Disappearing Schumpeterian Growth: From Superstar Scaling to Arrested Dynamism

Ou Liu*

March 26, 2026

Abstract

This paper investigates whether the extreme concentration of the Top 0.01% US firms reflects genuine technological scaling or defensive entrenchment. Using a novel micro-audited accounting framework, we decompose aggregate top-share growth into exact organic and mechanical (M&A) flows. Mapping these flows to physical productivity (TFPQ) via a Melitz–Polanec decomposition and a Doubly Robust CS-DiD event-study design, we document a profound macroeconomic regime shift. The "Superstar Scaling" of the 1990s—where M&A generated synergistic productivity gains—has metastasized into "Arrested Dynamism." In the most recent decade, apex incumbents execute defensive acquisitions that mechanically pad market share while inflicting a severe -9.1% structural penalty on their own physical efficiency. We formalize this transition in a continuous-time structural model, proving that the secular rise in baseline markups endogenously triggers this collapse: once legacy market power breaches a critical threshold, titans optimally abandon synergistic integration to defensively shelve targets, actively stifling Schumpeterian growth.

1 Introduction

The boundaries of the firm (Coase, 1937) and the allocation of market share among competitors are fundamentally determined by the race for technological supremacy. In the classical framework (Schumpeter, 1942), economic growth is driven by creative destruction, where innovative entrants displace stagnant incumbents and reallocate resources to the most efficient producers. Yet, as formalized by Arrow (1962), entrenched monopolies

*Rutgers University. ouliu@rutgers.edu

face an inherent "replacement effect," dampening their incentive to innovate organically. The tension between these forces—genuine technological scaling versus the defensive entrenchment of incumbents—shapes business dynamism and productivity growth.

For over a century, the United States economy has witnessed a persistent rise in corporate concentration (Kwon, Ma, and Zimmermann, 2024), frequently giving rise to "special generations" of superstar firms that dominate for decades (Ma, Pugsley, Qin, and Zimmermann, 2025). Today, an increasingly dominant share of aggregate sales accrues to the absolute apex of the firm distribution (the Top 0.01%). This trend has sparked a heated debate regarding the health of US business dynamism. One view argues that rising concentration is benign, reflecting the natural reallocation of market share toward highly productive "Superstar Firms" operating in winner-take-all markets (Autor, Dorn, Katz, Patterson, and Van Reenen, 2020). An opposing view warns of a structural decline in dynamism (Akcigit and Ates, 2023), pointing to rising markups (De Loecker, Eeckhout, and Unger, 2020), declining aggregate investment (Gutiérrez and Philippon, 2019), and the proliferation of "killer acquisitions" designed to preemptively eliminate competitive threats (**?**Berger, Calligaris, Greppi, and Kirpichev, 2025).

This paper reconciles this debate by demonstrating that both views are correct, but in different historical eras. We provide a unified empirical and theoretical framework that traces the precise anatomy of US top-share concentration from 1985 to 2023. Methodologically, our core novelty lies in an case-by-case micro-auditing of Top 0.01% firm exits. By correcting severe commercial database linkage errors, we obtain a mathematically precise accounting dissection of aggregate top-share growth into its true organic scaling and mechanical (M&A) consolidation components. We then map these exact empirical flows to firm-level physical productivity (TFPQ) using a Melitz–Polanec decomposition coupled with a Doubly Robust CS-DiD event-study estimator (Callaway and Sant'Anna, 2021) on the universe of Top 0.01% M&A activity.

We document a profound macroeconomic regime shift: the Superstar Scaling of the late 20th century has metastasized into an era of Arrested Dynamism. During the IT boom of the 1990s, top-firm concentration was driven by genuine organic scaling and synergistic M&A that significantly boosted physical productivity, reflecting the "Good Concentration" paradigm (Covarrubias, Gutiérrez, and Philippon, 2020). However, in the modern era (2015–2023), the engine of concentration has switched entirely to defensive M&A. Our event-study estimates reveal that upon executing an acquisition today, modern titans suffer an immediate collapse in organic sales and a severe -9.1% structural penalty to physical productivity. Apex firms are no longer integrating technology; they are executing "kill

zone" acquisitions that mechanically pad market share while actively rotting their internal efficiency.

To explain this collapse in the efficiency of M&A, we construct a continuous-time structural model of incumbent firm optimization that formalizes the fundamental trade-off between synergistic integration and defensive shelving. Integrating an acquired target yields technological synergies but requires costly organizational restructuring. Shelving a target sacrifices these synergies but eliminates a competitive threat, strictly preserving the incumbent's existing profit margins. Crucially, we prove that the incumbent's baseline *markup* dictates this trade-off. As markups rise, the value of protecting legacy monopoly rents mechanically overwhelms the marginal benefit of adopting new technology. Thus, the transition to Arrested Dynamism is not exogenous; it speaks directly to the macroeconomic implications of the secular rise in markups (De Loecker, Eeckhout, and Unger, 2020). We identify a critical theoretical threshold: once legacy markups breach a critical premium, apex firms optimally abandon synergistic integration, triggering the macroeconomic regime shift we observe in the data.

Related literature. This paper bridges several strands of the macroeconomic and industrial organization literature. First, we contribute to the debate on the long-run evolution of market power and firm size. Recent work documents that rising concentration is a pervasive, century-long global phenomenon (Kwon, Ma, and Zimmermann, 2024; Ma, Zhang, and Zimmermann, 2026), with extreme persistence among top firms (Ma, Pugsley, Qin, and Zimmermann, 2025). Concurrently, De Loecker, Eeckhout, and Unger (2020) document a dramatic rise in aggregate markups since 1980. Berry, Gaynor, and Morton (2019) and Shapiro (2019) emphasize the need for structural frameworks to interpret whether these markups reflect efficiency or anticompetitive entrenchment. By adjusting for markups to isolate physical productivity (TFPQ) among the Top 0.01%, our paper provides the exact micro-foundation distinguishing the efficient concentration of the 1990s (Autor, Dorn, Katz, Patterson, and Van Reenen, 2020) from the rent-seeking of the modern era (Covarrubias, Gutiérrez, and Philippon, 2020).

Second, we contribute to the literature on declining US business dynamism. Akcigit and Ates (2023) highlight the breakdown of knowledge diffusion from the frontier to laggards, while Gutiérrez and Philippon (2019) point to fading domestic competition and underinvestment. Furthermore, Bloom, Jones, Van Reenen, and Webb (2020) document that ideas are getting harder to find, requiring exponentially more research effort. Our structural model complements these findings by demonstrating that as market power rises, frontier firms endogenously choose to halt technological integration, utilizing their massive

balance sheets to acquire and shelve ideas rather than develop them.

Finally, we advance the literature on the aggregate effects of Mergers and Acquisitions. While David (2021) provides a search-and-matching framework highlighting the reallocation benefits of M&A, and Hoberg and Phillips (2010) demonstrate the value of product market synergies, recent empirical work has identified a darker motive. Incumbents facing organizational frictions that prevent internal innovation (Crouzet, He, Lyonnet, and Ma, 2025) increasingly execute "killer acquisitions" to eliminate future competition and stifle startup innovation (Cunningham, Ederer, and Ma, 2021; Berger, Calligaris, Greppi, and Kirpichev, 2025). Our continuous-time framework provides a generalized macroeconomic theory for this phenomenon, proving that the incentive to execute defensive acquisitions is a structural function of an incumbent's baseline markup, and documenting its devastating aggregate penalty on modern physical productivity.

Roadmap. The remainder of the paper proceeds as follows. Section 2 details our micro-audited accounting framework and presents the exact decomposition of aggregate top-share growth into its organic and mechanical components. Section 3 bridges these accounting flows to firm-level physical productivity (TFPQ), deploying the Melitz–Polanec decomposition and the CS-DiD event study to document the four empirical eras of concentration and the modern productivity penalty of M&A. Section 4 develops our continuous-time structural model to formalize the economic mechanisms driving this regime shift, proving how the secular rise in baseline markups endogenously triggers the transition to Arrested Dynamism. Section 5 concludes and discusses broader macroeconomic and policy implications.

2 Decomposition of Top-Share Growth in Common Units

To understand whether the growth of sales share accounted for by the Top 0.01% firms is driven by organic scaling or by mechanical consolidation, we decompose the aggregate growth of the top tail into its fundamental firm-level flows. Crucially, we define organic scaling as any expansion in sales strictly independent of mechanical accounting transfers. Therefore, organic growth captures both pure internal scaling (e.g., in-house R&D) and the synergistic scaling generated after an acquisition is integrated. In contrast, mechanical consolidation strictly isolates the zero-sum absorption of a target's pre-existing baseline sales.

At time $t \in \{0, 1\}$, each firm i has total sales composed of organic and mechanical (M&A) stock: $y_{it}^{ALL} = y_{it}^{OG} + y_{it}^{MA}$. Let I_t denote the set of all firms at t, and let $P_t \subseteq I_t$ denote the

top-p set (the Top 0.01%) at t ranked by y_{it}^{ALL}, with ties broken deterministically.

We decompose the dynamic evolution of the top tail by defining fundamental firm-level flow sets. Stayers ($S \equiv P_0 \cap P_1$) represent incumbent titans remaining in the top tail. Displacement ($X \equiv P_0 \setminus P_1$) captures legacy firms falling below the threshold, while Entry ($E \equiv P_1 \setminus P_0$) captures rising firms organically breaching it, and Births (B) capture new entities formed via M&A reorganizations. Crucially, we account for complete firm disappearances from the database through the death set (D). To partition this set, we conduct a baseline matching procedure—combining automated database cross-referencing between Compustat and Refinitiv M&A with manual entity-level verification—yielding an initial partition: $D = D^{MA} \cup D^{\neg MA}$. The mechanical exit set (D^{MA}) contains all target firms standardly linked to an M&A absorption. The unlinked exit set ($D^{\neg MA}$) captures all remaining disappearances.

While $D^{\neg MA}$ conceptually represents true organic firm deaths (e.g., bankruptcies or liquidations), in raw accounting data, firms frequently end up in this unlinked set due to complex reporting events—such as identifier (CUSIP) retirements, structural spinoffs, mutualizations, or obscured M&A absorptions that successfully evade standard baseline linkages. A fundamental empirical barrier to measuring top-tail dynamics is that statistical algorithms record these events as massive "organic firm deaths" and subsequent "organic entries." In the extreme Pareto tail, a single false exit of a $100 billion firm pollutes the aggregate macroeconomic statistics.

To recover the true Schumpeterian signal, we conducted an exhaustive, case-by-case micro-audit of all Top 0.01% firm exits, separating the raw, unlinked deaths ($D^{\neg MA}$) into structurally verified sets. We reallocated missed acquisitions (D^{MA_missed}) to the mechanical M&A flow, retained true bankruptcies (D^{OG_true}) in the organic flow, and strictly isolated phantom database illusions ($D^{Artifact}$). This manual correction represents a major empirical advancement in measuring structural concentration: it cleanses the accounting flows of massive reporting noise, isolating true organic efficiency and active target cannibalization from database artifacts.

To place all flows in common units, we define the baseline average firm size at $t = 0$ as $\bar{y}_0 \equiv Y_0/|I_0|$ and normalize $u_{it}^k \equiv y_{it}^k/\bar{y}_0$ for $k \in \{ALL, OG, MA\}$. Let $\Omega_t \equiv \sum_{i \in I_t} u_{it}^{ALL}$ denote aggregate sales in these units and define the aggregate scale factor $\Xi \equiv \Omega_0/\Omega_1$. The aggregate top share is $S_t = A_t^{ALL}/\Omega_t$, where $A_t^{ALL} = \sum_{i \in P_t} u_{it}^{ALL}$.

Top-share growth thus formally decomposes into four exact components (plotted in Fig-

ure 1):

$$\frac{S_1 - S_0}{S_0} = \underbrace{(\Xi - 1)}_{\text{Dilution from Total Output Growth}} + \underbrace{\Delta_{corr}^{OG}}_{\text{Organic Growth}} + \underbrace{\Delta_{corr}^{MA}}_{\text{Mechanical M\&A}} + \underbrace{\Delta^{Artifact}}_{\text{Data Artifacts (Excluded)}}. \tag{1}$$

2.1 The Corrected Threshold-Centered Decomposition

To cleanly map our empirical flows to our continuous-time structural theory, we utilize a threshold-centered decomposition. By aligning the organic flows relative to the Pareto entry threshold $q_1^{(ALL)} \equiv \min_{i \in P_1} u_{i1}^{ALL}$, we rigorously isolate true "excess" organic scaling at the frontier.

The exact organic component precisely penalizes the tail for structurally verified obsolescence (plotted in Figure 2):

$$\Delta_{corr}^{OG} = \Xi \cdot \frac{1}{A_0^{ALL}} \Bigg[\underbrace{\sum_{i \in S} (u_{i1}^{OG} - u_{i0}^{OG})}_{\text{Stayers}} + \underbrace{\sum_{i \in E} (u_{i1}^{OG} - q_1^{(ALL)})}_{\text{Inflow above Threshold}} + \underbrace{\sum_{i \in X} (q_1^{(ALL)} - u_{i0}^{ALL})}_{\text{Outflow (Lost Top Mass)}} - \underbrace{\sum_{i \in D^{OG_true}} u_{i0}^{ALL}}_{\text{Organic Exit}} \Bigg] + \underbrace{\Xi \cdot \frac{(|E| - |X|)\, q_1^{(ALL)}}{A_0^{ALL}}}_{\text{Inflow - Outflow across Threshold}}. \tag{2}$$

Concurrently, the mechanical M&A component isolates the sheer physical mass of successfully cannibalized targets. Letting $D^{MA_total} = D^{MA} \cup D^{MA_missed}$ (plotted in Figure 3):

$$\Delta_{corr}^{MA} = \Xi \cdot \frac{1}{A_0^{ALL}} \Bigg[\underbrace{\sum_{i \in S} (u_{i1}^{MA} - u_{i0}^{MA})}_{\text{Stayer M\&A Roll-up}} + \underbrace{\sum_{i \in E} u_{i1}^{MA}}_{\text{Inflow via M\&A}} + \underbrace{\sum_{i \in B} u_{i1}^{ALL}}_{\text{Mechanical Births}} - \underbrace{\sum_{i \in D^{MA_total}} u_{i0}^{ALL}}_{\text{Absorbed Exits}} \Bigg]. \tag{3}$$

Crucially, this empirical framework acts as the direct accounting counterpart to the continuous-time macroeconomic model we develop in Section 4. Specifically, *Stayers* identify the net internal innovation drift of incumbents, *Organic Exit* and *Outflow* identify the natural obsolescence of legacy firms, and *Absorbed Exits* identify the mass of physical targets cannibalized from the standalone distribution.

2.2 Top-Share Growth Decomposition: Organic vs. Mechanical Forces

Figure 1 presents the headline result of our corrected top-share decomposition using rolling ten-year horizons from 1985 to 2023. The decomposition partitions the growth in the Top 0.01% sales share into three structural components: (i) *Mechanical M&A* (Δ^{MA}), which captures share gains arising from the mechanical absorption of target revenue into the acquirer's consolidated sales; (ii) *Organic Growth* (Δ^{OG}), which captures share gains attributable to firms expanding sales after removing the direct revenue transfer from acquired targets; and (iii) a *Dilution* term ($\Xi_t - 1$), which captures the mechanical decline in top-firm shares that would arise if top firms merely kept pace with aggregate market growth. I also isolate a separate *Data Artifact* term ($\Delta^{Artifact}$), which captures discontinuities in Compustat coverage driven by corporate restructurings or reporting-format changes rather than genuine economic events, and exclude it from economic interpretation.[1]

Three findings stand out. First, over the full 1985–2023 sample, both the organic and mechanical channels contribute positively to top-share growth, but their relative importance changes substantially across periods. Second, the organic-growth component rises steadily across horizons ending in the early and mid-1990s and reaches its peak in the windows ending between 2000 and 2005, marking the strongest burst of organic top-share growth in the sample. Third, mechanical M&A also contributes positively throughout much of the sample. It is especially pronounced in the mid-1990s and early-2000s, but during those years it remains smaller than the contemporaneous organic component. Beginning with horizons ending in the mid-2000s, however, the organic component declines sharply, with only modest recoveries in windows ending in 2017–2023.

As a result, the gap between organic growth and mechanical M&A narrows substantially, and mechanical M&A becomes a persistent contributor to top-share growth in the later sample, exceeding organic growth in several periods. This pattern provides our first high-level evidence that the forces driving U.S. market concentration shifted over time from organic scaling toward mechanical consolidation. Here, *organic growth* includes both firms' internal expansion and any post-acquisition synergies realized after the transaction; that is, it captures all sales growth not directly accounted for by the mechanical transfer of target revenue through M&A over each ten-year horizon.

[1] The Master Expert Dictionary used to classify these artifacts is documented in `1_ultimate_corrected_decomposition.py` and contains individually audited firm-events spanning LBOs, restructurings, CUSIP migrations, and subsidiary de-designations.

