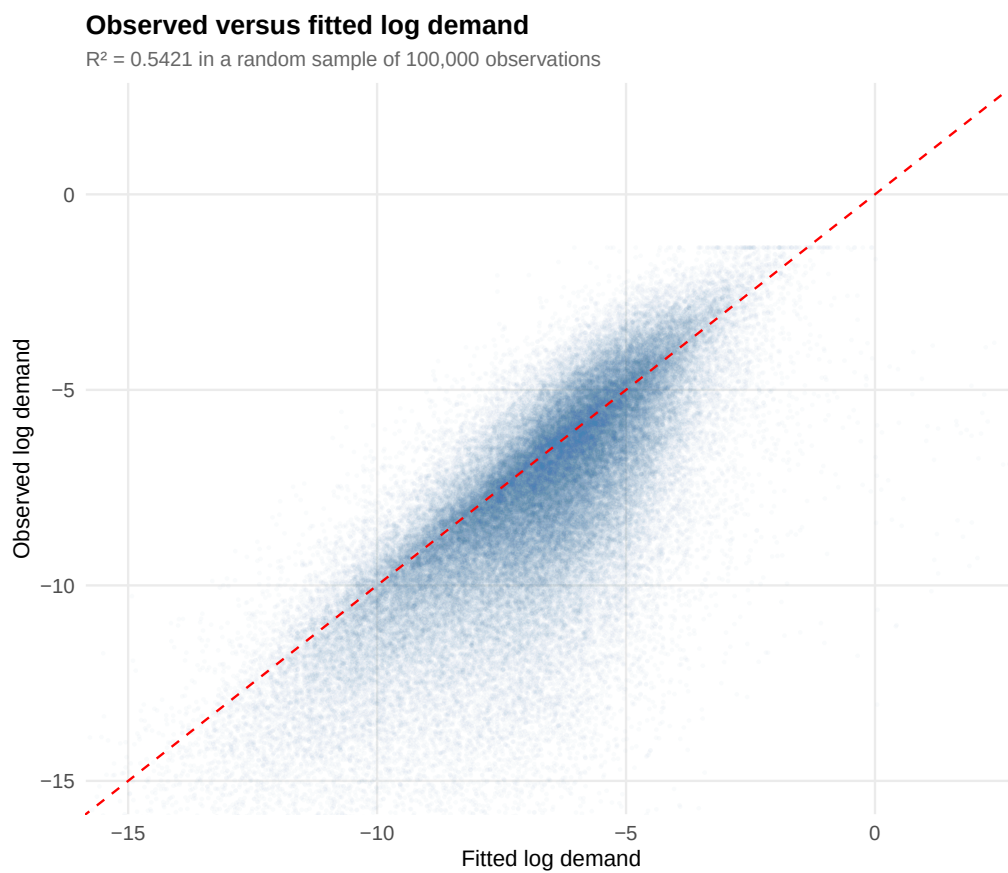


Figure 18. Observed versus fitted log demand

Scatter plot of observed versus fitted log demand ($\log \delta$) on a random subsample. $R^2 = 0.54$ on the log scale.

Appendix G Identification and instrument robustness

This appendix presents identification and instrument-robustness diagnostics: first-stage strength and Hausman comparison (G.1), a falsification using pure active investors (G.2), the lag-2 instrument comparison (G.3), exclusion-restriction controls for visibility and liquidity (G.4), Active Share adjustment sensitivity (G.5), benchmark assignment sensitivity (G.6), a double sort of IXI with profitability (G.7), a future-IXI falsification (G.8), and substitution-structure and dynamics diagnostics (G.9). It opens with the year-by-year instrument diagnostics.

The demand estimation rests on the equalized-IXI instrument. Table 34 reports stock-year diagnostics, distinct from the investor-level demand moments. The instrument is significantly related to realized IXI in 20 of 23 years: the stock-level partial R^2 of the equalized instrument for log IXI, conditional on size and book equity, is 0.04 in 2001 and 0.03–0.05 in recent years, and the within-year first-stage t -statistics exceed conventional thresholds in every year except 2010 to 2012 (Table 34). The conditional coefficient is positive through 2008 (0.15, 0.13, and 0.19 in 2001, 2004, and 2008), near zero in 2010 to 2012, and negative thereafter (−0.12, −0.26, and −0.21 in 2014, 2018, and 2023); because the demand system is estimated year by year, the reversal does not weaken identification within a year, but the instrument’s relation to realized IXI is of the opposite sign in the second half of the sample. Because the conditional relation between index breadth and market capitalization shifts as passive capital concentrates in the largest stocks, all instrument diagnostics are estimated year by year rather than pooled across regimes. The index-assignment event study of Section 4.5 corroborates identification from variation that does not use the instrument at all. The Hausman comparison of Section 3.6 shows that instrumenting changes the estimates, and a second-lag instrument, which retains equalization but dates exposure one quarter earlier, recovers the same sign in 21 of 23 years and nearly the same magnitude on the equal-weighted by-year path (Sections G.1 and G.3).

Table 34. Instrument diagnostics by year and Hausman comparison

<i>Panel A: Stock-level first stage by year (conditional on size and book equity)</i>							
	2001	2004	2008	2010	2014	2018	2023
Partial R^2	0.04	0.02	0.03	0.00	0.01	0.05	0.05
First-stage coefficient	0.15	0.13	0.19	0.00	−0.12	−0.26	−0.21
t -statistic	10.8	7.3	9.8	0.1	−5.0	−11.5	−12.2
<i>Panel B: Hausman comparison, instrumented vs raw IXI coefficient</i>							
	IV		Raw				
AUM-weighted mean	0.101		0.111		ratio 0.9; paired $t = -23$		
Median	−0.443		0.015		18,854 investor-years		

Note: Panel A reports, for selected years, the partial R^2 and the coefficient from yearly regressions of log IXI on the log equalized instrument, log book equity, and log market equity. The conditional coefficient has an absolute OLS t -statistic above 1.96 in 20 of the 23 sample years and changes sign around 2010, so pooled diagnostics would average across two regimes. Panel B compares investor-level IXI demand coefficients estimated with the equalized instrument and with raw IXI on the matched investor-year sample. Estimates use the fund-only IXI measure, 2001–2023, with holdings dated by public availability.

The gradient itself is stable across every specification we report (Appendix I). The coefficient moves by less than 10% across the ridge-penalty grid, and the benchmark-assignment method

is innocuous (Spearman $\rho = 0.979$ between the best-fit assignment used in construction and a stated-benchmark variant; Section G.6); S&P 500, Russell 1000, and Russell 2000 membership dummies retain 90% of it, and institutional-ownership-structure controls between 82% and 136%; and a pooled lasso over 59 candidate characteristics selects IXI at both standard penalty choices. In a Shapley-Owen R^2 decomposition, IXI accounts for between 34% and 57% of the explained cross-sectional variation in stock-level elasticity in every sample year, absorbing most of what the standard model attributes to book equity.