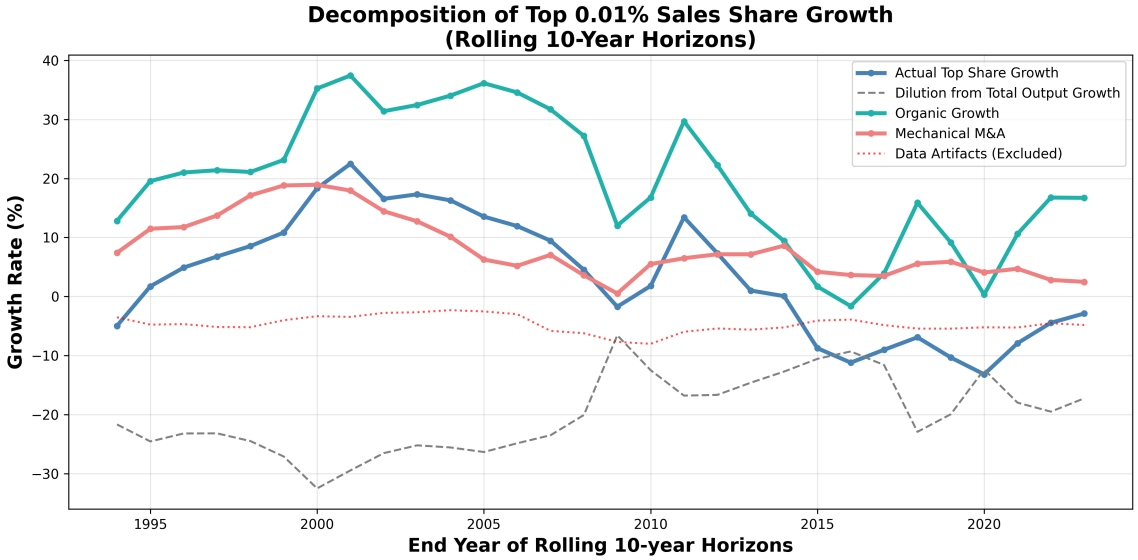


Figure 1: Decomposition of Top 0.01% Sales Share Growth (Rolling 10-Year Horizons). Each series shows the annualized contribution to the growth rate of the Top 0.01% sales share over the ten-year window ending in the year indicated on the horizontal axis. *Actual Top Share Growth* (steel-blue) is the left-hand side of the identity. *Organic Growth* (teal) and *Mechanical M&A* (coral) are the two structural forces. *Dilution* (gray, dashed) is the counterfactual growth that would occur if top firms merely kept pace with aggregate output. *Data Artifacts* (red, dotted) are isolated discontinuities excluded from inference. All quantities are expressed as percentage growth rates.

2.3 Decomposing Organic and Mechanical Contributions

Organic Components. Figure 2 decomposes the organic contribution into four margins: *Stayers* (firms already in the top tier at the beginning of the horizon), *Inflow above Threshold* (firms growing into the top tier from below), *Inflow minus Outflow across Threshold* (net flow across the threshold), and *Organic Exit*.

The dominant margin throughout the sample is the *Stayers* component. Its contribution rises strongly across horizons ending in the 1990s and peaks in windows ending around 2000–2005, indicating that the earlier strength of organic top-share growth was primarily driven by revenue expansion among incumbent top-tier firms. After the mid-2000s, however, the stayer contribution declines markedly and remains substantially lower for most horizons ending after 2010.

The other organic margins are comparatively modest. *Inflow above Threshold* remains positive throughout the sample, indicating that some firms continue to grow into the top tier organically, although its magnitude moderates relative to the early 2000s. The *Inflow minus Outflow across Threshold* term also stays positive but gradually weakens over time. By contrast, *Organic Exit* is negative in all periods but small in magnitude relative to the other

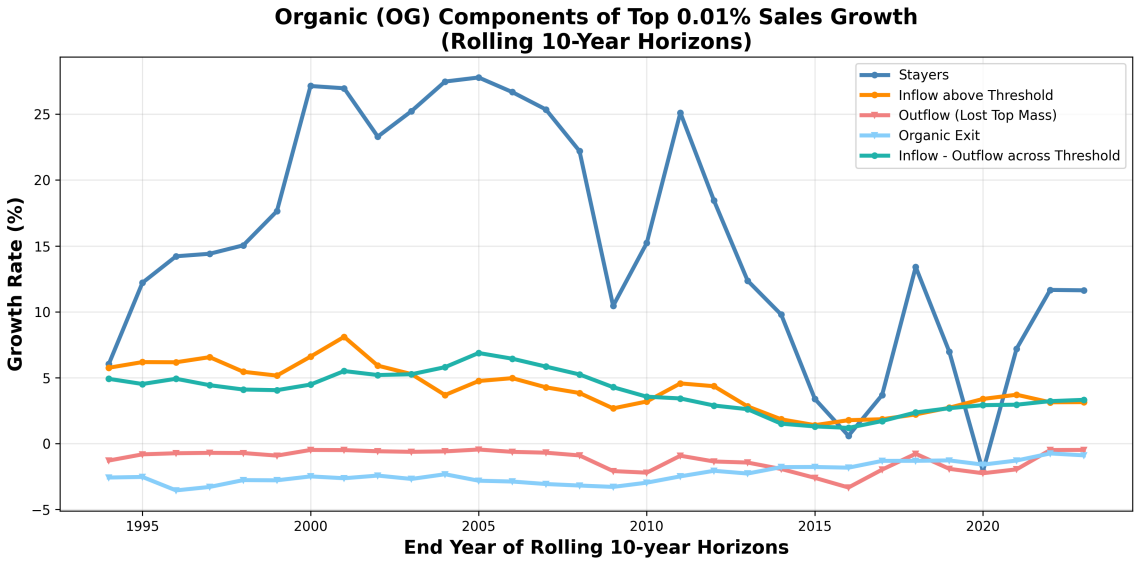


Figure 2: Sub-Components of Organic Growth (Rolling 10-Year Horizons). *Stayers* (steelblue) capture revenue growth of firms continuously in the top tier. *Inflow above Threshold* (orange) is the contribution of firms organically entering the top group. *Outflow (Lost Top Mass)* (coral, inverted) captures firms that organically fall out of the top tier. *Organic Exit* (skyblue, inverted) captures firms that exit Compustat entirely through bankruptcy or dissolution. *Inflow minus Outflow across Threshold* (teal) is the net organic churning term. All quantities are annualized percentage contributions over rolling ten-year horizons.

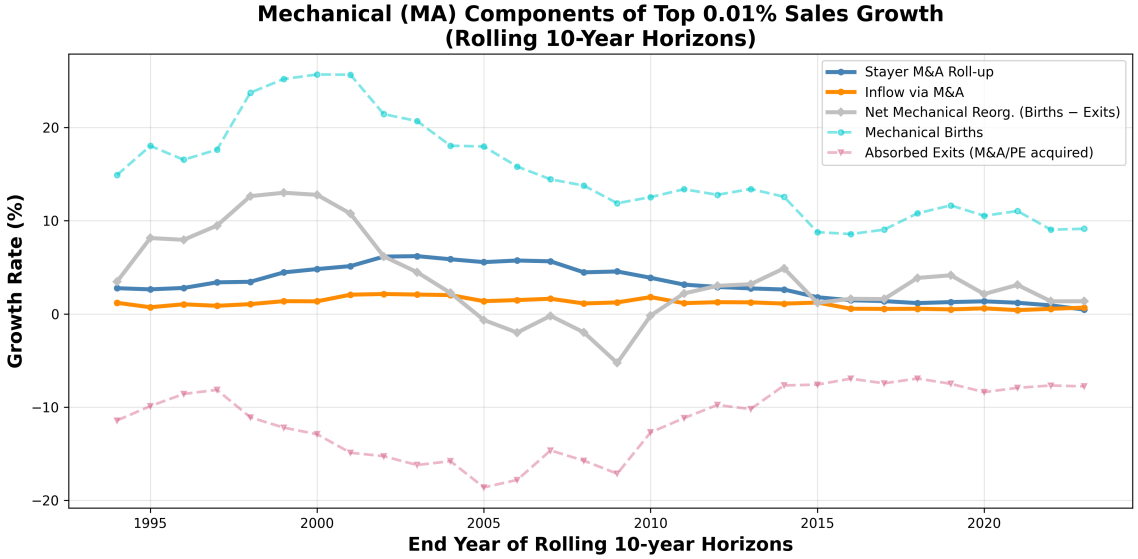


Figure 3: Sub-Components of Mechanical M&A Growth (Rolling 10-Year Horizons). *Stayer M&A Roll-up* (steelblue) is the contribution of acquisitions made by firms already in the top tier. *Inflow via M&A* (orange) captures firms that enter the top tier by acquiring their way to scale. *Mechanical Births* (turquoise) captures newly formed consolidated entities that immediately appear in the top tier. *Absorbed Exits* (palevioletred, inverted) captures top-tier firms that are themselves acquired by another party, removing them as independent entities. All quantities are annualized percentage contributions over rolling ten-year horizons.

components. Overall, the figure indicates that variation in the aggregate organic component is driven primarily by changes in the growth of incumbent top-tier firms rather than by large swings in organic entry or exit.

Mechanical M&A Components. Figure 3 decomposes the mechanical M&A contribution into four margins: *Stayer Roll-up* (mechanical transfer of target revenue via acquisitions undertaken by firms already in the top tier), *Inflow via M&A* (firms entering the top tier through acquisition-driven expansion), *Mechanical Births* (new firm identifiers that appear following acquisition-related restructuring), and *Absorbed Exits* (firms that disappear from the top tier after being acquired).

Several patterns are visible. First, both *Stayer Roll-up* and *Inflow via M&A* are persistently positive throughout the sample, indicating that acquisitions contribute to top-share growth both through expansion by incumbent leaders and through acquisition-driven entry into the top tier. Both margins reach higher levels in horizons ending in the late 1990s and early 2000s and subsequently decline, though they remain positive in later periods.

Second, *Mechanical Births* is positive and sizable throughout the sample—especially in horizons ending in the late 1990s and early 2000s—while *Absorbed Exits* is negative in all periods and largest in absolute value in horizons ending around the early-to-mid 2000s. Because these two margins reflect opposite sides of acquisition-related restructuring, the *Net Mechanical Reorganization* series provides a useful summary: it is strongly positive in horizons ending in the late 1990s and early 2000s, near zero or briefly negative around the mid-to-late 2000s, and modestly positive thereafter.

Taken together, the mechanical decomposition shows that M&A-driven top-share growth arises from multiple margins rather than from a single dominant channel. *Stayer Roll-up* and *Inflow via M&A* remain persistently positive throughout the sample, though both are larger in horizons ending in the late 1990s and early 2000s and smaller thereafter. The reorganization-related margins—captured separately by *Mechanical Births* and *Absorbed Exits* and summarized by their net sum—also contribute importantly, especially in the earlier part of the sample. Overall, the figure indicates that the mechanical component reflects a combination of incumbent roll-up, acquisition-driven entry, and acquisition-related reorganization, with the relative importance of the reorganization margin diminishing after the early 2000s.

3 The Macroeconomic Anatomy of Concentration: From Superstar Scaling to Arrested Dynamism

Having established the exact accounting flows driving the concentration of the Top 0.01% in Section 2, we now unpack the micro-foundations of these flows. Specifically, we must determine whether the massive reallocation of market share toward apex incumbents is driven by genuine technological superiority or by the mechanical suppression of competition through mergers and acquisitions.

To isolate the true technological scaling engine from the mechanical consolidation engine, standard revenue-based total factor productivity (TFPR) is insufficient, as it conflates physical efficiency with markups (De Loecker, Eeckhout, and Unger, 2020). When a titan executes a wave of M&A, it reduces competitive intensity and raises its pricing power, causing TFPR to rise mechanically even if underlying physical technology stagnates. Relying on TFPR would therefore blind us to the true nature of modern concentration.

Instead, we must bridge our exact top-share accounting identity to the physical productivity dynamics of individual firms. By constructing a markup-adjusted physical productivity measure (TFPQ) and deploying it within both a macroeconomic Melitz–Polanec decomposition and a causal CS-DiD event-study framework, we document a profound regime shift in the behavior of the Top 0.01%.

3.1 Melitz–Polanec Decomposition: Long-Run Productivity Dynamics

The accounting decomposition in Section 2.2 establishes *what* drove top-share growth, but not *whether* this was efficient. To answer the efficiency question, we apply the Melitz–Polanec (2015) decomposition to our markup-adjusted TFP measure for firms in the Top 0.01%, using the same rolling ten-year horizon approach. Figure 4 plots the cumulative log TFP change decomposed into the Within-Firm, Reallocation, and Net Entry channels over the 1985–2023 period.

The time-series trajectory of total TFP growth for Top 0.01% firms is highly non-monotonic. Cumulative TFP rose robustly through the late 1990s and early 2000s, driven jointly by within-firm improvements and positive net-entry contributions as high-productivity superstar firms expanded and less productive incumbents exited. After approximately 2005, the within-firm contribution levels off and then declines, while the net-entry term turns persistently negative. By the end of the sample, cumulative TFP growth has largely stalled, and the small positive contribution that remains comes almost entirely from the

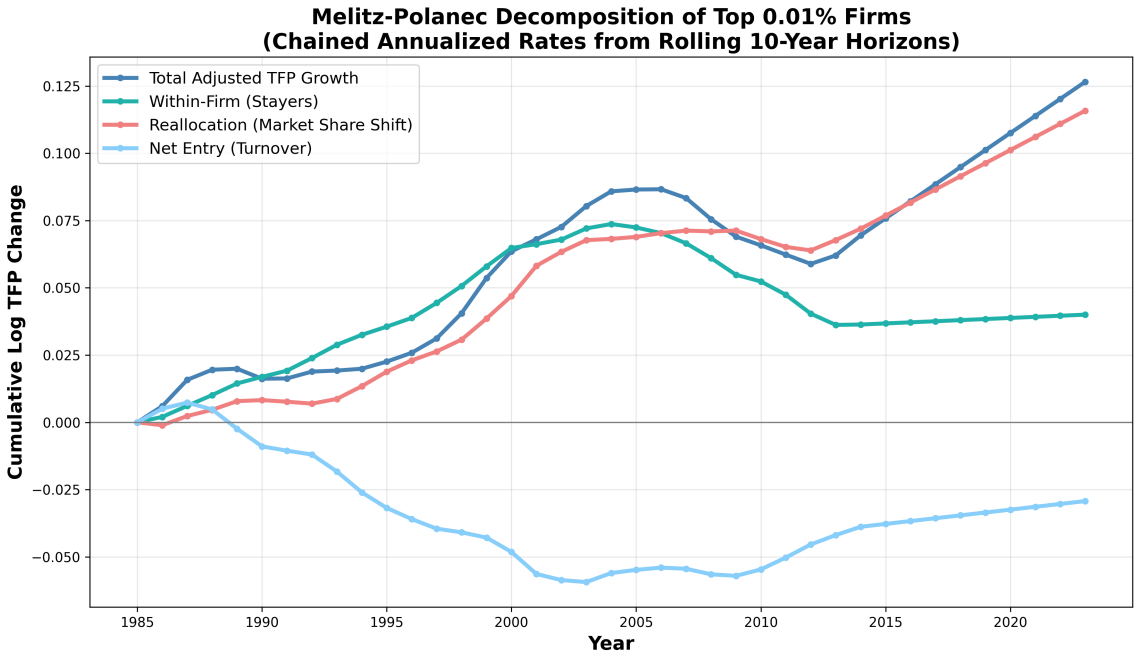


Figure 4: Melitz–Polanec TFP Decomposition of the Top 0.01% (Cumulative, Chained). Series are constructed by chaining annualized rates from rolling ten-year horizon Melitz–Polanec decompositions estimated on the Top 0.01% firm panel with markup-adjusted TFP. *Total Adjusted TFP Growth* (steelblue) is the aggregate change. *Within-Firm* (teal) captures average TFP improvement among stayer firms. *Reallocation* (coral) captures market share shifts toward initially more productive firms. *Net Entry* (skyblue) captures the TFP contribution of entry and exit turnover. The horizontal axis plots the year, indexed to zero at 1985.

reallocation channel—implying that even within the stagnant top tier, market share is shifting toward the more productive incumbents, rather than being driven by rising productivity across the board.

Figure 5 disaggregates the Net Entry term into its six constituent margins, providing the first granular accounting of what underlies the post-2005 productivity drag.