G.1 First-stage strength and Hausman comparison

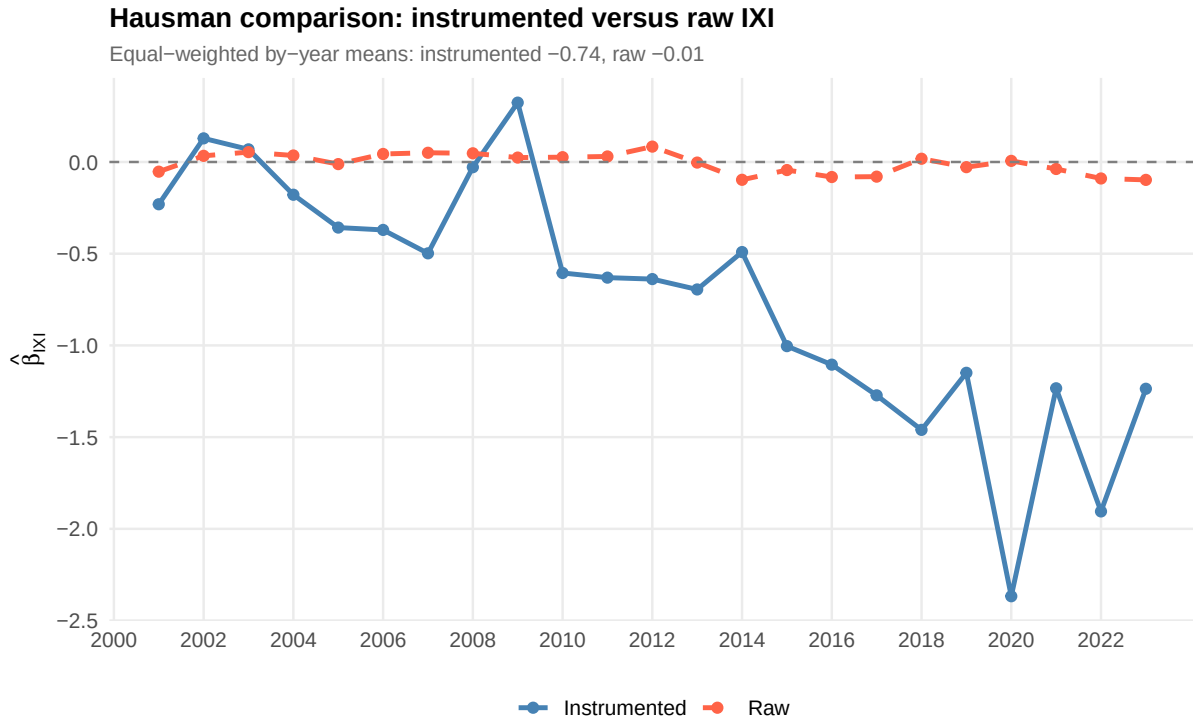


Figure 19. Instrumented versus raw IXI coefficients over time

AUM-weighted mean IXI demand coefficient from the IV specification (solid) and raw uninstrumented specification (dashed). The equal-weighted by-year raw path is indistinguishable from zero (mean -0.01) while the instrumented path averages -0.74 ; the AUM-weighted means are 0.10 (IV) and 0.11 (raw).

On a paired basis across 18,854 investor-years the instrumented coefficient differs from the raw one ($t = -23$; Figure 19), and the gap is concentrated among smaller investors, where the unweighted and capital-weighted summaries differ most. Section G.3 separately checks sensitivity to an additional quarter of instrument lag.

G.2 Falsification using purely active investors

If IXI captures a genuine passive demand channel, it should predict the portfolio allocations of passively managed or benchmark-tracking investors but not those of pure active investors such

as hedge funds. Table 35 disaggregates the investor-level IXI demand coefficient ($\hat{b}_{IXI}$) from the Kojien-Yogo demand system by investor type.

The results support the passive-channel interpretation. Using the fund-based passive classification (Appendix E, Section E.1), predominantly passive entities ($> 50\%$ index fund AUM) exhibit a large positive AUM-weighted IXI coefficient (+0.89), while purely active entities show a negative coefficient (-0.27) and mixed entities sit between them (+0.25). The falsification is sharpest among active hedge funds: if IXI captured a general characteristic effect rather than a passive-specific channel, investors with no passive mandate would still load on it. They do not load positively; their AUM-weighted coefficient is negative (-0.10), consistent with active hedge funds tilting away from heavily indexed stocks rather than tracking them.

Table 35. IXI demand coefficient by fund-based passive classification

Group	$\hat{\beta}_{IXI}$ (AUM-wt)	$\hat{\beta}_{IXI}$ (equal-wt)	Investors	AUM (\$T, summed)
Active ($< 1\%$ passive fund AUM)	-0.267	-0.933	1,023	256
Mixed (1–50%)	0.254	-0.296	222	65
Passive ($> 50\%$)	0.888	0.636	108	112
Active hedge funds	-0.099	-0.119 ($t = -1.1$)	88	

Note: Investor-level IXI demand coefficients from the demand system, by fund-based passive classification (entities with no linked funds carry no passive fund AUM and are classified active). AUM column sums investor-year AUM over the sample. The hedge-fund row restricts to FactSet hedge funds in the active group: investors with no passive mandate show no positive IXI tilt, the falsification the instrument-validity argument requires. Estimates use the fund-only IXI measure, 2001–2023, with holdings dated by public availability.

G.3 Second-lag instrument comparison

Figure 20 compares the IXI demand coefficient under the baseline equalized instrument with the same instrument lagged by a second stock quarter. The equal-weighted annual coefficient paths share the same sign in 21 of 23 years and have a correlation of 0.99; the second-lag path recovers about 96 percent of the baseline magnitude. The result is therefore similar when the equalized exposure is measured earlier. Both specifications retain the equalized construction and its exclusion restriction.

G.4 Controls for visibility and liquidity

A potential concern with the IXI instrument is that index membership may proxy for analyst coverage, liquidity, or institutional visibility, all of which could independently affect demand elasticity. To address this, Table 36 progressively augments the baseline stock-level elasticity regression with analyst coverage (IBES), proportional bid-ask spread (CRSP), trading volume, and share turnover (daily volume / shares outstanding).

Adding analyst coverage, spread, and volume reduces the IXI coefficient from -0.287 to -0.201 , and it remains statistically significant. Adding turnover and year-by-size-quintile effects gives a coefficient of -0.243 , retaining 85 percent of the baseline magnitude. These fixed effects absorb differences across size groups within each year. The negative IXI gradient therefore survives comparisons among stocks in the same size group and controls for observed visibility and liquidity.

Table 36. Visibility and liquidity controls

	(1) Baseline	(2) + Analysts	(3) + Spread	(4) + All	(5) + Year×Size FE
IXI	−0.287*** (0.060)	−0.242*** (0.050)	−0.172*** (0.053)	−0.201*** (0.041)	−0.243*** (0.032)
log(ME)	−0.047*** (0.002)	−0.036*** (0.002)	−0.037*** (0.003)	−0.029*** (0.003)	
log(BE)	0.012*** (0.002)	0.013*** (0.002)	0.012*** (0.002)	0.013*** (0.002)	0.010*** (0.002)
log(1 + Analysts)		−0.033*** (0.003)		−0.012*** (0.003)	−0.011*** (0.003)
log(Spread)			0.020*** (0.003)	0.009*** (0.003)	0.007*** (0.002)
log(Volume)				−0.014*** (0.002)	−0.014*** (0.003)
log(Turnover)					0.001 (0.003)
Fixed effects	Year	Year	Year	Year	Year×Size Q
Clustering	P+Y	P+Y	P+Y	P+Y	P+Y
<i>N</i>	77,713	77,713	77,713	77,713	77,713
Within <i>R</i> ²	0.237	0.247	0.242	0.259	0.036
IXI % change from (1)		−15.6%	−39.9%	−29.9%	−15.3%

Notes: This table tests whether the IXI–elasticity relationship survives controlling for stock-level visibility and liquidity proxies. The dependent variable is the stock-level aggregate price elasticity from the demand system. Column (1) is the baseline. Columns (2)–(4) progressively add analyst coverage (IBES), bid-ask spread (CRSP), and trading volume. Column (5) adds turnover (daily volume / shares outstanding) and replaces year fixed effects with year×size-quintile fixed effects, which absorb differences across size groups within each year. All five columns are estimated on one common sample. IXI retains 85% of its baseline magnitude in column (5). Standard errors are double-clustered by stock (P) and year (Y). Significance: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Estimates use the fund-only IXI measure, 2001–2023, with holdings dated by public availability.

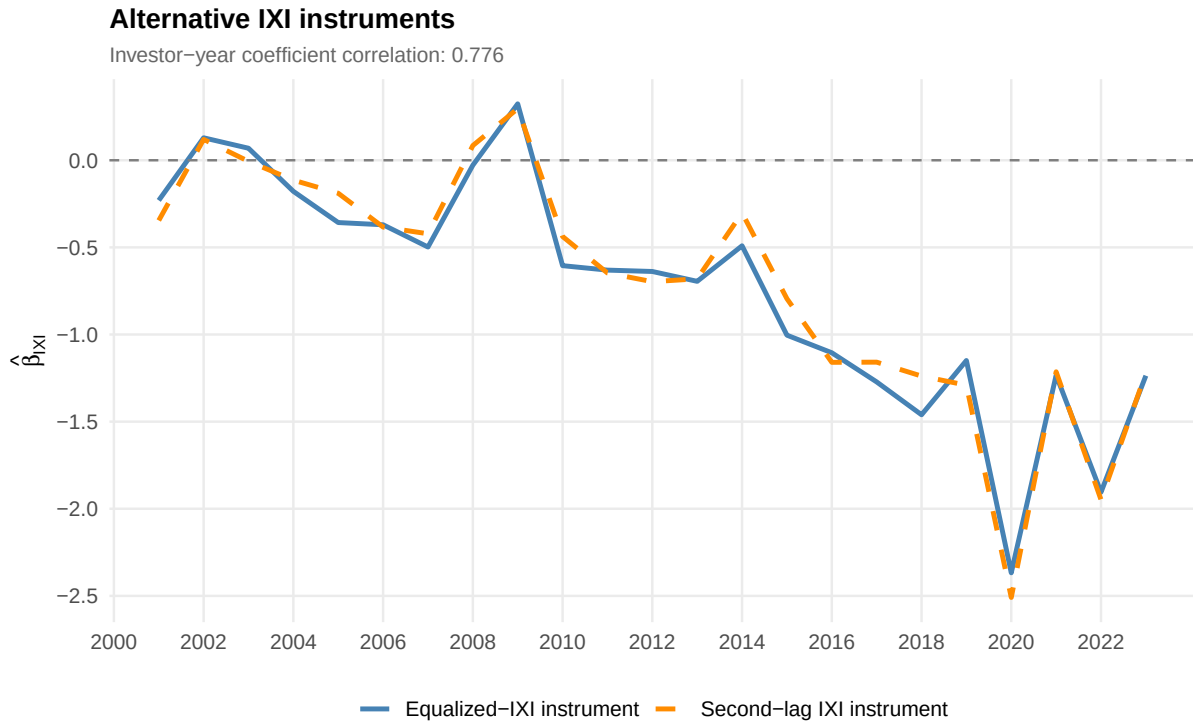


Figure 20. Alternative IXI instruments

Equal-weighted by-year mean IXI demand coefficient from the equalized instrument (solid) and its second-quarter lag (dashed), 2001–2023. The lag-2 path tracks the equalized path in sign, trend, and magnitude (investor-year correlation 0.78, by-year path correlation 0.99).

G.5 Active Share adjustment

The channel regressions test the Active Share adjustment directly. Splitting each stock’s IXI into its pure-passive share and the Active-Share-adjusted holdings of benchmarked active funds, the component horse race in Appendix C shows the declared-passive, CI, and PCI components each entering negatively and significantly (Table 27). The capital retained by the adjustment therefore has passive-like price content. This statement concerns its association with elasticity; the within-fund flow tests in Table 14 do not support a general claim of passive-like trading behavior.

G.6 Benchmark assignment

The primary measure assigns each active fund to the benchmark whose weights overlap most with its realized portfolio (Appendix B), in the spirit of the minimum Active Share assignment of Cremers and Petajisto (2009). As a sensitivity test, we instead assign every fund to its stated prospectus benchmark. Despite frequent disagreement between stated and best-fit benchmarks at the fund level (consistent with Sensoy, 2009), the stock-level measure is nearly unchanged: the Spearman rank correlation is 0.979, with 87% of stocks in the same quintile and 99% within one quintile. Most IXI dollars come from realized index-fund holdings, which are unchanged by

this reassignment; only the active-fund branch moves.¹⁸ The assignment rule has little effect on stock rankings, but best fit preserves the economic meaning of indexing capital when labels and portfolios disagree.

G.7 Double sort on IXI and profitability

A concern is that IXI proxies for firm quality: profitable, dividend-paying stocks are disproportionately included in major indices, and profitability independently affects demand elasticity. To address this, we sort stocks independently into IXI quintiles and profitability quintiles within each year and compute mean elasticity for each of the 25 cells. The IXI Q5–Q1 elasticity spread is highly significant within *every* profitability quintile: -0.141 ($t = -32.9$) among low-profitability stocks, -0.238 ($t = -57.6$) among mid-profitability stocks, and -0.205 ($t = -40.7$) among high-profitability stocks. A regression with an $\text{IXI} \times \text{profitability}$ interaction term confirms that the interaction is marginally significant ($t = -2.1$) but economically small (-0.007), meaning the IXI–elasticity gradient is present at all profitability levels with only modest variation. The negative IXI gradient persists within each profitability quintile.

G.8 Future-IXI falsification

If the IXI–elasticity relationship were driven by trending firm characteristics (e.g., stocks gradually becoming “blue-chip” quality) rather than contemporaneous passive ownership, then *future* IXI changes should predict *current* elasticity even after controlling for current IXI. We test this by regressing stock-level elasticity at time t on current $\log(\text{IXI}_t)$ and the future IXI change $\Delta \log(\text{IXI})_{t+1 \rightarrow t+2}$, using December-measured monthly IXI for precise timing. The future change variable has low correlation with current IXI ($r = -0.19$), avoiding the multicollinearity that contaminates tests using future IXI levels ($r = 0.87$).

The future change coefficient is $+0.003$ ($t = 1.49$, $p = 0.15$) with double-clustered standard errors (stock and year), insignificant and with the *opposite* sign from what the trending-characteristics story predicts (which requires a negative coefficient). Adding firm fixed effects to absorb all time-invariant stock characteristics reduces the future change coefficient to -0.000 ($t = -0.34$, $p = 0.74$), statistically indistinguishable from zero. Current IXI retains a negative, statistically significant coefficient in both specifications. The near-zero future coefficient favors contemporaneous passive ownership over trending firm characteristics.

G.9 Substitution structure and dynamics

The demand system restricts cross-asset substitution through investor-level price coefficients (Koijen and Yogo, 2019; Fuchs et al., 2025; Haddad et al., 2026). This restriction matters for the interpretation of elasticity levels. Dynamic price adjustment is a separate concern: supply-shock instruments can affect return variance and the relation between estimated and structural demand slopes (He et al., 2025; van Binsbergen et al., 2026). On the monthly ownership design used for the price results, the cumulative return after the impact window provides no evidence of positive build-up through month twelve. This timing evidence does not establish the exclusion restriction or validate the model’s substitution structure. The mechanical benchmark of Section 2.4 remains an accounting comparison that holds the active response fixed.

¹⁸The alternative modifies only active funds: overlap with the stated benchmark replaces best-fit overlap, and contributions follow the stated benchmark’s weights. Index-fund holdings and the market-capitalization denominator are unchanged.

Appendix H Event-study evidence

This appendix presents the S&P 500 dynamic difference-in-differences evidence (H.1), uses Russell reconstitution to validate the timing and price implications of IXI (H.2), and discusses the bridge to the strategic-response framework of [Haddad et al. \(2025\)](#) (H.3).

H.1 S&P 500 pretrend and dynamic difference-in-differences

The matched dynamic difference-in-differences design and its coefficients are reported in the main text (Figure 9 and Table 37); this appendix records the full event-time path behind them. Table 37 lists the full event-time path and the pre-event coefficients underlying the parallel-trends checks: neither the IXI pre-trend joint test ($F = 1.52$, $p = 0.22$) nor the elasticity pre-trend joint test ($F = 0.19$, $p = 0.83$) rejects.

Table 37. S&P 500 additions: dynamic difference-in-differences

Event time	−3	−2	−1	+0	+1	+2	+3
IXI	−0.007* (0.004)	−0.004 (0.003)	0 (ref.)	0.013*** (0.002)	0.017*** (0.004)	0.018*** (0.004)	0.015*** (0.005)
Elasticity	−0.009 (0.015)	−0.003 (0.011)	0 (ref.)	−0.011* (0.006)	−0.019*** (0.006)	−0.019*** (0.006)	−0.025*** (0.006)

Note: Event-time difference-in-differences coefficients relative to year -1 , 163 S&P 500 additions (2002–2022) matched to same-year controls of similar size and closest pre-event IXI; IXI is dated at the report month, so a position enters the measure in the month it was held rather than when the report became public; the elasticity leg is the demand model estimated with holdings dated by public availability; standard errors clustered by event. Pre-trend joint tests (years -3 , -2): IXI $F = 1.52$ ($p = 0.22$); elasticity $F = 0.19$ ($p = 0.830$).