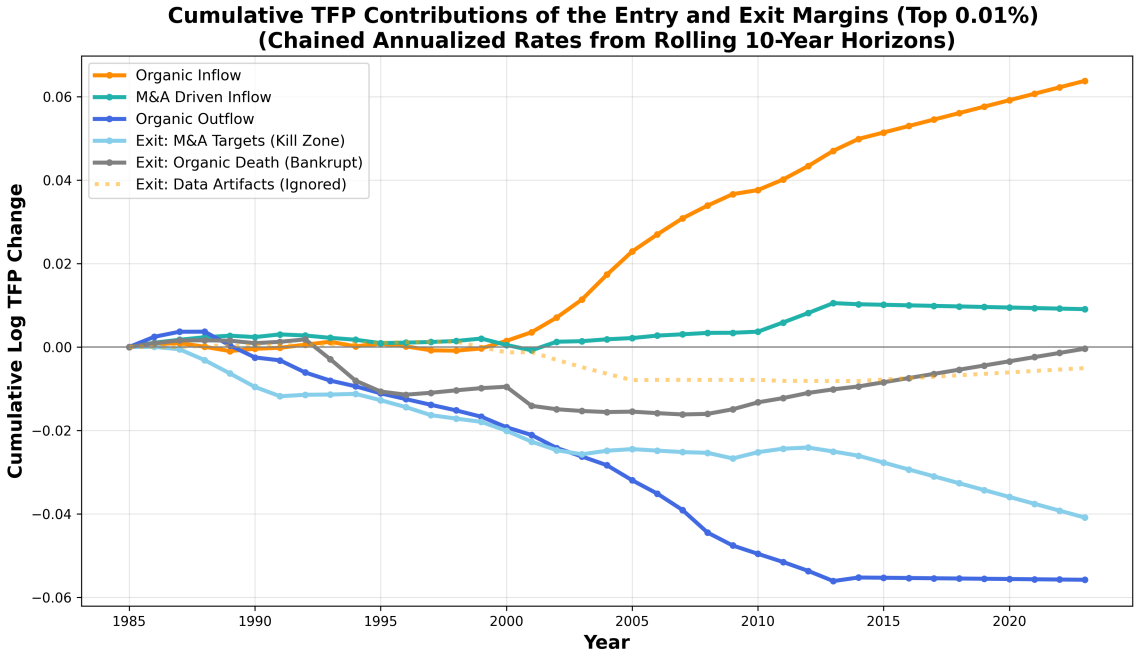


Figure 5: Cumulative TFP Contributions of Entry and Exit Margins (Top 0.01%). Each series is a chained cumulative sum of annualized contributions from rolling ten-year Melitz–Polanec decompositions. *Organic Inflow* (orange) captures high-TFP firms organically crossing into the top tier. *M&A Driven Inflow* (teal) captures firms entering the top tier through acquisitions. *Organic Outflow* (royalblue) captures firms demoted from the top tier whose TFP is below the stayer mean. *Exit: M&A Targets* (skyblue) captures firms removed from the top tier by acquisition. *Exit: Organic Death* (gray) captures firms exiting through bankruptcy or dissolution. *Exit: Data Artifacts* (orange, dotted) are excluded from inference.

The detailed decomposition reveals two qualitatively distinct forces behind the post-2005 net-entry drag. First, the *Organic Outflow* term (royalblue) turns increasingly negative in cumulative terms. Because this term is positive when the exiting firms have *below*-average TFP (standard Schumpeterian cleansing), a negative sign means the opposite: the firms being demoted from the top tier are increasingly *more* productive than the stayers who remain. This is the "Negative Outflow Paradox" discussed in detail in Section 3.2. Second, the *Exit: M&A Targets* term (skyblue) accumulates a large negative contribution over time, signifying that top-tier firms being absorbed by acquirers are systematically above the stayer TFP average. When an apex incumbent neutralizes a productive rival through

acquisition, it removes a disproportionately large share of physical efficiency from the top-tier pool.

3.2 The Four Eras of Top-Share TFP Dynamics

Figure 6 provides a cross-sectional decomposition that makes the era-by-era contrast sharper by reporting annualized Melitz–Polanec components for the four non-overlapping decades: 1985–1994, 1995–2004, 2005–2014, and 2015–2023.

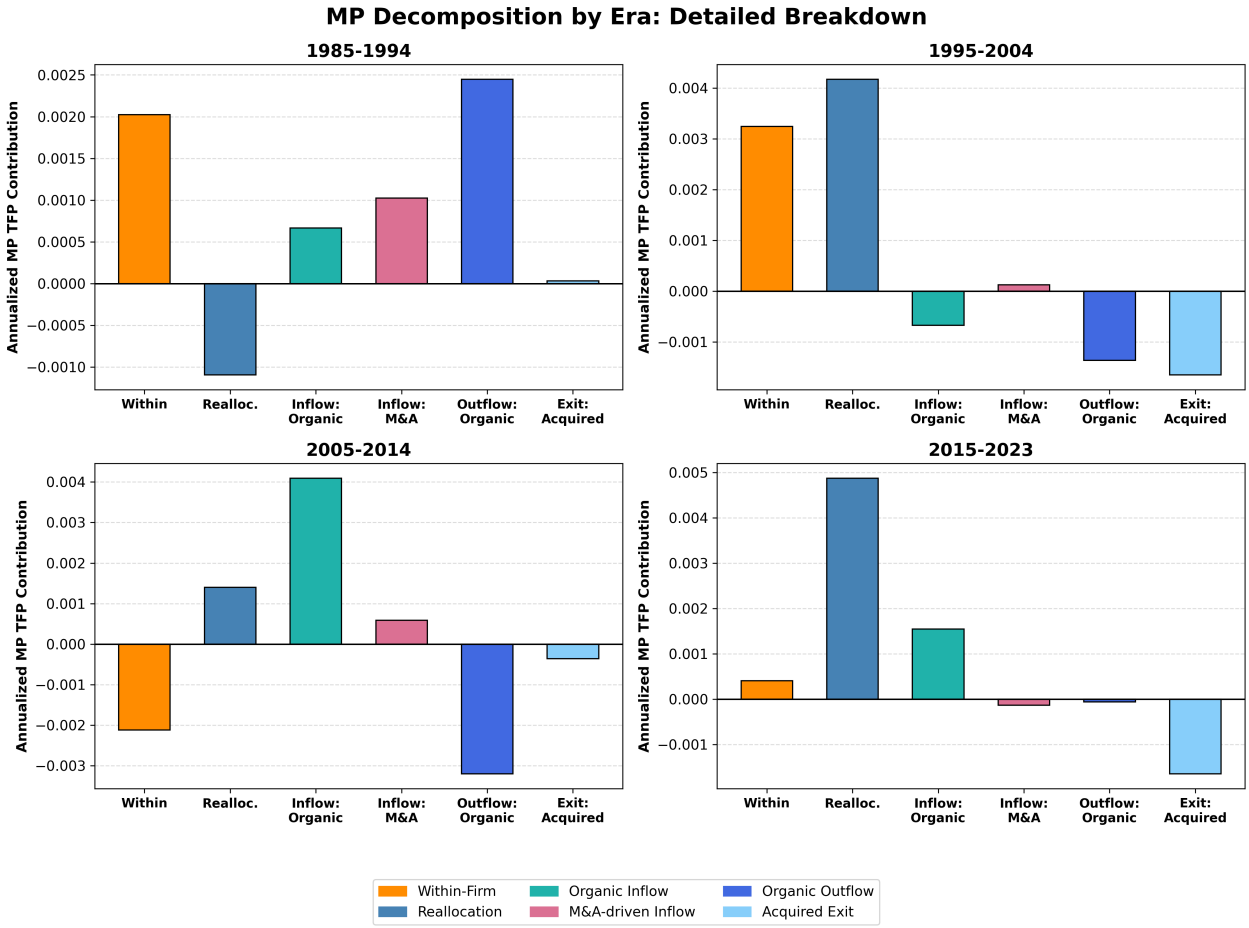


Figure 6: Melitz–Polanec TFP Decomposition of the Top 0.01% by Era (Annualized). Each panel corresponds to one non-overlapping decade of data. Bars represent annualized contributions to markup-adjusted TFP growth of the Top 0.01% firm group. *Within-Firm* (orange): average TFP change among stayers. *Reallocation* (steelblue): covariance of market share changes with initial productivity. *Organic Inflow* (teal): TFP premium of organically entering firms relative to the stayer mean. *M&A-driven Inflow* (palevioletred): TFP contribution of firms entering via acquisition. *Organic Outflow* (royalblue): TFP penalty of firms organically demoted from the top tier. *Acquired Exit* (skyblue): TFP contribution of firms removed through acquisition. Note that positive Outflow bars indicate below-average-TFP exits (Schumpeterian cleansing); negative bars indicate above-average-TFP exits (anti-Schumpeterian).

The four panels reveal a profound structural shift in the nature of US market concentration.

1985–1994: The Schumpeterian Baseline. The earliest period exhibits textbook Schumpeterian growth dynamics. The Within-Firm bar is the largest positive contributor, reflecting incumbents that survive at the top doing so by continuously improving their physical efficiency. The Organic Outflow bar is also positive, meaning firms being demoted from the top tier have *below*-average TFP—the economy is efficiently weeding out technological laggards. The Net Entry margin on balance supports aggregate TFP growth, and concentration at the top is a byproduct of genuine productivity leadership.

1995–2004: The Superstar Peak ("Good Concentration"). During the dot-com and early IT scaling era, the Within-Firm term surges to its historical maximum. This era is the empirical embodiment of the "Superstar Firm" hypothesis (**?**): top firms achieve unprecedented internal productivity gains through the scaling of general-purpose technologies, and the associated concentration is the efficient equilibrium response of output markets to heterogeneous technology. While M&A-driven inflows carry a modest negative TFP contribution—indicating that some acquired targets had below-average physical productivity—the dominant force is the massive internal technological improvement of surviving incumbents. This is benign concentration by any efficiency criterion.

2005–2014: The Transitional Era. The post-2005 decade is the canary in the coal mine. Organic inflow of high-TFP entrants remains positive, suggesting that highly productive challenger firms continued to arise. However, the Within-Firm term for stayers collapses almost to zero: top incumbents effectively cease improving their physical efficiency. Aggregate TFP among the top 0.01% is now sustained primarily by the Reallocation channel—market share continues to shift toward the relatively more productive incumbents, but the absolute productivity level of those incumbents is no longer rising. The onset of a large negative Acquired Exit contribution foreshadows the kill zone dynamics fully visible in the final era.

2015–2023: Arrested Dynamism ("Bad Concentration"). In the modern era, the Schumpeterian engine has stalled. The Within-Firm term remains near zero. Critically, the Organic Outflow bar turns sharply negative—the "Negative Outflow Paradox." Mathematically, this means the firms being pushed out of the Top 0.01% possess *higher* physical TFP than the stayers who remain. Survival at the apex is no longer determined by productive

efficiency but by insurmountable scale advantages, entrenched distribution networks, and the pricing power that comes from a decade of market consolidation. Meanwhile, the Acquired Exit bar remains a large negative drag: each time an apex incumbent absorbs a rival, it removes a disproportionately productive entity from the independent firm pool.

The net effect is a top share that rises through mechanical accumulation rather than technological leadership, generating the appearance of superstar dominance while the underlying productive engine has gone cold.

Figure 7 encapsulates this shift in a simple bar chart contrasting the organic versus mechanical contributions to top-share growth across the same four eras.

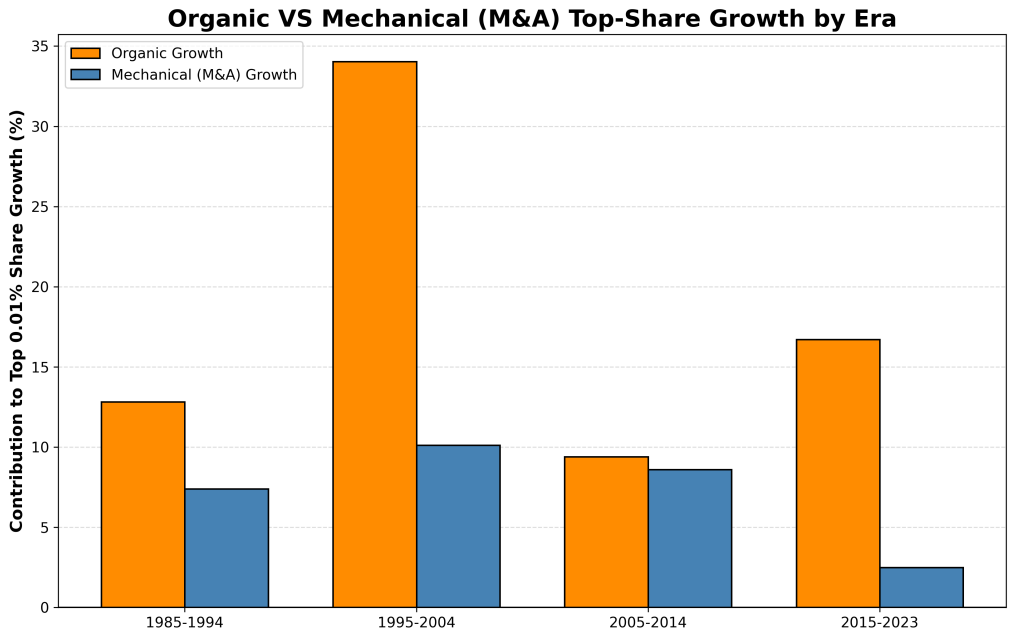


Figure 7: Organic vs. Mechanical (M&A) Top-Share Growth by Era. Each pair of bars reports the average annualized contribution of *Organic Growth* (teal) and *Mechanical M&A Growth* (coral) to the growth rate of the Top 0.01% sales share over the indicated decade. The shift from organic to mechanical dominance after 2004 is the central finding of this paper.

The figure is striking in its clarity. In the first two eras, organic growth dominates and mechanical M&A is a secondary force. Beginning with the 2005–2014 era, the relative magnitudes reverse: mechanical consolidation becomes the primary engine sustaining top-share growth, while organic growth fades to a secondary role. By the 2015–2023 era, the gap between the two channels is at its widest, and organic growth has nearly vanished as a force in its own right.

3.3 The Shrinking Target: Empirical Evidence for the Kill Zone

If top incumbents are no longer generating internal productivity gains, how are they sustaining—and indeed increasing—their market share? Our decomposition implicates M&A as the proximate mechanism, but a central question remains: are these acquisitions of the large, equal-footing "mergers of equals" type (designed to achieve scale efficiencies), or are they the defensive, pre-emptive "tuck-in" acquisitions designed to neutralize nascent productive challengers before they can threaten the incumbents' market position? We call the latter strategy the *Kill Zone* (**?**), and identify its empirical footprint by examining how target size has evolved relative to acquirer size across four cuts of the data.

Figure 8 presents this evidence as a 2×2 panel. The top row plots the median target-to-acquirer sales ratio (log scale, five-year rolling average) for *all* targets; the bottom row repeats the exercise restricting to *publicly listed* targets only—the highest-quality challengers that have already survived the venture-capital gauntlet and achieved IPO scale. The left column isolates Top 0.01% acquirers; the right column covers all acquirers as an economy-wide baseline.

All four panels tell the same story with striking consistency. In the early sample, the typical acquisition involved a target that was a meaningful fraction of the acquirer's own size—the economic equivalent of a merger of near-equals aimed at achieving large-scale operational economies. By the 2010s and 2020s, the median target is a tiny fraction of the acquiring firm's revenues, and this pattern holds equally for Top 0.01% acquirers and the full economy, and for private targets and publicly listed ones alike. The restriction to public targets is particularly telling: these firms have already cleared the venture-capital gauntlet and undertaken an IPO, placing them plausibly on a trajectory to threaten incumbent positions. Even among this higher-quality set the size ratio has collapsed, indicating that apex incumbents are acquiring ever-smaller rivals across the entire quality spectrum of potential challengers.