H.2 Russell reconstitution and realized IXI

Russell reconstitution validates that IXI records benchmark-linked ownership when tracker mandates change. The test uses the public May-to-June change in Benchmarking Intensity as an external measure of the benchmark-contract shock and treats IXI as the outcome. The sample contains Russell 1000 and Russell 2000 incumbents from 2007 through 2018 within 300 reconstructed company ranks of the applicable promotion or demotion edge. Controls include capitalization, local rank slopes, prior membership, band status, beta, lagged spread and turnover, prior December IXI, and year effects. The provider’s proprietary rank-day capitalization remains unavailable, so this is a local exposure design rather than a Russell assignment discontinuity.

Figure 21 traces the monthly IXI response relative to the prior December. The January through May coefficients are close to zero. The response appears in June, completes by September, and persists through year-end. In September, the coefficient is 0.203 with a first-stage F -statistic of 101.35; adding firm fixed effects yields 0.188. The March-to-September coefficient is positive at each of the three bandwidths, remains positive when any single year is omitted, and has an exact year-cluster sign-flip p -value of 0.0005. The timing is therefore specific to implementation rather than a continuation of pre-event IXI movement.

Licensed tracker holdings corroborate the timing result. FactSet IWB and IWM positions move in the direction prescribed by each observed transition (Table 38). IWB ownership rises and IWM ownership falls for Russell 2000 to Russell 1000 transitions; the signs reverse for Russell

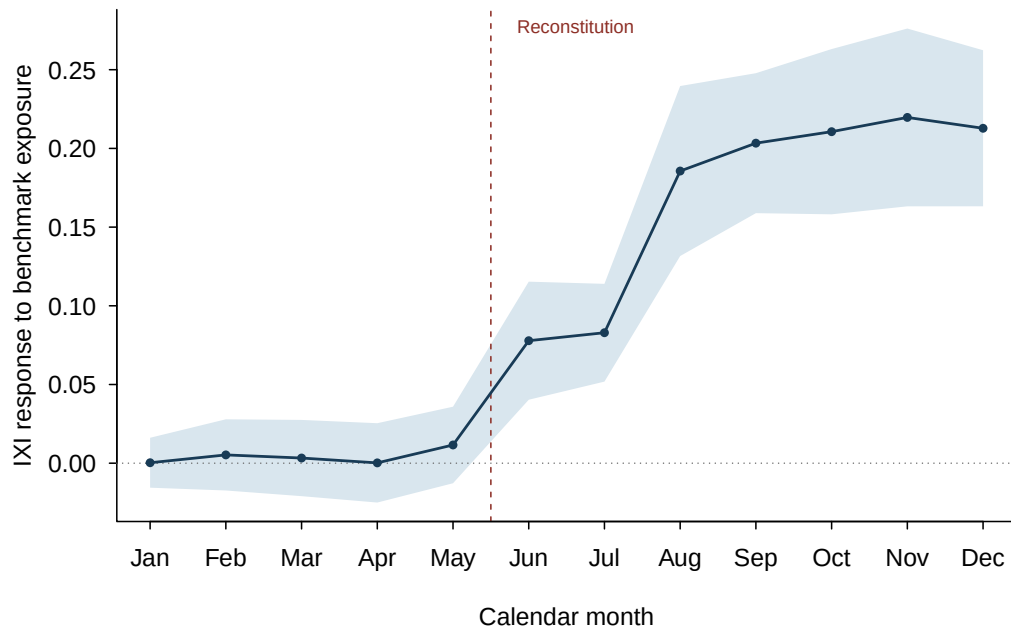


Figure 21. IXI around Russell reconstitution

The figure plots the coefficient of the public May-to-June change in Benchmarking Intensity on monthly IXI measured relative to the prior December. The local sample contains post-banding Russell incumbents from 2007 through 2018 within 300 reconstructed company ranks of the applicable transition edge. Shading gives 95% confidence intervals based on the largest of two-way PERMCO-year, year-clustered, and PERMCO-clustered standard errors, evaluated with eleven reference degrees of freedom. The vertical line marks the start of annual reconstitution.

1000 to Russell 2000 transitions. These portfolio changes validate the economic content of the exposure shock but cannot instrument for IXI independently because tracker holdings are part of realized passive ownership.

Table 38. Russell transitions and realized tracker ownership

Transition	Observations	Δ IWB	Δ IWM	Δ IXI
Russell 1000 to Russell 2000	255	-0.043	1.156	3.095
Russell 2000 to Russell 1000	295	0.081	-2.156	-0.969

Notes: The table reports mean changes in percentage points around annual Russell reconstitution for observed transitions in the 2007–2018 local sample. IWB tracks the Russell 1000 and IWM tracks the Russell 2000. For each fund-year, the pre-event position comes from the latest FactSet holdings report on or before May 31 and the post-event position from the first report between June 25 and August 31. Holdings are divided by split-adjusted CRSP shares outstanding. The signs show tracker reassignment and are descriptive, not a separate instrument for IXI. IXI is the fund-only IXI measure, so the post-event change is measured once the reconstituted positions are public, about two months after the June reconstitution. Time-valid identifiers map 99.95% of source keys, CRSP shares cover 98.25% of mapped holdings, and post-event tracker presence agrees with observed Russell membership for 97.25% of the local sample.

The tracker holdings also supply the pre-event ownership inputs for the price test. The predicted change combines ownership in the departing tracker with the destination tracker’s median ownership among incumbents in the prior June, with the event assignment determining the direction. Its correlation with the observed tracker change is 0.954. This construction uses neither the stock’s post-event holding nor the destination tracker’s post-event median.

The price comparison covers twelve annual reconstitutions. Table 21 therefore reports year-level sign-flip inference as well as clustered standard errors. The return interval begins after publication of the preliminary list and ends at implementation; the ownership inputs precede the event.

H.3 Bridge to strategic response

The bridge to Haddad et al. (2025) has two parts. First, the pass-through of the non-indexed share into stock-level elasticity (Table 39). Their Table 4 reports about one third, the value their estimated strategic response implies; one is the no-response benchmark. In this demand system each investor’s price coefficient is estimated at the investor-year level, so a stock’s elasticity moves with passive ownership only through the composition of its holders, and the pass-through is 1.1 (standard error 0.1) with year effects, 1.1 with stock and year effects, and 1.7 (standard error 1.1) with S&P 500 additions as the instrument. The comparison with their third reflects the elasticity object each system produces, not an independent test of the response; the aggregate accounting of Section 4.4.1 is a no-response accounting.

Second, the within-investor conduct test of Table 18, reported for every investor group and both treatments of IXI in Table 40. With realized IXI the interaction is positive for every active group, the same for complexes above and below 60 percent fund Active Share, and unchanged by a size horse race or by a quadratic in the price term. Instrumenting IXI with the equalized allocation reverses it, to -0.14 (0.05) for active complexes, with a reduced form of -0.12 ($t = -7$), -0.04 for all investors, -0.06 for all active filers, and zero for passive complexes. The

instrumented gradient is the one strategic substitution predicts. A quadratic in the instrumented price term leaves the interaction negative but imprecise, so curvature is not excluded in the instrumented specification; it is absent with realized IXI. The instrumented size horse race in column (12) has no usable precision, with a standard error of 38 on the interaction, and is reported only for completeness.

Table 39. Pass-through of passive ownership into stock-level elasticity

	(1)	(2) OLS	(3)	(4) IV
<i>Panel A: HHL units, $\Delta \log(1 - \text{IXI}_{n,t})$</i>				
$\Delta \log(1 - \text{IXI})$	1.115*** (0.106)	1.091*** (0.105)	1.156*** (0.122)	1.713 (1.088)
First-stage F				28.5
N	64,909	63,994	64,909	1,986
<i>Panel B: own units, $\Delta \log \text{IXI}_{n,t}$</i>				
$\Delta \log \text{IXI}$	-0.051*** (0.007)	-0.053*** (0.006)	-0.053*** (0.007)	-0.263 (0.174)
First-stage F				16.0
N	64,909	63,994	64,909	1,986
Year FE	Yes	Yes	Yes	Yes
Stock FE		Yes		
Book equity controls			Yes	

Notes: The dependent variable is the annual change in the log of a stock's aggregate demand elasticity; observations are consecutive stock-year pairs from 2001 to 2023. Panel A expresses passive ownership in the units of [Haddad et al. \(2025\)](#), the log of one minus the indexed share, so the coefficient is the pass-through of a change in the non-indexed share into elasticity. Panel B uses the paper's own units. Column (3) adds lagged log book equity and its annual change. Column (4) instruments it with an indicator for a treated stock in its S&P 500 addition year and the year after, on the size- and IXI-matched addition sample. Standard errors are two-way clustered by stock and year.

Reading. [Haddad et al. \(2025\)](#) report 0.26 by OLS, 0.35 to 0.39 with fixed effects, and 0.34 by instrumental variables in their Table 4. A pass-through of one is the no-response benchmark, the value that obtains when investors leave their price coefficients unchanged as indexed ownership rises. Price coefficients here are estimated at the investor-year level, so a stock's elasticity moves with its passive share only through the composition of its holders. A pass-through at or above one therefore says that holder composition alone delivers the full mechanical effect, and the within-investor response is estimated separately in Table 18.

Table 40. Within-investor conduct by investor group and by instrument

	<i>Dependent variable: $\ln(w_{i,t}(n)/w_{i,t}(0))$</i>													
	Realized IXI in the instrument							Equalized IXI in the instrument						Realized
	(1) All actives	(2) Linked actives	(3) Linked $AS \geq 0.6$	(4) Linked $AS < 0.6$	(5) Linked advisers	(6) All actives size race	(7) Linked actives size race	(8) Linked actives	(9) All 13F	(10) All actives	(11) Passive (placebo)	(12) Linked actives size race	(13) Linked actives quadratic	(14) Linked actives quadratic
Log market-to-book (IV), β_0	1.061*** (0.071)	1.297*** (0.100)	1.280*** (0.108)	1.311*** (0.164)	1.319*** (0.116)	1.076*** (0.070)	1.306*** (0.106)	1.021*** (0.089)	1.022*** (0.062)	0.949*** (0.094)	1.182*** (0.077)	1.397** (0.708)	0.733** (0.370)	1.289*** (0.148)
Log market-to-book $\times$ Log IXI (IV)	0.130** (0.054)	0.293*** (0.096)	0.297*** (0.107)	0.305*** (0.052)	0.297*** (0.111)	0.118** (0.053)	0.288*** (0.098)	-0.141** (0.055)	-0.036 (0.035)	-0.058 (0.082)	-0.004 (0.043)	-10.778 (37.886)	-0.376 (0.333)	0.296** (0.124)
Log market-to-book $\times$ Log ME (IV)						0.099 (0.085)	0.034 (0.109)					7.901 (27.433)		
Log market-to-book squared (IV)													0.575 (0.430)	0.008 (0.166)
Log IXI	0.140*** (0.029)	0.200*** (0.034)	0.193*** (0.036)	0.223*** (0.039)	0.199*** (0.036)	0.146*** (0.024)	0.202*** (0.030)	0.265*** (0.093)	0.464*** (0.089)	0.179* (0.100)	0.413*** (0.131)	-2.747 (9.965)	-0.060 (0.169)	0.203*** (0.035)
Reduced form, instrument $\times$ eq. IXI								-0.125*** (0.017)	-0.043** (0.020)					
First-stage F , log market-to-book	900.0	1089.3	1256.2	167.3	978.9	991.5	1209.3	755.6	565.0	840.4	692.1	962.6	1239.9	1086.5
First-stage F , IXI interaction	15.3	16.4	14.3	36.2	17.5	58.3	46.8	166.3	98.5	116.9	171.6	97.2	115.4	37.9
First-stage F , size interaction						98.3	104.3					144.3		
First-stage F , log IXI								278.8	545.7	300.9	398.9	339.6	462.1	
First-stage F , squared term												21.0	30.7	
Investor $\times$ Quarter FE								Yes						
Investors	1,023	252	206	97	145	1,023	252	252	1,207	1,023	109	252	252	252
Observations	39,294,300	8,585,676	6,835,343	1,355,095	5,698,148	39,294,300	8,585,676	8,304,741	52,081,322	38,114,860	5,099,989	8,304,741	8,304,741	8,585,676
Implied $\Delta\beta_0$, p90 vs. p10 log IXI	0.228	0.547	0.558	0.559	0.560	0.206	0.538	-0.250	-0.067	-0.097	-0.008	-19.158	-0.669	0.553

Notes: The dependent variable and controls follow Table 18. All columns use investor-by-quarter fixed effects, AUM weights, and standard errors clustered by investor, stock, and quarter. In columns (1)–(7) and (14), lagged realized log IXI is treated as exogenous; log market-to-book and its interaction with IXI are instrumented using the counterfactual market-equity instrument and its interaction with realized IXI. Columns (8)–(13) also instrument IXI, using equalized log IXI and its interaction with the market-equity instrument. Active entities have less than 1 percent passive fund AUM; “all actives” includes entities without linked funds, while “linked” requires a fund match. Entity Active Share is the AUM-weighted mean across linked active funds. Predominantly passive entities have more than 50 percent passive fund AUM. Columns (6), (7), and (12) add an instrumented price-by-size interaction; columns (13) and (14) add an instrumented squared price term. The reduced-form row uses the market-equity instrument interacted with equalized log IXI. The last row scales the interaction by each sample’s p90–p10 gap in standardized log IXI. Coefficient equality across columns is not implied by separate significance tests. * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$.

A cross-investor analogue of their structural χ , which compares investors rather than stocks, is not recoverable in this setting. In the HHL model each investor's elasticity falls with the aggregate elasticity of the stocks she holds, $\mathcal{E}_{ik} = \underline{\mathcal{E}}_i - \chi \mathcal{E}_{agg,k}$ with $\chi > 0$ under strategic substitution. The reduced-form analogue regresses $1 - \hat{\beta}_{0,i}$ on the portfolio-weighted aggregate elasticity of stocks held, instrumented with portfolio-weighted IXI. Sorting drives this regression. Elastic investors hold elastic portfolios, with a cross-investor correlation of +0.39, so the slope carries the wrong sign for the within-stock substitution HHL identify. The instrument does not resolve this problem because an investor's own price sensitivity determines both the stocks she holds and her portfolio's index exposure. The bridge therefore runs through the stock-level objects above, where active and passive capital can be separated.

Two further position-level checks do not sharpen the reconstitution result of Table 15. A fund-flow test does not establish passive-like pass-through. The direct-flow loading is 1.451 for overlap and 0.746 for active overweight, but their difference is not significant ($p = 0.198$). For outflows the ordering reverses, with an overlap loading of 0.753 against 1.339 for active overweight and a difference of -0.586 ($p < 0.001$). Flows are a noisy prescription, since they tell the fund to scale rather than what to trade. In a separate prediction comparison, overlap does not establish an advantage over plain position size in predicting the fund’s net-of-drift weight reallocation, and continuing-constituent reweights do not distinguish the sleeves.

Appendix I Panel-regression robustness

This appendix reports ownership-based controls (I.1), index membership and benchmark structure (I.2–I.4), position architecture inside active funds (I.5), non-linearity (I.6), variable selection (I.7–I.8), and block bootstrap inference (I.9).

I.1 Alternative ownership controls

Augmenting the elasticity regression with top-10 investor concentration (Ben-David et al., 2021), 13F passive ownership share, and active institutional ownership leaves the IXI coefficient essentially intact: it retains between 82% and 136% of its baseline across these controls, and is, if anything, larger when all are included jointly (Table 41).