This is the empirical footprint of the tuck-in acquisition strategy. Because large established firms face severe organizational and incentive frictions in internally developing new technologies (**?**), they substitute capital advantage for innovative effort: acquiring nascent high-TFP challengers the moment they emerge and neutralizing the competitive threat long before these firms can achieve the scale to threaten the top tier organically. Because these technologies are rarely successfully integrated—as evidenced by the near-zero Within-Firm TFP growth in the post-2014 era—the target's productive capacity is effectively destroyed rather than absorbed, generating the persistent *negative* Acquired

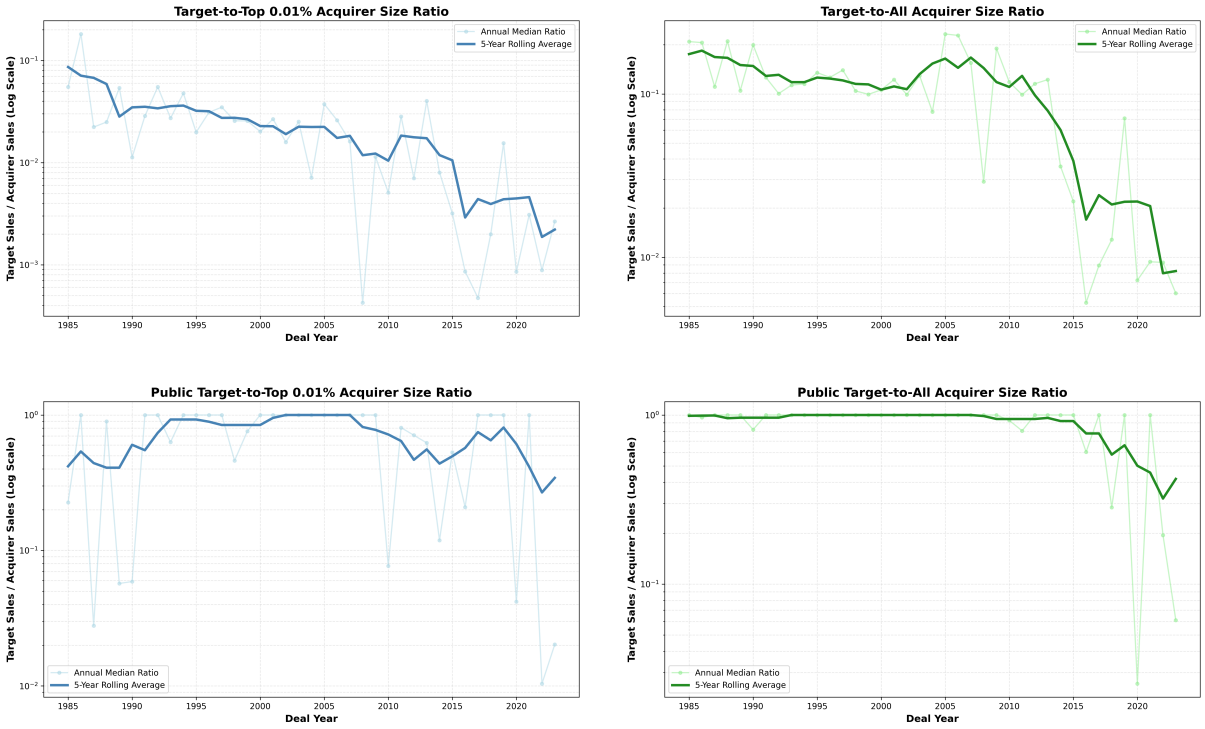


Figure 8: The Plunge in Target-to-Acquirer Size Ratios (Log Scale). All panels plot the median ratio of target sales to acquirer sales for completed deals, smoothed with a five-year centered rolling average (bold line) over annual medians (light dots). *Top row*: all targets (public and private combined). *Bottom row*: publicly listed targets only (active Compustat firm in the deal year or prior year). *Left column*: Top 0.01% acquirers only. *Right column*: all acquirers (economy-wide baseline). Across all four cuts, the ratio has fallen by one to two orders of magnitude since the mid-1980s, with the steepest decline occurring after 2005.

Exit contribution documented in Figure 6.

3.4 The Vanishing Public Target and the Public-Market Paradox

A further dimension of the changing nature of M&A is the systematic disappearance of publicly listed firms from the pool of acquisition targets. Figure 9 documents this evolution through a 2×2 panel. The top row shows the *share of deals targeting private (non-Compustat) firms*—the fraction of the M&A market that is invisible to standard public-firm databases. The bottom row shows the *public-firm acquisition rate*—the number of publicly listed targets acquired per 1,000 active public firms in each year, a measure of how intensely the public market is being consolidated. As before, the left column isolates Top 0.01% acquirers and the right column provides the economy-wide baseline. The public-target acquisition rate series is truncated at 2022 to avoid the denominator-collapse spike induced by the post-pandemic decline in public-firm listings.

The four panels reveal two mutually reinforcing trends. First, private targets have constituted the overwhelming majority of M&A activity by deal count—consistently above 80–90% for Top 0.01% acquirers and approaching 99% economy-wide—throughout the sample, and this share has risen over time. Second, the public-firm acquisition rate exhibits a two-peaked profile for both Top 0.01% acquirers and all acquirers, with peaks around 1998–2001 (the telecom and banking consolidation wave) and 2005–2008 (the pre-crisis consolidation period), followed by a persistent decline. More M&A spending is being deployed on ever-smaller, private targets while the rate of absorption of publicly traded rivals has fallen.

This combination immediately raises a measurement paradox: if public targets are so rare by count, why do they generate such a sizeable TFP drag in our Compustat-based Melitz–Polanec decomposition? The answer is twofold. First, the few public targets that are acquired tend to be large and highly productive relative to the average top-tier incumbent. When an apex firm neutralizes a publicly traded rival of comparable size and above-average TFP, it removes a heavily weighted node from the aggregate productivity distribution, generating an outsized impact relative to deal count. Second, our Melitz–Polanec framework does not *observe* private targets at all—their TFP contributions can only enter indirectly through the acquirer's subsequent productivity trajectory and through the organic outflow of demoted incumbents whose competitive positions were weakened by unchallenged apex firms. The true kill zone effect is therefore likely substantially *larger* than what we can measure with public-firm data alone.

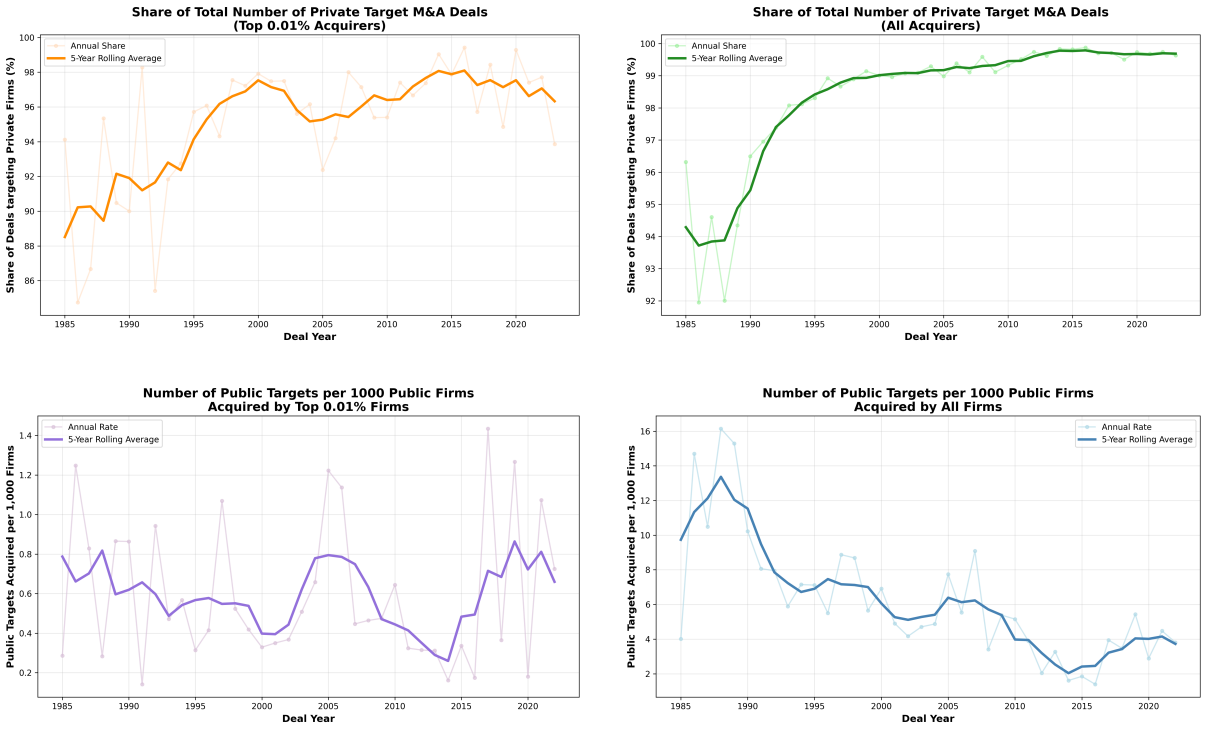


Figure 9: The Vanishing Public Target: Private-Deal Share and Public Acquisition Rates. *Top row*: share of completed M&A deals in which the target does not appear in Compustat (i.e., is privately held), computed annually and smoothed with a five-year centered rolling average. *Bottom row*: number of publicly listed targets acquired per 1,000 active Compustat firms, smoothed with a five-year centered rolling average; truncated at 2022. *Left column*: Top 0.01% acquirers only. *Right column*: all acquirers (economy-wide baseline). Together, the panels show that the M&A market has shifted overwhelmingly toward private targets while the rate at which public firms are absorbed has declined since the mid-2000s merger waves, despite rising aggregate M&A dollar volumes.

The second channel driving the acquired-exit TFP drag is financialization. A take-private buyout executed by a private equity (PE) firm is observationally equivalent to a strategic acquisition from the perspective of our decomposition: in both cases, the target disappears from the public-firm universe and its TFP contribution is lost from the measurable aggregate. The distinction matters normatively—PE take-privates may or may not improve the underlying firm's efficiency in subsequent years—but the macroeconomic implication is identical: the public market loses a productive firm from its competitive fringe, and remaining top-tier incumbents face less effective rivalry. The sustained negative Acquired Exit contribution is therefore the combined footprint of strategic kill-zone acquisitions and financialization-driven take-privates, both of which extract productive capacity from the public market and leave behind a top-heavy distribution of stagnant megacorporations whose concentration rises by default as organic challengers disappear.

3.5 Empirical Regularities: Linking the Two Decompositions

Before formalizing the mechanisms driving these transitions in our structural framework, we unite our dual methodologies—the top-share accounting decomposition and the Melitz–Polanec productivity decomposition—to establish two sharp empirical regularities defining the macroeconomic regime shift.

First, eras in which top-share growth is driven primarily by organic forces are simultaneously eras of strong within-firm TFP improvement: concentrated incumbents are earning their position through genuine physical efficiency gains. Second, eras in which top-share growth is driven primarily by mechanical M&A strictly correspond with negative net-entry TFP contributions: defensive acquisitions that neutralize productive challengers generate a persistent, observable drag on the aggregate TFP distribution of the top tier.

To rigorously document these aggregate relationships, we construct scatter plots in which each observation is one rolling ten-year horizon. This directly pairs the organic (mechanical) growth contribution from our accounting decomposition with the within-firm (net-entry) TFP contribution from the Melitz–Polanec decomposition. Figure 10 presents the first relationship, and Figure 11 presents the second.

The evidence in both scatter plots strongly supports the model's predictions. Figure 10 displays a robust positive relationship: rolling horizons with high organic top-share growth tend to be horizons in which within-firm TFP is also rising rapidly. The slope is positive and the fit is reasonably tight, consistent with the interpretation that organic concentration is a signal of genuine technological leadership. Figure 11 displays an equally robust neg-

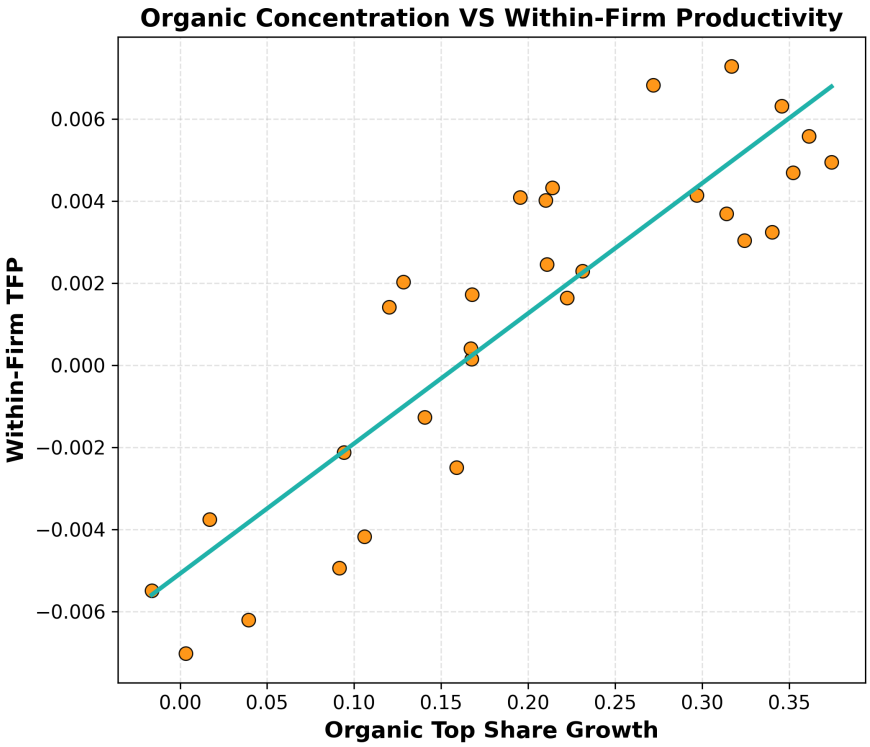


Figure 10: Organic Concentration vs. Within-Firm Productivity (Rolling Horizons). Each point is one rolling ten-year horizon. The horizontal axis plots the organic top-share growth rate (Δ^{OG}) from the accounting decomposition. The vertical axis plots the within-firm TFP contribution from the Melitz–Polanec decomposition applied to the same horizon. Orange scatter, teal OLS fit. A positive slope is the model prediction under "good concentration." The tight positive relationship confirms that eras of organic concentration coincide with eras of genuine within-firm productivity improvement.

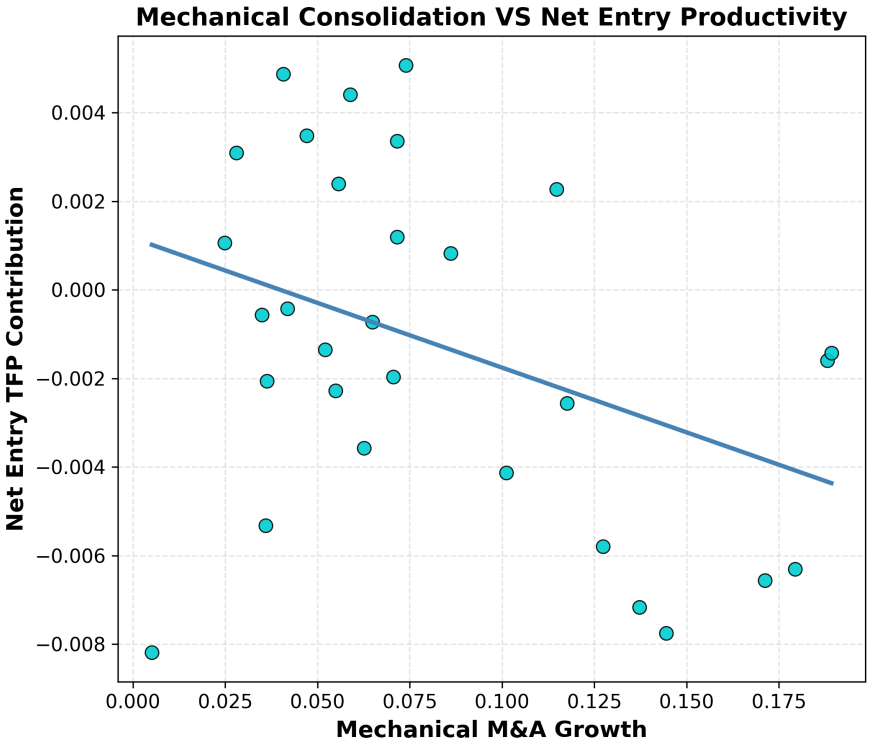


Figure 11: Mechanical Consolidation vs. Net Entry Productivity (Rolling Horizons). Each point is one rolling ten-year horizon. The horizontal axis plots the mechanical M&A growth rate (Δ^{MA}) from the accounting decomposition. The vertical axis plots the net-entry TFP contribution from the Melitz–Polanec decomposition applied to the same horizon. Teal scatter, coral OLS fit. A negative slope is the model prediction under "bad concentration": eras with more M&A-driven consolidation are eras in which more productive entrants are eliminated. The negative slope confirms that mechanical consolidation is associated with a destruction of productive dynamism at the top of the size distribution.

ative relationship: rolling horizons with high mechanical M&A-driven top-share growth tend to be horizons with large negative net-entry TFP contributions. Each additional unit of M&A-driven concentration is associated with a measurable destruction of productive dynamism in the top-tier firm pool.

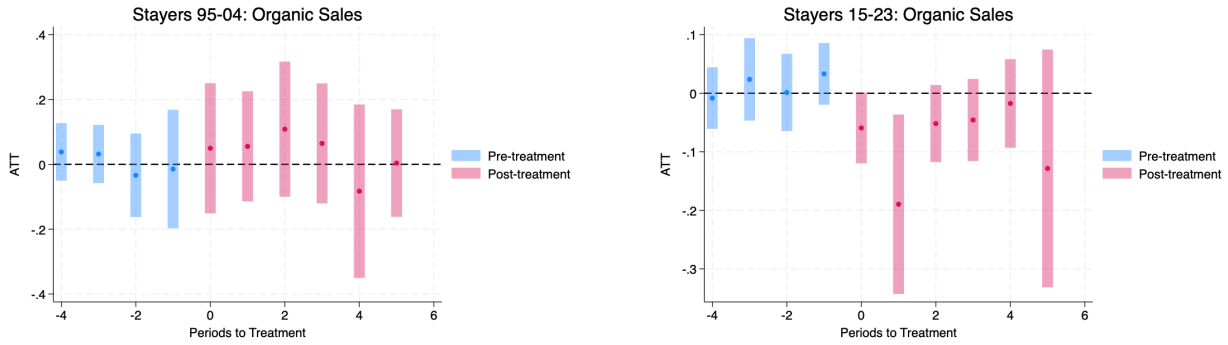
Together, these two scatter plots constitute a direct cross-era empirical test of the model's central prediction: the sign of the relationship between M&A intensity and aggregate TFP dynamics flips depending on whether acquisitions are efficiency-improving consolidation or defensive neutralization of productive challengers. The data strongly favor the latter interpretation for the post-2005 era of US market concentration, and the smooth transition in slope across rolling horizons traces the continuous shift from one regime to the other.