Table 41. Alternative ownership controls

Added control	$\log(\text{IXI})$	t	Retention
None (baseline)	-0.0219	-7.3	100%
Top-10 institutional concentration	-0.0179	-6.9	82%
13F passive share	-0.0219	-7.1	100%
Active institutional ownership	-0.0225	-8.0	103%
All ownership controls	-0.0298	-9.1	136%

Note: Stock-year regressions of elasticity on $\log \text{IXI}$ and $\log \text{ME}$ with year fixed effects, adding 13F-based ownership-structure controls (annual means of quarterly measures); sample 2001–2023, $n = 77,319$. IXI is the fund-only IXI measure, so a stock’s value reflects index membership already public at the time. Standard errors double-clustered by stock and year.

I.2 Index-membership controls

One concern is that IXI simply proxies for membership in a major index: stocks in the S&P 500 or Russell 1000 may be more inelastic for reasons unrelated to the intensity of passive indexing (e.g., visibility, liquidity, analyst coverage). To test this, we construct binary indicators for S&P 500, Russell 1000, and Russell 2000 membership from benchmark constituent weights at each quarter, along with a continuous count of the total number of benchmark indices in which a stock appears.

Table 42 reports the results. Adding the three membership indicators retains 90% of the IXI coefficient (column 2, -0.0215 to -0.0194), and the coefficient is larger under firm fixed effects

Table 42. Index membership, index count, and the IXI-elasticity gradient

<i>Panel A: Levels (year fixed effects unless noted)</i>				
	(1) Baseline	(2) + Dummies	(3) + Firm FE	(4) + Index count
log(IXI)	-0.0215*** (0.0030)	-0.0194*** (0.0027)	-0.0241*** (0.0031)	-0.0130*** (0.0027)
S&P 500		-0.0107* (0.0065)		
Russell 1000		-0.0270*** (0.0045)		
Russell 2000		-0.0188*** (0.0049)		
log(index count)				-0.0197*** (0.0070)
Retention of baseline	100%	90%	112%	61%
<i>Panel B: First differences (within stock, year fixed effects)</i>				
	Δ Baseline		+ Δ membership, Δ count	
$\Delta \log(\text{IXI})$	-0.0359***	(0.0034)	-0.0248***	(0.0031)
$\Delta \log(\text{index count})$			-0.0189***	(0.0046)
Retention of baseline	100%		69%	

Notes: Stock-year regressions of aggregate price elasticity on log(IXI), log(ME), and the listed controls; standard errors double-clustered by stock and year. Membership indicators are December benchmark-constituent snapshots for the S&P 500, Russell 1000, and Russell 2000. Index count is the number of distinct benchmark families with positive IXI contribution to the stock. IXI is the fund-only IXI measure, so a stock's value reflects index membership already public at the time. Sample 2001–2023: Panel A uses 77,751 stock-years (76,460 with firm fixed effects); Panel B uses 68,612 first differences. The retention row reports the log(IXI) coefficient as a percentage of the column (1) baseline.

(column 3, retention 112%). Controlling for the continuous count of benchmark families holding the stock reduces it to 61% of its baseline (column 4); the count itself enters negatively (-0.020 , $t = -2.8$), so breadth of benchmark coverage carries part of the information, while IXI retains an independent association. In the horse race the S&P 500 indicator is significant only at the ten percent level while IXI remains strongly significant, so IXI absorbs the elasticity-relevant content of membership rather than the reverse. Panel B repeats the test in first differences: within-stock changes in IXI predict changes in elasticity (-0.036), and the relationship retains 69% of its magnitude (-0.025 , $t = -7.9$) after controlling for concurrent changes in index membership and family count, with the change in the count also entering negatively (-0.019 , $t = -4.2$). IXI captures the dollar-weighted intensity of passive indexing, not merely binary index membership.

I.3 Extensive and intensive margins

Table 43. Extensive versus intensive margin of benchmark coverage

Panel A decomposes the IXI–elasticity relationship into the number of benchmark families and IXI per family. The pooled horse race in the last row includes both margins simultaneously. Panel B reports the IXI-per-family coefficient within quintiles of the family count (Q1 = fewest families, Q5 = most families). Benchmark families are the index families of the IXI measure, the same unit used for the index count in Table 42. In the first row of Panel A the regressor is the log family count alone, so the IXI-per-family column is empty and the t -statistic refers to the family-count coefficient. Standard errors are double-clustered by stock and year.

	IXI-per-family coefficient	t	Mean family count	N	Within R^2
<i>Panel A: Pooled margins</i>					
Log family count only		-7.51		75,011	0.273
Log IXI per family only	-0.0170***	-5.68		75,011	0.261
Both margins	-0.0090***	-3.69		75,011	0.275
<i>Panel B: Within family-count quintiles</i>					
Q1 (fewest)	-0.0073***	-2.78	3.4	14,993	0.016
Q2	-0.0084**	-2.29	9.1	15,001	0.064
Q3	-0.0218***	-5.38	12.4	15,005	0.150
Q4	-0.0191***	-4.88	14.3	15,001	0.234
Q5 (most)	-0.0195***	-6.25	16.4	15,011	0.204

Table 43 decomposes IXI into an extensive margin (number of contributing benchmark families) and an intensive margin (IXI per family). In a pooled horse race (Panel A), both margins are significant, with the extensive margin the larger of the two ($t = -7.5$ vs. $t = -3.7$ for the intensive margin). Panel B shows that the intensive margin is negative within every family-count quintile, significant at the 5% level in the second quintile and at the 1% level in the others ($t = -2.3$ to -6.3). The IXI–elasticity relationship reflects both the breadth of index coverage and the depth of passive capital deployed through each family.

I.4 Four-class index architecture

The index-level taxonomy assigns each benchmark in the roster to broad cap-weighted, sector or industry, factor or style, and thematic or niche classes. Classification uses index names and

family information, followed by manual review of 163 indices that account for 95.0% of indexing capital. Growth and value variants of otherwise broad families are classified as factor or style rather than broad.

Class contributions are measured on the same quarterly support as the demand-elasticity panel. An unclassified fund residual and a nonfund 13F residual enter every joint regression. The components sum to the extended ownership measure; the primary IXI measure contains the fund branch only.

Table 12 reports the estimates. All four class coefficients are negative in the joint level and first-difference specifications. Broad cap-weighted (-0.0134 , $t = -4.71$) and factor or style (-0.0144 , $t = -8.23$) have the largest coefficients per standard deviation, and their equality is not rejected ($p = 0.49$); sector or industry (-0.0032) and thematic or niche (-0.0028) are smaller, and equality with the broad class is rejected for both ($p = 0.003$ and $p < 0.001$). Broad exposure predicts lower elasticity when entered separately (-0.262 , $t = -4.12$). Holdings in this exhibit are dated at the report month, as in the S&P addition and Tesla exhibits; the elasticity outcome comes from the annual demand system.

1.5 Position architecture inside active funds

For each active fund-stock-quarter, benchmark overlap is the smaller of the fund and benchmark weights, and active overweight is the positive difference between them. The turnover analysis retains consecutive fund-quarter transitions with a stable selected benchmark, at least 5% average mass in each component, and at least 99% return coverage for lagged positions. It covers 282,088 transitions from 14,835 funds. Turnover compares current component weights with lagged weights evolved by realized returns. Persistence comes from stock-level current-on-lag component regressions with fund-quarter-transition effects and standard errors clustered by fund and quarter.

Panel A of Table 14 reports the primary result. Benchmark overlap turns over less and is more persistent than active overweight when both components are economically meaningful. The lower-turnover result is not invariant to the sample rule: on all 352,697 transitions with both components merely positive, the equal-transition turnover difference is 0.0002 ($p = 0.832$). The AUM-weighted turnover difference remains negative, and the persistence contrast remains positive.