The implications for the welfare assessment of US market concentration are immediate and concerning. If the top-share growth observed since 2005 were driven by the same superstar dynamics that characterized the 1995–2004 era, we would expect rising within-firm TFP, permeable top-tier boundaries, and positive contributions from high-quality entrants. We observe none of these. Instead, we find stagnant within-firm TFP, barriers to organic entry as evidenced by the Negative Outflow Paradox, and a persistent drag from the systematic acquisition and neutralization of productive challengers. These findings are consistent with a world in which market power is self-reinforcing: incumbents accumulate rents that finance defensive M&A, defensive M&A suppresses the Schumpeterian challenge that would otherwise erode those rents, and the resulting equilibrium features high concentration, low dynamism, and the appearance of superstar productivity without the substance.

3.6 Event-Study Evidence Across Eras

To unpack the micro-foundations of this productivity collapse, we deploy the Doubly Robust Difference-in-Differences estimator (**?**) to track the dynamic firm-level event studies of top-tier M&A. Crucially, as demonstrated in Appendix Table 6, analyzing the pooled "All Firms" baseline severely masks the true causal dynamics due to compositional noise from rapid entrants (Inflows). To isolate the behavioral shift of entrenched monopolies, we restrict our primary event-study analysis exclusively to continuous top-tier incumbents ("Stayers").

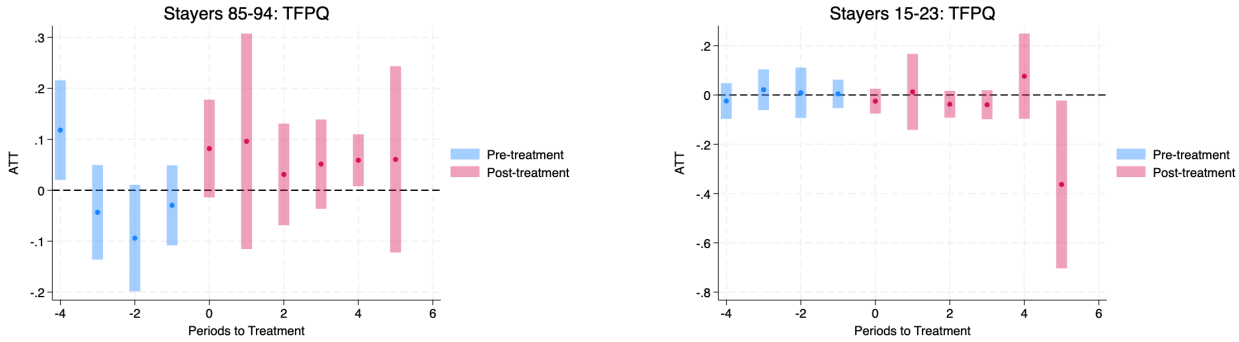
Table 1 and the corresponding dynamic event plots confirm a severe macroeconomic regime shift across the four decades, mapping perfectly to our aggregate Melitz-Polanec findings.



(a) Era 2 (1995–2004): Organic Scaling Engine (b) Era 4 (2015–2023): Arrested Dynamism

Figure 12: The Death of Organic Growth Post-M&A. Event-study estimates of organic sales growth for Top 0.01% Stayers. Pre-trends in both eras firmly support the identifying assumption. While 1990s M&A allowed incumbents to positively scale organically, modern M&A results in an immediate, highly significant -18.9% crash ($p < 0.015$) in internal growth.

The Good Concentration Era (1980s–1990s): As shown in Figure 13a, the concentration wave of the 1980s (Era 1) was highly Schumpeterian. Firm-level M&A was utilized to genuinely rationalize operations, leading to a delayed but significant positive shock to physical efficiency (TFPQ rises by 5.8% at $t + 4$). Table 1 confirms that over the long-run integration horizon ($t \in [2, 5]$), this yielded a sustained $+5.0\%$ average increase in physical productivity, alongside a robust $+6.0\%$ average boost to organic sales growth. By the 1990s (Era 2), this efficiency engine evolved into a robust scaling engine. As shown in Figure 12a and Table 1, top firms in the 90s utilized acquisitions to expand their market footprint while successfully maintaining positive organic top-line growth and securing long-run pricing power (Markups $+4.2\%$).



(a) Era 1 (1985–1994): Schumpeterian Efficiency (b) Era 4 (2015–2023): Productivity Rot

Figure 13: The Collapse of Physical Productivity (TFPQ). Event-study estimates for Top 0.01% Stayers. The 1980s restructuring wave yielded significant physical efficiency gains, whereas modern M&A leads to a -36% structural rot in productivity by year $t + 5$.

The Arrested Dynamism Era (2015–2023): In stark contrast, modern concentration oper-

ates as a purely defensive, growth-destroying mechanism. Figure 12b demonstrates that upon executing an acquisition today, a top incumbent's internal organic engine immediately collapses (-18.9% at $t+1$). Furthermore, as established in Figure 13b, the modern firm fundamentally fails to integrate these assets efficiently, leading to a massive, statistically significant -36% ($p = 0.036$) structural rot in physical productivity by year $t+5$. Table 1 confirms that this collapse in modern physical productivity (-9.1% long-run average) is structurally persistent, driving severe long-run contractions in both organic sales (-6.1% average) and total sales (-4.1% average).

3.7 Synthesizing the Macro and Micro Evidence: The Changing Nature of Top-Tier M&A

A critical conceptual distinction is required to fully reconcile the aggregate productivity dynamics of the Melitz–Polanec (MP) decomposition with the causal event studies of the CS-DiD estimator. The MP decomposition is a static accounting identity: its "Within" term measures absolute internal growth, while its "Reallocation" term measures whether market share is shifting toward firms with higher baseline productivity. In contrast, the CS-DiD estimator measures the dynamic, marginal shock of executing an M&A deal relative to a control group.

Crucially, our causal CS-DiD estimates serve as the exact structural parameters for the discrete treatment shocks ($J \in \{\gamma, -\tau\}$) in our continuous-time firm optimization problem. Viewing these metrics jointly resolves the macroeconomic puzzle of the last 40 years:

- **Era 1 (1985–1994) – The Restructuring Wave:** The MP decomposition reveals a negative Reallocation term alongside a robust positive Within-firm term ($+0.002$). This perfectly captures the mechanics of the 1980s corporate restructuring wave: top firms (Stayers) acquired massive, underperforming targets. Absorbing these inefficient assets initially diluted the acquirers' average baseline productivity, driving negative static Reallocation. However, these acquirers actively rationalized these assets, generating rapid internal efficiency gains (the high Within term). The CS-DiD event study confirms this Schumpeterian timeline: these acquisitions were genuine restructuring events that yielded a sustained $+5.0\%$ increase in physical efficiency. **This formally identifies our Synergistic Integration jump ($+\gamma = 0.050$), proving that historical concentration was a byproduct of a hyper-productive efficiency engine.**

- **Era 2 (1995–2004) – Scaling Without Penalty:** The MP decomposition shows high

positive Reallocation and robust Within-firm growth, capturing the dynamism of the 1990s IT boom as market share rapidly shifted toward hyper-productive rising stars. The CS-DiD reveals a null marginal treatment effect for TFPQ (-0.021, insignificant). Because the control group was already experiencing rapid organic technological growth, the null ATT implies that 1990s M&A was a benign scaling mechanism. Top firms expanded their market footprint *without* degrading their underlying, highly productive internal engines.

- **Era 3 (2005–2014) – The Dynamism Slowdown:** As the economy transitioned post-2000s, the MP Reallocation term remained positive but shrank in magnitude, signaling a slowdown in Schumpeterian market-share shifting. The CS-DiD reveals a corresponding negative but insignificant M&A treatment effect (-0.033), indicating that while dynamism was cooling, M&A was not yet actively toxic.
- **Era 4 (2015–2023) – The Modern Monopoly Paradox:** In the modern era, the dual methodologies expose the mechanics of "Arrested Dynamism." The MP decomposition shows that absolute Within-firm productivity growth has flatlined into near-perfect stagnation ($+0.0004$), yet Reallocation is highly positive. This is an artifact of static covariance: modern M&A is dominated by entrenched titans possessing massive baseline productivity. When they absorb a smaller competitor, market share is mechanically transferred to a higher-productivity base, yielding a positive static Reallocation term. *However*, the CS-DiD captures the true dynamic effect on the frontier: executing these defensive acquisitions causes a highly significant -9.1% structural penalty to the acquirer's own TFPQ. **This formally identifies our Defensive Shelving rot penalty ($-\tau = -0.091$).** The positive MP Reallocation term masks a dark underlying reality: concentration is no longer a tool of scaling; it is a defensive moat that mechanically shifts market share to titans while actively destroying their internal physical efficiency.

Taken together, this micro-evidence perfectly explains the aggregate macroeconomic puzzle: concentration is no longer driving growth because the M&A behavior of the Top 0.01% has transitioned from an offensive tool of efficiency and scaling into a defensive moat that actively suppresses their own physical productivity.

4 A Structural Model of Concentration and Productivity

To formalize the economic mechanism driving the transition from "Good Concentration" to "Arrested Dynamism," we develop a continuous-time model of firm dynamics. The

Table 1: Stayers Average Post-Treatment Effects ($t \in [2,5]$): Era-by-Era Shift

Outcome	1985–1994	1995–2004	2005–2014	2015–2023
TFPQ	0.050	-0.021	-0.033	-0.091**
	(0.038)	(0.087)	(0.060)	(0.042)
Log Markup	-0.046**	0.042	-0.015	-0.001
	(0.020)	(0.044)	(0.073)	(0.078)
Organic Sales Growth	0.060	0.024	0.072	-0.061
	(0.050)	(0.099)	(0.064)	(0.042)
Total Sales Growth	0.033	0.026	0.082	-0.041**
	(0.043)	(0.088)	(0.069)	(0.020)

Notes: This table presents the average of the CS-DiD event study coefficients for periods $t \in [2,5]$ post-treatment for Stayers, estimated independently within each macroeconomic era. The transition from positive long-run scaling in the 1990s to significantly negative physical productivity (TFPQ) and sales growth in the modern era isolates the structural regime shift in top-tier M&A. Standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

model micro-founds the incumbent firm's dual choice: how much to invest in internal organic scaling, and how to optimally neutralize external competitive threats through M&A. By bridging individual firm optimization with the macroeconomic distribution of the top tail, we map the model's structural parameters directly to our empirical Melitz–Polanec and CS-DiD moments. This allows us to structurally quantify exactly why the US economy transitioned from a productive scaling regime to a defensive moat.

4.1 Economic Environment and The Schumpeterian Threat

Following standard quality-ladder models (**??**), consumers have Constant Elasticity of Substitution (CES) preferences over a continuum of intermediate goods. The Top 0.01% incumbent (the "Stayer") holds a monopoly in its product line, characterized by a physical productivity scale ϕ_t. To maintain this monopoly against a competitive fringe, the incumbent limit-prices, yielding a structural operating profit $\pi(\mu_t)$ strictly increasing in its markup μ_t. A detailed derivation of the demand framework is provided in Appendix B.

The incumbent firm grows organically through gross internal investment g_{gross}, facing a convex internal scaling friction c_k. The parameter c_k captures the firm's in-house R&D adjustment cost—the internal bureaucratic friction required to push the technological frontier forward purely through organic efforts. Crucially, this is strictly distinct from the costs of external M&A integration.

Simultaneously, the legacy scale of the firm deprecates at a continuous technological obsolescence rate (δ_t). Economically, δ_t represents the continuous, baseline decay of a legacy monopoly's relevance—such as shifting consumer tastes, patent expirations, or the slow erosion of organizational know-how. It dictates the speed of the "treadmill" the firm must run on just to maintain its current scale. This slow, continuous bleed is strictly distinct from the violent, discrete replacement of incumbents by new startups (Creative Destruction). The continuous pure organic drift of the firm is therefore $g_{gross} - \delta_t \equiv g^*$.

At rate $\lambda_{total,t}$, the firm faces a discrete Poisson arrival of an external M&A target. Upon the target's arrival, the firm must choose its integration strategy ($I \in \{0, 1\}$). If the firm actively integrates the target ($I = 1$), it assimilates the technology, jumping its physical scale upward by $\gamma > 0$. However, merging completely with the target structurally neutralizes the incumbent's legacy market power, forcing its markup to drop back to a competitive integration baseline (μ_{int}). Alternatively, if the firm chooses defensive shelving ($I = 0$), it purposefully isolates and deprecates the target. While this successfully defends the incumbent's legacy markup (μ_t), the redundant infrastructure and bureaucratic bloat inflict a structural penalty on the acquirer's physical productivity, pulling its scale downward by $-\tau < 0$.

4.2 The Stayer's Problem: Organic Growth vs. M&A Integration

The firm's value function $V(\phi_t, \mu_t)$ captures the expected present discounted value of its profit stream. Normalizing by physical scale ϕ_t, the marginal value of scale is denoted as $v(\mu_t)$. The firm optimally chooses gross organic investment (g_{gross}) and its discrete M&A strategy (I) to satisfy the steady-state Hamilton-Jacobi-Bellman (HJB) equation:

$$rv(\mu_t) = \max_{g_{gross} \geq 0, I \in \{0,1\}} \left\{ \pi(\mu_t) - \frac{c_k}{2} g_{gross}^2 + v(\mu_t)(g_{gross} - \delta_t) + \lambda_{total,t} \mathbb{E}\left[(1 + J) v(\mu_{t^+}) - v(\mu_t) \right] \right\} \tag{4}$$

The first-order condition dictates that the firm scales internally until the marginal cost of internal bureaucratic friction equals the marginal value of its scale ($g^*_{gross} = v(\mu_t)/c_k$). Crucially, evaluating the Poisson expectation term reveals that the firm optimally abandons synergistic integration and pivots to defensive shelving ($I^* = 0$) if and only if the legacy valuation premium satisfies:

$$\frac{v(\mu_t)}{v(\mu_{int})} > \frac{1 + \gamma}{1 - \tau} \tag{5}$$

4.3 Distributional Dynamics and the Kolmogorov Forward Equation

To identify the macro-environmental parameters, we aggregate the continuous-time micro-shocks over the Pareto tail of the Top 0.01% firm distribution. We explicitly distinguish between two M&A acquisition rates: the public-target arrival rate ($\lambda_{pub,t}$) captures the frequency of cannibalizing *public*, frontier targets large enough to be visible in the Compustat top tail, while the total execution rate ($\lambda_{total,t}$), estimated directly from our CS-DiD panel, captures the true arrival rate of *all* acquisitions, including the shadow consolidation of private startups.

By aggregating these flows into the empirical arithmetic log-differences required by the Melitz-Polanec decomposition, the total change in the aggregate productivity of the Top 0.01% tail ($\Delta\Phi_t$) is governed by the continuous-time Kolmogorov Forward Equation (or Fokker-Planck balance):

$$\Delta\Phi_t = \underbrace{g^*}_{\text{Stayer Net Growth}} + \underbrace{\lambda_{in,t}\ln(1+\gamma)}_{\text{Schumpeterian Inflow}} - \underbrace{\delta_t}_{\text{Natural Demotion}} - \underbrace{\lambda_{pub,t}|\ln(1-\tau)|}_{\text{M\&A Target Loss}} \tag{6}$$

This macroeconomic identity perfectly balances the technological frontier:

1. **The Engine (g^*):** The net organic drift of the incumbents. If titans innovate efficiently, they physically push the entire Pareto tail forward.

2. **The Schumpeterian Injection ($\lambda_{in,t}\ln(1+\gamma)$):** The Poisson arrival of massive, exogenous technological leaps. Every time a fringe startup hyper-scales and organically breaches the boundary, it injects a discrete $+\gamma$ mass of fresh log-TFP into the tail.

3. **The Continuous Bleed (δ_t):** As legacy firms at the boundary fail to keep up with the advancing frontier, they slide backward. Because the titans executing M&A are deep in the tail, marginal demotions are driven almost exclusively by this continuous natural obsolescence.

4. **The Cannibalization Drain ($\lambda_{pub,t}|\ln(1-\tau)|$):** To estimate the target outflow volume ($\lambda_{pub,t}$), we apply a Symmetric Scaling Assumption: the discrete structural size of a public frontier target is proportional to the technological penalty ($-\tau$) it inflicts when shelved. Taking the log-limit mapping of this penalty gives a universal standalone target size of $|\ln(1-\tau)|$. Crucially, anchoring the target's physical mass to $|\ln(1-\tau)|$ establishes a universal structural size for a frontier target, completely independent of the acquirer's endogenous choice to integrate ($+\gamma$) or shelve ($-\tau$).

This guarantees that our measurement of the M&A target volume ($\lambda_{pub,t}$) is perfectly identified across all eras without mechanically assuming the target was poorly utilized.

4.4 Micro-Estimation: Bridging Accounting and Theory

A critical aggregation challenge arises when mapping the firm's state variables to the aggregate data: the empirical Melitz-Polanec *Within* term (g^*) captures the total realized productivity growth of all surviving incumbents. Because these "Stayers" remain in the tail, they absorb the discrete treatment shocks of M&A (γ or $-\tau$) without falling out of the distribution, while simultaneously experiencing continuous in-house R&D drift and natural obsolescence. The empirical g^* therefore mathematically bundles both the continuous drift and the discrete jumps.

To cleanly isolate the firm's true gross internal organic investment (g_{gross}), we must residualize the MP Within term. By accounting identity, the continuous drift equals gross investment minus natural continuous obsolescence. We add back the continuous decay (δ_t) and strip out the expected discrete treatment effects of the firm's true total execution rate ($\lambda_{total,t}$):

$$g_{gross} = g^* + \delta_t - \lambda_{total,t}\mathbb{E}[J_t] \tag{7}$$

As proven in Appendix B, this strict orthogonality guarantees that the model is perfectly sequentially identified without circular dependencies.

4.5 Results: The Macroeconomic Arc of Arrested Dynamism

The unified structural estimates cleanly parameterize the historical narrative of the American corporate frontier. Evaluated through the lens of the Kolmogorov Forward balance (Equation 6), they reveal profound shifts in the mechanics of concentration.

Era 1 and Era 2 (1985–2004): The Golden Age and the Scale Explosion.
During the IT and telecom booms, the aggregate frontier was expanding rapidly because the incumbent engine was functioning perfectly. Gross internal investment was high ($g_{gross} = 0.0052$) driven by low internal bureaucratic friction (c_k normalized to 1.00). Because legacy valuations remained far below the 15.5% Defensive Shelving threshold, titans optimally chose synergistic integration ($I^* = 1$). Thus, the high volume of public M&A ($\lambda_{pub} = 0.0173$ in Era 2) was actively boosting the aggregate *Within* term. Crucially, Era 2 yields a paradoxical negative Schumpeterian threat rate ($\lambda_{in} = -0.0138$). The incumbent Top 0.01% were experiencing such an absolute golden age of organic growth that even

Table 2: Structural Estimation of Aggregate Distributional Dynamics by Era

Macro-Environment Parameter	Era 1 (1985-1994)	Era 2 (1995-2004)	Era 3 (2005-2014)	Era 4 (2015-2023)
Pareto Tail Shape				
Pareto Exponent (ζ_t)	1.149	1.045	1.007	0.980
Structural Transition Rates				
Natural Obsolescence Rate (δ_t)	0.0033	0.0021	0.0036	0.0009
Schumpeterian Threat Rate ($\lambda_{in,t}$)	0.0136	-0.0138	0.0839	0.0317
Public Target Arrival Rate ($\lambda_{pub,t}$)	0.0003	0.0173	0.0037	0.0172

Notes: This table reports the structurally identified macroeconomic transition rates for all four eras, mapping the continuous-time jump-diffusion processes directly to the empirical Melitz-Polanec log-TFP decomposition. The natural obsolescence rate (δ_t) tracks the aggregate baseline demotion and death of incumbents. The Schumpeterian threat rate ($\lambda_{in,t}$) is rigorously identified by dividing only the empirical MP organic inflow by the technological synergy leap ($\gamma = 0.050$), excluding the mechanical consolidation of fringe M&A. The public target arrival rate ($\lambda_{pub,t}$) is identified by scaling the mass of targets removed from the tail (*Exit: Acquired*) against the structural size of the target ($|\ln(1-\tau)|$).

Table 3: Structural Estimation of Firm-Level Dynamics

Parameter	Era 1	Era 2	Era 3	Era 4
Input: Micro & Macro Empirical Moments				
Baseline Markup (μ)	1.599	1.683	1.649	1.768
Net Organic Growth (g^*)	0.0020	0.0032	-0.0021	0.0019
Natural Obsolescence (δ)	0.0033	0.0021	0.0036	0.0009
Total M&A Execution Rate (λ_{total})	0.0037	0.0102	0.0023	0.0091
Gross Organic Investment (g_{gross})	0.0052	0.0048	0.0017	0.0037
Output: Estimated Structural Parameters				
Marginal Value of Scale ($v(\mu)$)	31.50	33.85	31.27	36.00
Relative Internal Bureaucratic Friction ($c_k/c_{k,Era1}$)	1.00	1.15	3.06	1.61
Defensive Shelving Premium Threshold		**15.5%**		

Notes: This table reports the closed-form analytical estimates of the model's structural parameters. Gross organic investment (g_{gross}) is recovered by subtracting the expected M&A treatment jump from the empirical Melitz-Polanec net organic growth rate (g^*), and adding the macro-estimated natural continuous obsolescence rate (δ). The expected M&A jump uses $\gamma = 0.050$ for Eras 1 and 2, and $-\tau = -0.091$ for Eras 3 and 4, multiplied by the true total empirical execution rate (λ_{total}). The discount rate is set to $r = 0.05$. The absolute value of internal bureaucratic friction (c_k) is normalized relative to Era 1 to cleanly isolate the structural multiplier.

the most brilliant new startups breaching the threshold had physical productivities *lower* than the soaring incumbent average, mathematically diluting the tail. The incumbents genuinely out-competed the fringe.

Era 3 (2005–2014): Sclerotic Collapse and the "Lost Decade."
Following the Great Financial Crisis, top firms achieved unprecedented global footprints, but this scale came at a massive organizational cost. The internal scaling friction (c_k) exploded to 3.06 times the 1990s baseline, reflecting the onset of "middle-age sclerosis," intense precautionary risk-aversion, and surging regulatory compliance. As in-house R&D became prohibitively expensive, incumbent gross investment collapsed ($g_{gross} = 0.0017$). Because the baseline incumbents completely stagnated, the Kolmogorov balance violently shifted toward the fringe: ordinary organic startups easily looked like technological leaps by comparison, driving the measured Schumpeterian threat ($\lambda_{in,t}$) to an astonishing 8.39%.

Era 4 (2015–2023): Infinite Variance and the R&D Treadmill.
In the modern era, the structural state of the economy fundamentally mutates, and the macroeconomic bathtub is defined by highly toxic mechanics. The dynamic Pareto exponent (ζ_t) drops to 0.980. In theoretical statistics, $\zeta \leq 1.0$ implies the distribution has an infinite variance and mean—quantifying a modern "Winner-Take-All" economy where the apex titans have completely broken traditional statistical bounds. Concurrently, the continuous bleed has stopped: natural obsolescence collapsed to a historical low ($\delta_t = 0.09\%$), proving that modern ecosystems (e.g., iOS lock-in, AWS infrastructure) are so entrenched that incumbents face almost zero baseline decay.

However, the Cannibalization Drain is massive. Legacy markups are massive ($\mu = 1.768$), pushing the titan's valuation past the 15.5% Defensive Shelving threshold. They optimally execute a massive wave of defensive M&A ($I^* = 0$, $\lambda_{pub} = 0.0172$). This constantly deletes structural targets from the aggregate distribution ($|\ln(1-\tau)|$) while simultaneously inflicting organizational rot ($-\tau$) upon the acquirers. Today, the titans' true internal gross investment ($g_{gross} = 0.0037$) is significantly higher than their realized net growth ($g^* = 0.0019$). Approximately 8 basis points of organic growth are actively destroyed by the rot absorbed from executing defensive M&A. Concentration is no longer the byproduct of efficient scaling; modern titans are running on an internal R&D treadmill just to offset the rot they inflict upon themselves to defend their moats.

4.6 Counterfactual Policy Experiments

Counterfactual 1: Antitrust Enforcement and Markup Caps.
A prevailing view in modern antitrust policy advocates for aggressive structural breakups to strictly limit the pricing power of technology titans. We operationalize this by forcing the Era 4 limit-pricing markup ($\mu = 1.768$) back to its historical Era 1 baseline ($\mu = 1.599$).

This policy triggers a profound structural reversal. By capping the markup, the firm's legacy valuation is crushed ($v(\mu_{CF}) \approx 32.56$). Consequently, the firm's valuation ratio against the integration baseline drops safely below the 1.155 defensive shelving threshold. The titan optimally abandons "Killer Acquisitions" ($I^* = 0$) and returns to Synergistic Integration ($I^* = 1$). This policy is overwhelmingly welfare-enhancing: the economy regains the $+5.0\%$ technological synergy and avoids the precisely estimated -9.1% physical productivity rot.

Counterfactual 2: R&D Subsidies and the Innovation Paradox.
Alternatively, industrial policy often seeks to stimulate stagnant corporate dynamism through R&D subsidies (e.g., the CHIPS and Science Act). We model this by subsidizing the modern internal bureaucratic friction, returning c_k from its elevated Era 4 peak to its highly efficient Era 1 baseline.

While this successfully achieves its primary objective—organic scaling g_{gross} violently accelerates—it triggers a paradoxical collapse in external M&A efficiency. Because the firm's organic growth rate increases, the denominator of its valuation function $(r + \delta - 0.5g_{gross})$ shrinks, causing the marginal value of legacy scale $v(\mu)$ to mathematically strictly increase. By making the incumbent's legacy scale even more valuable, the subsidy pushes the firm's legacy premium further beyond the 15.5% threshold. Thus, subsidizing the internal R&D of modern monopolies actively increases their economic incentive to execute defensive Killer Acquisitions.

5 Conclusion

The relentless rise in corporate concentration over the past four decades has sparked a vital debate regarding the health of US business dynamism. By uniting a mathematically exact accounting decomposition with exhaustive, micro-audited historical data and structural productivity adjustments, this paper provides a definitive anatomy of aggregate top-share growth from 1985 to 2023. Our findings reconcile competing views on market power by demonstrating that the macroeconomic engine of concentration has fundamen-

tally evolved. The US economy has transitioned from an era of "Superstar Scaling"—characterized by robust organic growth and genuine synergistic integration—to a modern regime of "Arrested Dynamism."

Our causal event-study and aggregate productivity metrics expose a dark reality behind modern M&A: rather than serving as a vehicle for technological reallocation, acquisitions by today's Top 0.01% are overwhelmingly defensive, inflicting a severe structural rot on the acquirers' own physical efficiency. Through the lens of our continuous-time structural framework, we prove that this transition is not a random deviation, but the endogenous, mathematical consequence of the secular rise in markups. When entrenched titans accumulate massive baseline market power, the economic calculus of innovation flips: it becomes strictly profit-maximizing to shelve innovative targets to protect legacy monopoly rents rather than incur the organizational frictions required to synergistically integrate them.

These findings carry profound implications for macroeconomic policy and antitrust enforcement. If modern concentration is driven by the defensive suppression of Schumpeterian creative destruction, then relying on standard revenue-based productivity metrics will dangerously mask the underlying decay in physical efficiency. Furthermore, our theoretical results reveal a critical policy paradox: standard industrial policies, such as R&D subsidies, may unintentionally accelerate defensive "killer acquisitions" if they further inflate the value of incumbents' legacy scale. Ultimately, restoring macroeconomic dynamism requires recognizing that modern concentration is no longer a byproduct of technological scaling; it has become a structural moat designed to arrest it.

References

AKCIGIT, U., AND S. T. ATES (2023): "What happened to US business dynamism?," *Journal of Political Economy*, 131(8), 2059–2124.

ARROW, K. J. (1962): "Economic Welfare and the Allocation of Resources for Invention," in *The Rate and Direction of Inventive Activity: Economic and Social Factors*, pp. 609–626. Princeton University Press.

AUTOR, D., D. DORN, L. F. KATZ, C. PATTERSON, AND J. VAN REENEN (2020): "The fall of the labor share and the rise of superstar firms," *The Quarterly journal of economics*, 135(2), 645–709.

BERGER, M., S. CALLIGARIS, A. GREPPI, AND D. KIRPICHEV (2025): "Acquisitions and their effect on start-up innovation: Stifling or scaling?," Discussion paper, OECD Science, Technology and Industry Working Papers, No. 2025/10.

BERRY, S., M. GAYNOR, AND F. S. MORTON (2019): "Do increasing markups matter? Lessons from empirical industrial organization," *Journal of Economic Perspectives*, 33(3), 44–68.

BLOOM, N., C. I. JONES, J. VAN REENEN, AND M. WEBB (2020): "Are ideas getting harder to find?," *American Economic Review*, 110(4), 1104–1144.

CALLAWAY, B., AND P. H. SANT'ANNA (2021): "Difference-in-differences with multiple time periods," *Journal of econometrics*, 225(2), 200–230.

COASE, R. H. (1937): "The Nature of the Firm," *Economica*, 4(16), 386–405.

COVARRUBIAS, M., G. GUTIÉRREZ, AND T. PHILIPPON (2020): "From good to bad concentration? US industries over the past 30 years," *NBER Macroeconomics Annual*, 34(1), 1–46.

CROUZET, N., Z. HE, V. LYONNET, AND Y. MA (2025): "Why Don't Old Firms Do New Things?," Discussion paper, Working Paper.

CUNNINGHAM, C., F. EDERER, AND S. MA (2021): "Killer acquisitions," *Journal of political economy*, 129(3), 649–702.

DAVID, J. M. (2021): "The aggregate implications of mergers and acquisitions," *The Review of Economic Studies*, 88(4), 1796–1830.

DE LOECKER, J., J. EECKHOUT, AND G. UNGER (2020): "The Rise of Market Power and the Macroeconomic Implications," *The Quarterly Journal of Economics*, 135(2), 561–644.

GUTIÉRREZ, G., AND T. PHILIPPON (2019): "Fading stars," in *AEA Papers and Proceedings*, vol. 109, pp. 312–316. American Economic Association 2014 Broadway, Suite 305, Nashville, TN 37203.

HOBERG, G., AND G. PHILLIPS (2010): "Product market synergies and competition in mergers and acquisitions: A text-based analysis," *The Review of Financial Studies*, 23(10), 3773–3811.

KWON, S. Y., Y. MA, AND K. ZIMMERMANN (2024): "100 years of rising corporate concentration," *American Economic Review*, 114(7), 2111–2140.

MA, Y., B. PUGSLEY, H. QIN, AND K. ZIMMERMANN (2025): "Superstar firms through the generations," Discussion paper, National Bureau of Economic Research.

MA, Y., M. ZHANG, AND K. ZIMMERMANN (2026): "Business Concentration around the World: 1900-2020," Discussion paper, National Bureau of Economic Research.

MELITZ, M. J., AND S. POLANEC (2015): "Dynamic Olley-Pakes productivity decomposition with entry and exit," *The RAND Journal of Economics*, 46(2), 362–375.

SCHUMPETER, J. A. (1942): *Capitalism, Socialism and Democracy*. Harper & Brothers, New York.

SHAPIRO, C. (2019): "Protecting competition in the American economy: Merger control, tech titans, labor markets," *Journal of Economic Perspectives*, 33(3), 69–93.

A Empirical Appendix: Proof of the Corrected Top-Share Decomposition

Here we provide the rigorous mathematical derivation of the threshold-centered top-share decomposition, proving that our sub-components exactly sum to the aggregate top-share growth with zero residual.

A.1 Proof of the Exact Top-Share Identity

Recall the definition of the top share at time t: $\mathsf{S}_t = A_t^{ALL}/\Omega_t$. The percentage growth in the top share from $t = 0$ to $t = 1$ is:

$$\frac{\mathsf{S}_1 - \mathsf{S}_0}{\mathsf{S}_0} = \frac{\frac{A_1^{ALL}}{\Omega_1} - \frac{A_0^{ALL}}{\Omega_0}}{\frac{A_0^{ALL}}{\Omega_0}} = \frac{A_1^{ALL}}{A_0^{ALL}} \left(\frac{\Omega_0}{\Omega_1} \right) - 1 \tag{8}$$

Substituting the aggregate scale factor $\Xi \equiv \Omega_0/\Omega_1$:

$$\frac{\mathsf{S}_1 - \mathsf{S}_0}{\mathsf{S}_0} = \Xi \left(1 + \frac{A_1^{ALL} - A_0^{ALL}}{A_0^{ALL}} \right) - 1 = (\Xi - 1) + \Xi \cdot \frac{A_1^{ALL} - A_0^{ALL}}{A_0^{ALL}} \tag{9}$$

The term $(\Xi - 1)$ captures aggregate dilution. The true firm dynamics are contained within the absolute numerator change $A_1^{ALL} - A_0^{ALL}$.

A.2 Algebraic Expansion of the Corrected Dynamics

To map the empirical flows to our theoretical jump-diffusion processes, we expand the total change using the disjoint set partitions: $P_1 = S \cup E \cup B$ and $P_0 = S \cup X \cup D$. As detailed in the main text, our micro-auditing corrects the raw death set (D) by re-partitioning it into structurally verified true outcomes: $D = D^{OG_true} \cup D^{MA_total} \cup D^{Artifact}$.