The direct-flow test uses CRSP fund flows linked to the FactSet holdings panel through WFICN identifiers. The link covers 77.4% of target-sample lagged AUM; requiring contemporaneous prices leaves 64.2% of target AUM and 10.95 million positions. Position changes are regressed on direct flow interacted with lagged overlap and active-overweight weights, with fund-by-quarter-transition and fund-by-stock fixed effects and clustering by fund and quarter. The overlap-minus-active loading is positive but insignificant (0.705, $p = 0.198$), and outflows reverse the predicted ordering (-0.586 , $p < 0.001$). The evidence supports the turnover-and-persistence result, not a general claim that benchmark-overlap positions are managed like passive capital.

1.6 Scale and raw-unit nonlinearity

The IXI-elasticity relation remains strongly negative in raw IXI units. The quadratic, tercile, within-quintile, and size-residualized specifications describe its shape within the observed sample. They do not identify saturation, depletion, or the marginal effect outside that range.

Table 44. Non-linearity in the IXI–elasticity relationship

This table tests whether the IXI–elasticity relationship is linear or convex. Columns (1)–(2) estimate $\text{Elast}_n = \alpha + \beta_1 \text{IXI}_n + \beta_2 \text{IXI}_n^2 + \gamma \log(\text{ME}_n) + \epsilon_n$; a positive β_2 indicates convexity, and the implied marginal effect at IXI level x is $\beta_1 + 2\beta_2 x$. Columns (3)–(4) estimate separate slopes for each IXI tercile (defined within year). Standard errors are double-clustered by stock and year. Sample: 2001–2023, annual stock-year panel, on the fund-only IXI measure, with holdings dated by public availability.

	<i>Quadratic</i>		<i>Piecewise linear</i>	
	(1)	(2)	(3)	(4)
IXI	−0.928*** (0.130)	−0.951*** (0.086)		
IXI ²	1.997*** (0.347)	1.787*** (0.235)		
IXI × Low tercile			−0.676*** (0.186)	−0.825*** (0.122)
IXI × Mid tercile			−0.480*** (0.100)	−0.551*** (0.061)
IXI × High tercile			−0.317*** (0.068)	−0.366*** (0.047)
log(ME)	−0.030*** (0.002)	−0.024*** (0.002)	−0.035*** (0.002)	−0.027*** (0.002)
Fixed effects	Year	Firm + Year	Year	Firm + Year
<i>N</i>	74,599	73,337	74,599	73,337
Within <i>R</i> ²	0.228	0.039	0.222	0.035
<i>Implied marginal effect d(Elast)/d(IXI):</i>				
at IXI = 0.05	−0.73	−0.77		
at IXI = 0.15	−0.33	−0.41		
at IXI = 0.30	0.27	0.12		

Table 44 reports the full set of non-linearity tests. Columns (1)–(2) add a quadratic term to the baseline IXI–elasticity regression. The IXI² coefficient is positive and significant, +2.00 ($t = 5.8$) in the cross section and +1.79 ($t = 7.6$) within firms. In raw IXI units, the implied within-firm marginal effect is −0.77 at IXI = 0.05, −0.41 at IXI = 0.15, and +0.12 at IXI = 0.30, near the 95th percentile, where few observations lie.

Columns (3)–(4) show the same pattern non-parametrically, with separate IXI slopes for each tercile of the within-year IXI distribution. In the cross section the slope becomes less negative, from −0.68 in the bottom tercile to −0.32 in the top; with firm fixed effects it moves from −0.83 to −0.37, less than half the bottom-tercile magnitude.

Within-quintile regressions (not tabulated) provide the most granular view. Estimating a separate IXI–elasticity slope within each IXI quintile (with firm and year fixed effects), the raw-space slope is steep in the least-indexed quintiles and small in the most-indexed: −2.46 ($t = -7.5$) in Q1, −1.06 ($t = -9.5$) in Q2, and −0.27 ($t = -3.2$) in Q3, then −0.10 ($t = -1.3$) in Q4 and −0.05 ($t = -1.3$) in Q5. This declining magnitude is a statement about level-unit

slopes.

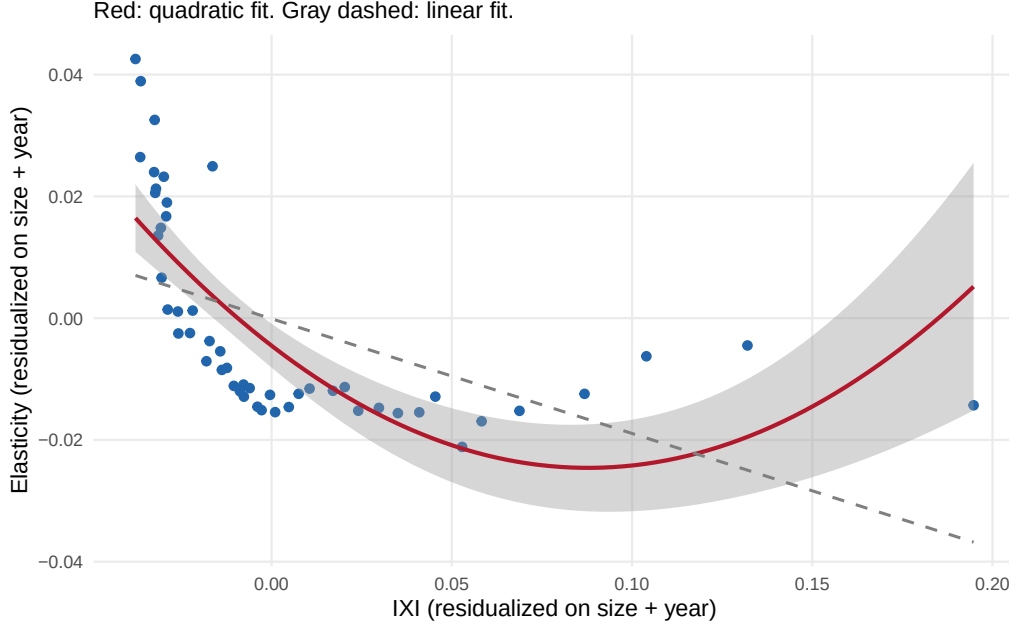


Figure 22. IXI and elasticity: size-residualized binned scatter

Each point is the mean of residualized elasticity and residualized IXI within one of 50 equal-sized bins, where both variables have been residualized on $\log(\text{ME})$ and year fixed effects. The solid red curve is a quadratic fit; the dashed gray line is a linear fit. Raw-space curvature remains after removing the mechanical correlation with size. Sample: 2001–2023.

Raw-space curvature remains after removing the size confound. Figure 22 plots the same binned scatter after residualizing both elasticity and IXI on $\log(\text{ME})$ and year fixed effects; the quadratic curvature remains visible. The curvature remains after winsorizing elasticity at the 1st and 99th percentiles.

The shape is not invariant to scale or outcome construction. Proportional specifications and fixed-breakpoint tests do not recover a common flattening or steepening pattern across the two elasticity measures. Raw-space curvature therefore does not distinguish economic mechanisms. We therefore treat the nonlinearity as descriptive and rely on the ownership decompositions for economic interpretation. The conduct evidence is in Appendix H, Section H.3.

I.7 Lasso variable selection

To assess whether IXI carries information beyond standard characteristics, we apply Lasso (ℓ_1) penalized selection over 59 candidates (four demand-system characteristics, IXI, and 54 WRDS financial ratios), with $\log$ book equity and the market-equity instrument left unpenalized. The design that respects the panel structure of the demand equation pools observations with investor-quarter fixed effects absorbed and chooses the penalty by cross-validation: IXI is selected at both the cross-validated minimum and the one-standard-error penalty, entering the path ninth among the 59 penalized candidates (Table 45). A per-investor-quarter version, which repeats the cross-validated selection in each sampled investor-quarter, selects IXI in 36% of equations. IXI survives selection against the full ratio set under the design appropriate to the demand equation.

Table 45. Lasso variable selection

Design	IXI outcome	Detail
Pooled, investor-quarter FE, 5-fold CV	Selected	$\lambda_{\min}$ and λ_{1se} ; entry 9 of 59
Per investor-quarter, 5-fold CV	Selection frequency 36%	39,616 regressions

Note: Candidate set: 59 penalized characteristics (WRDS financial ratios plus the demand-system characteristics) with log book equity and the market-equity instrument unpenalized. The pooled design demeans within investor-quarter and selects the penalty by cross-validation; the per-investor-quarter design repeats the selection in each sampled investor-quarter. IXI is the fund-only measure, with holdings dated by public availability.

I.8 Shapley-Owen R^2 decomposition

Shapley-Owen values decompose the cross-sectional variation in stock-level elasticity across characteristics. The Shapley value for characteristic k is its average marginal R^2 contribution across all 2^K subsets of predictors, yielding a unique, additive decomposition that is invariant to the order of variable inclusion. We compare two models: a base model with the five [Kojien and Yogo \(2019\)](#) characteristics (log book equity, profitability, investment, dividends/BE, and market beta) and an IXI model that adds IXI as a sixth characteristic. The dependent variable is the stock-level aggregate price elasticity from the IXI demand estimation.

Table 46. Shapley-Owen decomposition of elasticity R^2

	Shapley share (%)		Redistribution (IXI – Base)	Shapley value
	Base model	IXI model		
IXI	—	43.9	+43.9 pp	0.1307
Log book equity	78.1	40.0	–38.2 pp	0.1214
Profitability	5.8	4.8	–1.0 pp	0.0147
Dividends / BE	6.5	4.6	–2.0 pp	0.0144
Investment	5.7	4.3	–1.4 pp	0.0119
Market beta	3.8	2.4	–1.4 pp	0.0073
Total R^2	0.251	0.300	+0.049	
N (mean stocks/year)		3,460		
Years		2001–2023		

Notes: This table reports the Shapley-Owen decomposition of the cross-sectional R^2 of stock-level aggregate price elasticity. The Shapley value for characteristic k is its average marginal R^2 contribution across all 2^K subsets of predictors, ensuring an exact additive decomposition: $\sum_k \varphi_k = R^2$. The base model includes the five [Kojien and Yogo \(2019\)](#) characteristics. The IXI model adds IXI as a sixth characteristic. Shares are averaged across years. The redistribution column shows how each variable’s share changes when IXI is included. Elasticity is from the two-step GMM demand estimation using the equalized IXI instrument. Observations are winsorized at 1%/99% within each cross-section. IXI is the fund-only measure, with holdings dated by public availability.

Table 46 reports the results. Among the characteristics examined, IXI is the most important predictor of cross-sectional elasticity variation, capturing 43.9% of the total R^2 in the augmented model, above log book equity at 40.0%. The remaining four KY characteristics together account for only 16.1%. Adding IXI to the base model raises the mean cross-sectional R^2 from 0.25 to 0.30, a 20% improvement.

The redistribution pattern is particularly revealing. In the base model without IXI, log book equity accounts for 78.1%, consistent with the well-known correlation between size and passive index inclusion. When IXI enters the model, book equity’s share falls by nearly 40 percentage points to 40.0%, meaning roughly half its original contribution is absorbed by IXI. This implies that a large fraction of what appears to be a “size effect” on elasticity in the standard demand system is associated with passive index tracking: larger stocks are more inelastic in part because they carry higher index weight and thus attract more price-insensitive capital.

The IXI share is stable across subperiods even as the level of IXI grows, so its explanatory power is not confined to the post-crisis subsample.

One concern is that IXI’s large share may be mechanical because IXI enters the demand system. We therefore re-estimate the relationship using elasticity from the base model estimated *without* IXI. The IXI gradient is stronger: the coefficient is larger in absolute value and more significant in every size quintile (overall -0.041 , $t = -10.7$; Table 33, Appendix F).¹⁹

The small AUM-weighted IXI demand coefficient and the large Shapley share describe different features. The demand coefficient captures capital-weighted portfolio tilts, which net to near zero because passive and active investors offset. The Shapley share captures how much IXI explains the cross-sectional *dispersion* of elasticity. IXI predicts elasticity through the composition of each stock’s investor base, since stocks with high IXI attract systematically more price-inelastic investors, producing lower aggregate elasticity.

I.9 Block-bootstrap inference

Because stock-level elasticity is itself estimated from the demand system, cross-sectional standard errors may understate uncertainty (a generated-regressor problem). Table 47 addresses this by reporting block-bootstrap standard errors for the three specifications it covers: the baseline with year effects, the size-controlled specification, and the firm-plus-year specification. Each of 200 bootstrap iterations resamples investors with replacement within each year, recomputes stock-level elasticity from the resampled investor pool, and re-runs each regression specification. Resampling investors captures uncertainty from investor composition and aggregation, conditional on their fitted coefficients. It does not re-estimate each investor demand equation or capture all uncertainty in those coefficients.

Table 47. Block-bootstrap inference for the IXI–elasticity gradient

Specification	Coefficient	Analytic s.e.	Bootstrap s.e.	Ratio	Bootstrap t
Baseline (year FE)	-0.0528	0.0028	0.0065	2.4	-8.1
Size-controlled	-0.0215	0.0030	0.0060	2.0	-3.6
Firm FE + size control	-0.0258	0.0032	0.0061	1.9	-4.2

Note: Each of 200 bootstrap draws resamples the 1,207 investors with replacement, recomputes stock-level elasticity, and re-estimates the regression. Because elasticity is a generated regressand, the bootstrap standard errors are 1.9 to 2.4 times the analytic clustered standard errors. All three coefficients remain statistically significant. Estimates use the fund-only IXI measure, 2001–2023, with holdings dated by public availability.

The bootstrap bands are wider than the analytic clustered ones. Across the baseline, size-controlled, and within-firm specifications, bootstrap standard errors run 1.9 to 2.4 times the

¹⁹The elasticity computed from the base model is higher on average than the IXI-model elasticity, because the base model cannot attribute part of investors’ price insensitivity to passive indexing.

analytic ones (Table 47). The IXI gradient nonetheless remains significant under the wider bands, with bootstrap t -statistics of -8.1 , -3.6 , and -4.2 . Inference survives this composition bootstrap, conditional on the fitted investor coefficients.

Appendix J Supplementary return evidence

Heavily indexed stocks exhibit a larger announcement-window response to earnings news. This appendix reports that association and examines whether subsequent return patterns support slower price adjustment.

J.1 Earnings response and signal persistence

The return response to the same earnings surprise is larger in the middle and top IXI terciles than in the bottom tercile (Table 48). The estimates are associations. The later-return pattern does not survive the within-stock specification as a reliable full-year reversal, so we treat announcement amplification as supplementary evidence on price sensitivity. It does not identify an active-holder mechanism or a separate valuation wedge.

Table 49 asks whether return signals decay more slowly in high-IXI stocks. The interaction is positive in broad cross-sectional specifications, close to zero with size-by-date fixed effects, and negative within stocks. This pattern does not support slower price absorption.

Table 48. Earnings-surprise return response by IXI tercile

	Low IXI	Mid IXI	High IXI
SUE slope (price $\geq$ \$5)	5.04	6.30	6.45

Note: The table reports the announcement-window return response to standardized unexpected earnings by IXI tercile. Terciles are formed on the fund-only IXI measure in the calendar month before the announcement, so a stock's IXI reflects index membership already public at the time. The sample contains 236,236 earnings announcements for stocks priced at least \$5.

Table 49. IXI and 24-month signal persistence across specifications

Specification	Expanding window	Pre-2000 fit	5-year rolling	10-year rolling
Date FE	60.1***	60.7***	59.3***	78.7***
Date-specific signal slope	60.7***	78.7***	50.2***	63.0***
Industry $\times$ date	40.2***	56.5***	33.1***	40.1***
Size $\times$ date	9.1	20.5***	10.4*	26.2***
Within stock	-23.0***	-25.2***	-16.5***	-27.4***

Note: Each cell reports the coefficient on IXI interacted with the expected-return signal in a regression of 24-month forward returns. Rows vary the fixed effects; columns use expanding-window, fixed pre-2000, five-year rolling, and ten-year rolling signal forecasts. IXI is the fund-only IXI measure, lagged one quarter. The interaction weakens with size-by-date fixed effects and reverses under within-stock identification, so the table does not establish slower price absorption.