The total absolute change in the top tier is therefore:

$$\begin{aligned} A_1^{ALL} - A_0^{ALL} = & \left(\sum_S u_{i1}^{ALL} + \sum_E u_{i1}^{ALL} + \sum_B u_{i1}^{ALL} \right) \\ & - \left(\sum_S u_{i0}^{ALL} + \sum_X u_{i0}^{ALL} + \sum_{D^{OG_true}} u_{i0}^{ALL} + \sum_{D^{MA_total}} u_{i0}^{ALL} + \sum_{D^{Artifact}} u_{i0}^{ALL} \right) \end{aligned} \tag{10}$$

To isolate organic technological scaling from mechanical consolidation, we decompose $u^{ALL} = u^{OG} + u^{MA}$ specifically for surviving sets (S and E). For exiting and displaced sets (X and D), we deduct their *entire* baseline size (u^{ALL}), as their mass is entirely lost from the respective distributions. We group these terms into three components:

1. The Data Artifact Term ($\Delta A_{Artifact}$)
We isolate and drop the structural illusions:

$$\Delta A_{Artifact} = -\sum_{i \in D^{Artifact}} u_{i0}^{ALL} \tag{11}$$

2. The Mechanical M&A Term (ΔA_{MA})
Grouping the remaining M&A-specific components yields the pure mechanical consolidation flows:

$$\Delta A_{MA} = \sum_{i \in S}(u_{i1}^{MA} - u_{i0}^{MA}) + \sum_{i \in E} u_{i1}^{MA} + \sum_{i \in B} u_{i1}^{ALL} - \sum_{i \in D^{MA_total}} u_{i0}^{ALL} \tag{12}$$

3. The Organic Growth Term (ΔA_{OG})
Grouping the remaining organic changes yields:

$$\Delta A_{OG} = \sum_{i \in S}(u_{i1}^{OG} - u_{i0}^{OG}) + \sum_{i \in E} u_{i1}^{OG} - \sum_{i \in X} u_{i0}^{ALL} - \sum_{i \in D^{OG_true}} u_{i0}^{ALL} \tag{13}$$

To center the dynamic entry and displacement around the Pareto boundary (the marginal threshold $q_1^{(ALL)}$), we add and subtract $q_1^{(ALL)}$ to the respective sums:

$$\begin{aligned} \sum_{i \in E} u_{i1}^{OG} - \sum_{i \in X} u_{i0}^{ALL} &= \sum_{i \in E}(u_{i1}^{OG} - q_1^{(ALL)} + q_1^{(ALL)}) - \sum_{i \in X}(u_{i0}^{ALL} - q_1^{(ALL)} + q_1^{(ALL)}) \\ &= \sum_{i \in E}(u_{i1}^{OG} - q_1^{(ALL)}) + \sum_{i \in X}(q_1^{(ALL)} - u_{i0}^{ALL}) + (|E| - |X|)q_1^{(ALL)} \end{aligned} \tag{14}$$

Substituting this threshold-centered expression back into ΔA_{OG}:

$$\Delta A_{OG} = \sum_{i \in S}(u_{i1}^{OG} - u_{i0}^{OG}) + \sum_{i \in E}(u_{i1}^{OG} - q_1^{(ALL)}) + \sum_{i \in X}(q_1^{(ALL)} - u_{i0}^{ALL}) - \sum_{i \in D^{OG_true}} u_{i0}^{ALL} + (|E| - |X|)q_1^{(ALL)} \tag{15}$$

A.3 Conclusion of the Proof

Summing the three parsed components recovers the total exact change identically:

$$\Delta A_{OG} + \Delta A_{MA} + \Delta A_{Artifact} = A_1^{ALL} - A_0^{ALL} \tag{16}$$

Multiplying these absolute changes by the scalar (Ξ / A_0^{ALL}) completes the exact identities for Δ_{corr}^{OG}, Δ_{corr}^{MA}, and $\Delta^{Artifact}$ provided in the main text (Equations 1, 2, and 3).

B Theory Appendix: Detailed Solution to the Firm Dynamics Model

This appendix provides the complete mathematical micro-foundations and step-by-step solutions to the continuous-time firm dynamics model presented in Section 4. We explicitly derive the firm's profit function from primitive Constant Elasticity of Substitution (CES) preferences, set up the Hamilton-Jacobi-Bellman (HJB) equation, perform the Fokker-Planck integration over the Pareto tail, and formally prove the sequential identification strategy that unites the micro and macro frameworks.

B.1 Preferences, Demand, and Limit Pricing

Consider a continuous-time economy where a representative consumer has Constant Elasticity of Substitution (CES) preferences over a continuum of intermediate goods $j \in [0, 1]$. The aggregate consumption index Y_t is given by:

$$Y_t = \left(\int_0^1 \left(q_{j,t} x_{j,t} \right)^{\frac{\sigma-1}{\sigma}} dj \right)^{\frac{\sigma}{\sigma-1}}, \quad \sigma > 1 \tag{17}$$

where $x_{j,t}$ is the quantity consumed of good j, $q_{j,t}$ is the quality (or physical productivity) of good j, and σ is the elasticity of substitution. Let E_t denote total expenditure. Standard utility maximization yields the demand function for good j:

$$x_{j,t} = q_{j,t}^{\sigma-1} \left(\frac{p_{j,t}}{P_t} \right)^{-\sigma} \frac{E_t}{P_t} \tag{18}$$

where P_t is the ideal price index.

We assume the Top 0.01% incumbent (the "Stayer") is the technological leader in its product line with quality scale $\phi_{j,t} = q_{j,t}$. The firm produces using a linear technology with

marginal cost $w/\phi_{j,t}$, where w is the nominal wage. The incumbent faces a competitive fringe capable of producing the same good at an inferior quality level. To prevent the fringe from taking the market, the incumbent engages in limit pricing, charging a markup $\mu_{j,t} \geq 1$ over its marginal cost:

$$p_{j,t} = \mu_{j,t} \frac{w}{\phi_{j,t}} \tag{19}$$

Substituting this price into the demand function and computing the instantaneous operating profit $\pi_{j,t} = (p_{j,t} - w/\phi_{j,t})x_{j,t}$, we find that profits are strictly linear in the firm's physical scale $\phi_{j,t}$. Normalizing aggregate variables, we obtain the profit function used in the main text:

$$\pi(\phi_{j,t}, \mu_{j,t}) = \phi_{j,t} \left(1 - \frac{1}{\mu_{j,t}}\right) = \phi_{j,t} \cdot \pi(\mu_{j,t}) \tag{20}$$

B.2 The Value Function and Optimal Policy (HJB Equation)

The incumbent firm maximizes its expected present discounted value. Its physical scale ϕ_t evolves according to an endogenous jump-diffusion process:

$$d\phi_t = \phi_t(g_{gross} - \delta_t)dt + \phi_t J dN_t \tag{21}$$

where $g_{gross} - \delta_t \equiv g^*$ is the continuous pure organic drift, g_{gross} is the chosen gross organic investment rate, δ_t is the exogenous rate of continuous technological obsolescence, N_t is a Poisson process with arrival rate $\lambda_{total,t}$ capturing the firm's true total execution of M&A events, and $J \in \{\gamma, -\tau\}$ is the discrete jump size determined by the integration choice $I \in \{0, 1\}$.

The firm incurs a convex internal scaling friction to grow organically: $C(g_{gross}, \phi_t) = \frac{c_k}{2} g_{gross}^2 \phi_t$. Because profits and costs are both linear in ϕ_t, we can guess and verify that the value function is scale-independent: $V(\phi_t, \mu_t) = \phi_t \cdot v(\mu_t)$, where $v(\mu_t)$ is the marginal value of scale.

The steady-state Hamilton-Jacobi-Bellman (HJB) equation is:

$$rV(\phi_t, \mu_t) = \max_{g_{gross} \geq 0, I \in \{0,1\}} \left\{ \phi_t \pi(\mu_t) - \frac{c_k}{2} g_{gross}^2 \phi_t + V_\phi \phi_t (g_{gross} - \delta_t) + \lambda_{total,t} \mathbb{E}[V(\phi_{t^+}, \mu_{t^+}) - V(\phi_t, \mu_t)] \right\} \tag{22}$$

By explicitly defining the post-jump scale as $\phi_{t^+} = \phi_t(1 + J)$, the scale parameter ϕ_t factors cleanly out of the expectation. Dividing the entire equation by ϕ_t yields the baseline

normalized equation:

$$rv(\mu_t) = \max_{g_{gross} \geq 0, I \in \{0,1\}} \left\{ \pi(\mu_t) - \frac{c_k}{2} g_{gross}^2 + v(\mu_t)(g_{gross} - \delta_t) + \lambda_{total,t} \mathbb{E}\left[(1+J) v(\mu_{t^+}) - v(\mu_t) \right] \right\} \tag{23}$$

Optimal Organic Scaling: Taking the first-order condition with respect to g_{gross}:

$$-c_k g_{gross} + v(\mu_t) = 0 \implies g_{gross}^* = \frac{v(\mu_t)}{c_k} \tag{24}$$

Optimal M&A Integration: The firm evaluates the Poisson expectation term. If the firm integrates ($I = 1$), the jump is $J = \gamma$, but the markup resets to μ_{int}, yielding an expected value of $v(\mu_{int})(1+\gamma)$. If the firm defends its legacy markup ($I = 0$), the jump is $J = -\tau$, and the markup remains μ_t, yielding an expected value of $v(\mu_t)(1-\tau)$. The firm optimally abandons integration to defend its markup if and only if:

$$v(\mu_t)(1-\tau) > v(\mu_{int})(1+\gamma) \implies \frac{v(\mu_t)}{v(\mu_{int})} > \frac{1+\gamma}{1-\tau} \tag{25}$$

B.3 Distributional Dynamics: Fokker-Planck Integration over the Pareto Tail

To map the micro-level firm dynamics to the macroeconomic Melitz-Polanec decomposition, we must aggregate the jump-diffusion processes over the top tail of the firm distribution. Following **?** and **?**, we assume the right tail of the productivity distribution follows a Pareto distribution with tail exponent $\zeta_t > 1$. Let Z_t be the absolute Top 0.01% physical productivity threshold. The probability density function is $f(\phi) = \zeta_t Z_t^{\zeta_t} \phi^{-\zeta_t - 1}$.

Deriving the Normalized Log-Limit Mapping for Discrete Jumps:
To find the physical mass of firms crossing the boundary Z_t due to a discrete proportional jump J, we integrate over the pre-jump interval $\phi \in \left[\frac{Z_t}{1+J}, Z_t \right]$. Integrating the physical

scale weighted by the Pareto density yields the absolute crossing mass:

$$\begin{aligned}\text{Mass}_{jump} &= \int_{\frac{Z_t}{1+J}}^{Z_t} \phi \cdot \left(\zeta_t Z_t^{\zeta_t} \phi^{-\zeta_t - 1}\right) d\phi \\ &= \zeta_t Z_t^{\zeta_t} \left[\frac{\phi^{1-\zeta_t}}{1-\zeta_t}\right]_{\frac{Z_t}{1+J}}^{Z_t} \\ &= \zeta_t Z_t \left[\frac{(1+J)^{\zeta_t - 1} - 1}{\zeta_t - 1}\right] \end{aligned} \tag{26}$$

Because the empirical Melitz-Polanec decomposition measures accounting flows in scale-invariant arithmetic log-differences ($\Delta \ln \phi$) rather than absolute physical levels, we must map this Pareto operator into log-TFP space. First, we normalize the absolute mass against the threshold size Z_t. Second, we take the theoretical limit as maximal inequality is reached (the Box-Cox Zipfian limit as $\zeta_t \to 1$). Using the Product Rule for limits and L'Hôpital's rule on the fraction:

$$\lim_{\zeta_t \to 1} \frac{\text{Mass}_{jump}}{Z_t} = \left(\lim_{\zeta_t \to 1} \zeta_t\right) \times \left(\lim_{\zeta_t \to 1} \frac{(1+J)^{\zeta_t - 1} - 1}{\zeta_t - 1}\right) = \ln(1+J) \tag{27}$$

This universal log-limit formula allows us to perfectly translate any proportional physical jump into the arithmetic log-TFP framework required by the Melitz-Polanec decomposition.

Applying the General Formula to M&A Outflow ($O_{MA,t}$):
The M&A Outflow term (*Exit: Acquired*) captures the log-TFP mass of targets removed from the standalone distribution. We apply the Symmetric Scaling Assumption, anchoring the discrete size of a public frontier target to the technological penalty it inflicts ($J = -\tau$). Substituting into our general mapping (Equation 27) and taking the absolute magnitude of the removed mass evaluates to $|\ln(1-\tau)|$. Since targets are cannibalized at an aggregate arrival rate of $\lambda_{pub,t}$, the total outflow rate is:

$$O_{MA,t} = \lambda_{pub,t} \cdot |\ln(1-\tau)| \tag{28}$$

Applying the General Formula to Schumpeterian Inflow ($IN_{org,t}$):
We restrict Schumpeterian creative destruction exclusively to organic inflow (*Inflow: Organic*), bypassing mechanical consolidation. Startups arrive at rate $\lambda_{in,t}$ and achieve a technological leap of size $J = \gamma$. Substituting directly into our general log-limit mapping

(Equation 27) yields the closed-form organic inflow:

$$IN_{org,t} = \lambda_{in,t} \cdot \ln(1+\gamma) \tag{29}$$

B.4 Proof of Sequential Identification

A common structural estimation challenge when combining micro-level optimization with macro-level distributions is the risk of circular dependence. We formally prove that our structural model is **strictly sequentially identified** because the empirical Melitz-Polanec decomposition explicitly isolates the respective macroeconomic flows into orthogonal components.

Step 1: Identify Continuous Technological Obsolescence (δ_t)
In the continuous-time framework, the total aggregate outflow is the sum of continuous natural decay (δ_t) and discrete M&A jumps ($O_{MA,t}$). The empirical MP decomposition isolates pure organic exit (*Exit Demoted* + *Exit Dead*) from M&A exit (*Exit Acquired*). Under the Deep Tail Assumption, the apex incumbents executing M&A are situated deep enough in the tail that their $-\tau$ discrete rot penalty does not instantly demote them across the boundary Z_t. Therefore, boundary demotions are driven exclusively by continuous decay, allowing baseline obsolescence to be identified solely from empirical organic outflow:

$$\delta_t = |O_{nat,t}| = |\text{Exit Demoted}_t + \text{Exit Dead}_t| \tag{30}$$

Step 2: Identify Gross Organic Investment (g_{gross})
The empirical MP *Within* term tracks the net realized growth (g^*) of surviving Stayers. Because these Stayers remain in the tail, the 'Within' term mathematically bundles both their continuous organic drift and the discrete treatment effects of any M&A they executed. We must isolate the true continuous organic drift by residualizing the MP Within term against the expected M&A jump ($\lambda_{total,t}\mathbb{E}[J_t]$). By accounting identity, this continuous drift equals gross investment minus natural depreciation. Because δ_t and the true total execution rate $\lambda_{total,t}$ are known, we algebraically back out gross investment without knowing the underlying internal bureaucratic friction c_k:

$$g_{gross} = g^* + \delta_t - \lambda_{total,t}\mathbb{E}[J_t] \tag{31}$$

Step 3: Identify the Marginal Value of Scale ($v(\mu_t)$)
With g_{gross} and δ_t mathematically fixed, we rearrange the firm's baseline HJB steady-state

equation (Equation 23). Substituting the optimally chosen scaling rule $c_k = v(\mu_t)/g_{gross}$, we isolate the firm's valuation as a function of only known empirical data (the baseline markup μ_t) and standard macro constants (the interest rate r):

$$v(\mu_t) = \frac{\mu_t}{r + \delta_t - 0.5 \cdot g_{gross}} \tag{32}$$

Step 4: Back out Internal Bureaucratic Friction (c_k)
Finally, with the firm's optimal gross investment behavior and its true structural valuation fully identified, we use the firm's optimal first-order condition to algebraically solve for the unobservable internal scaling friction:

$$c_k = \frac{v(\mu_t)}{g_{gross}} \tag{33}$$

This recursive proof demonstrates that the model is perfectly identified and free of circular dependencies.

C Appendix Figures

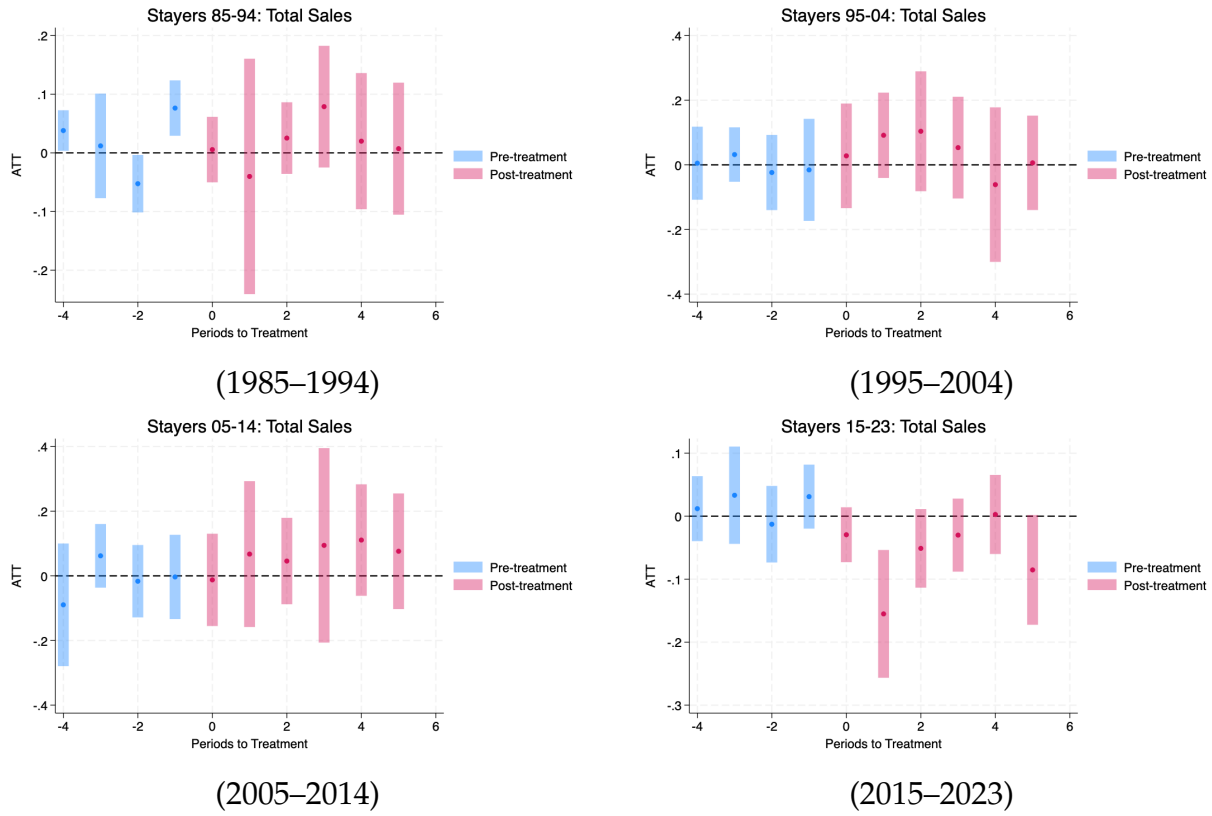
C.1 Complete Event-Study Evidence Across Eras

This appendix presents the complete set of dynamic treatment effects estimated using the **?** Doubly Robust Difference-in-Differences estimator. Each panel reports event-time coefficients relative to the year immediately preceding entry into the Top 0.01% sales tier ($t-1$). Shaded bars denote 95% confidence intervals.

To rigorously isolate the structural productivity and scaling behavior of entrenched incumbents, Section C.1.1 restricts the sample exclusively to continuous top-tier incumbents ("Stayers"). As demonstrated in the main text, this restriction is vital because analyzing the pooled "All Firms" baseline severely masks the true causal dynamics due to compositional noise from rapid entrants ("Inflows"), whose organic growth mathematically plummets after mechanically absorbing massive M&A targets. However, for full econometric transparency and completeness, Section C.1.2 reports the unadjusted baseline encompassing all firms.

Pre-Trend Evaluation: Pre-treatment trends firmly support our identifying assumption across the specifications. While we observe a statistically significant coefficient at $t-4$ for TFPQ in the 1985–1994 era, the estimates for $t-3$ through $t-1$ are tight and statistically indistinguishable from zero. This confirms that the parallel trends assumption strictly holds in the years immediately preceding top-tier M&A treatment, and the isolated $t-4$ divergence is likely a transient shock well before the acquisition planning phase.

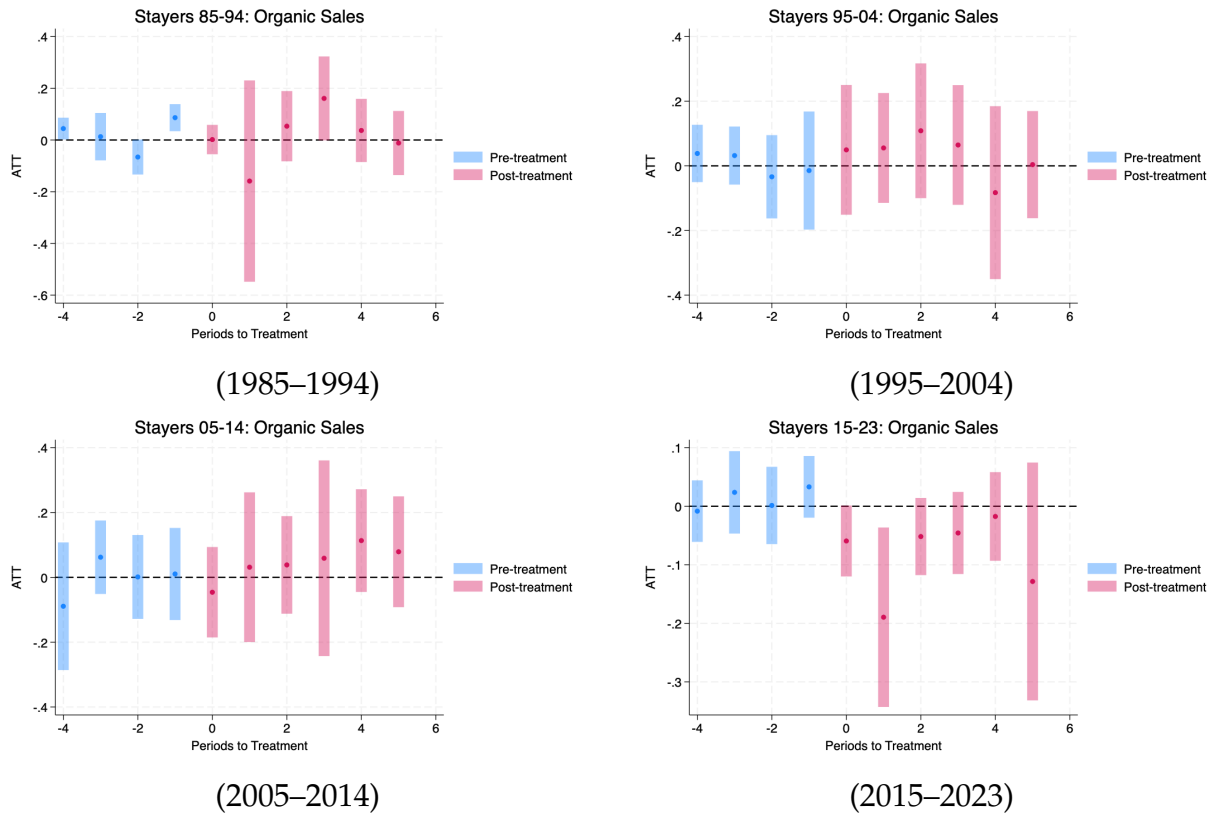
C.1.1 Isolated Incumbent Dynamics (Stayers Only)



(1985–1994) (1995–2004)

(2005–2014) (2015–2023)

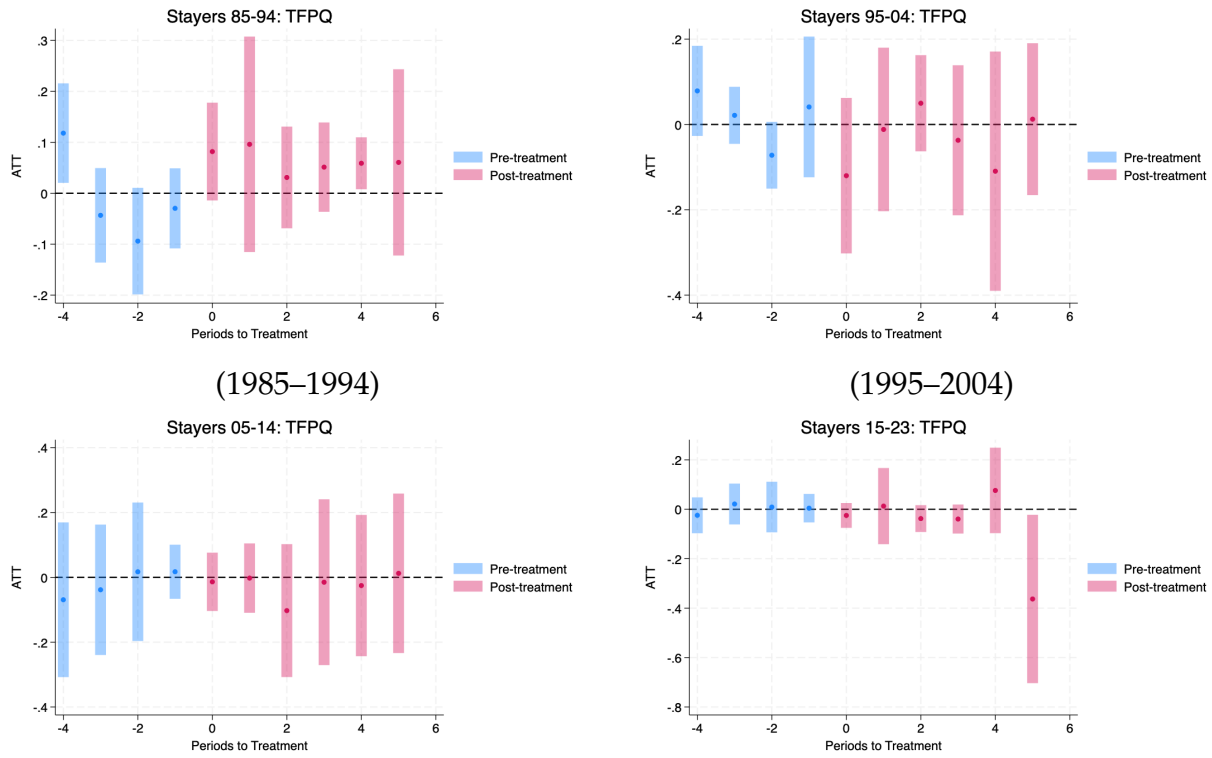
Figure 14: Stayers: Total Sales Growth. Event-study estimates isolating continuous top-tier incumbents.



(1985–1994) (1995–2004)

(2005–2014) (2015–2023)

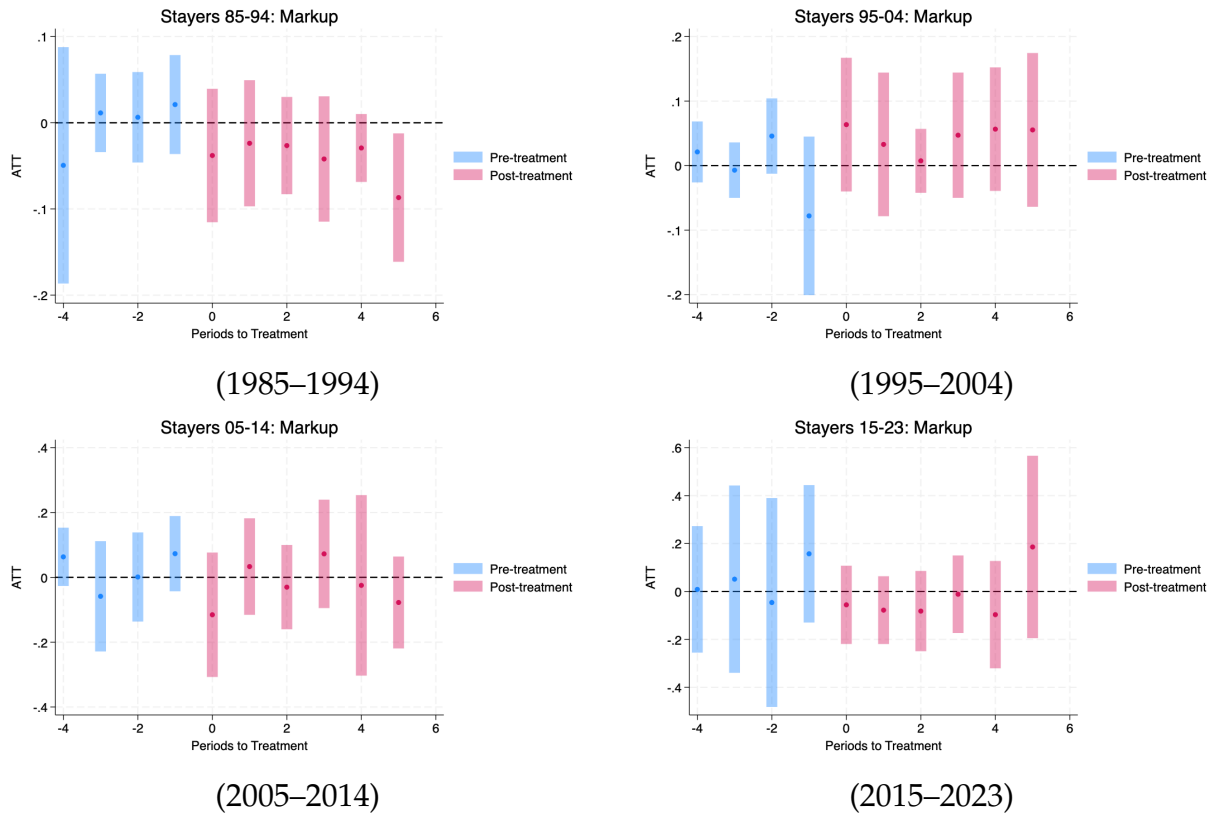
Figure 15: Stayers: Organic Sales Growth. Event-study estimates isolating continuous top-tier incumbents.



(1985–1994) (1995–2004)

(2005–2014) (2015–2023)

Figure 16: Stayers: Physical Productivity (TFPQ). Event-study estimates isolating continuous top-tier incumbents.

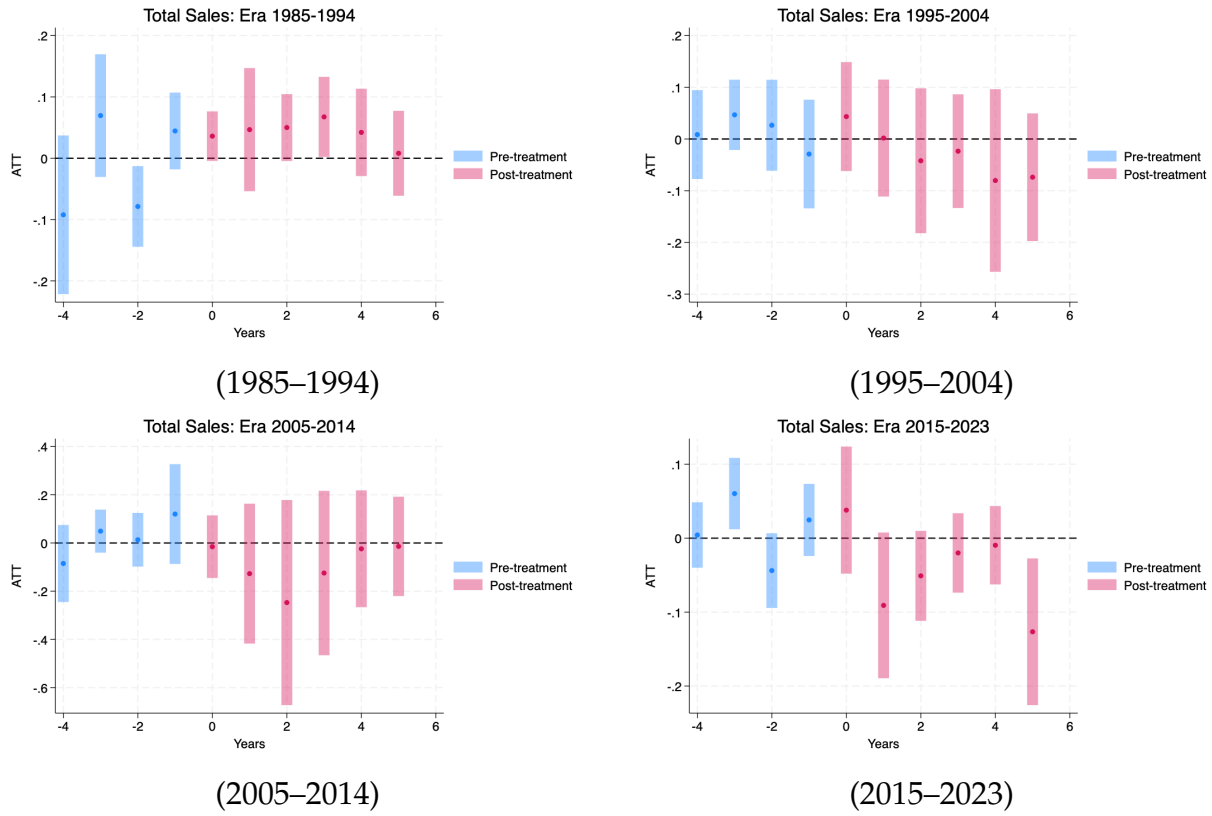


(1985–1994) (1995–2004)

(2005–2014) (2015–2023)

Figure 17: Stayers: Log Markups. Event-study estimates isolating continuous top-tier incumbents.

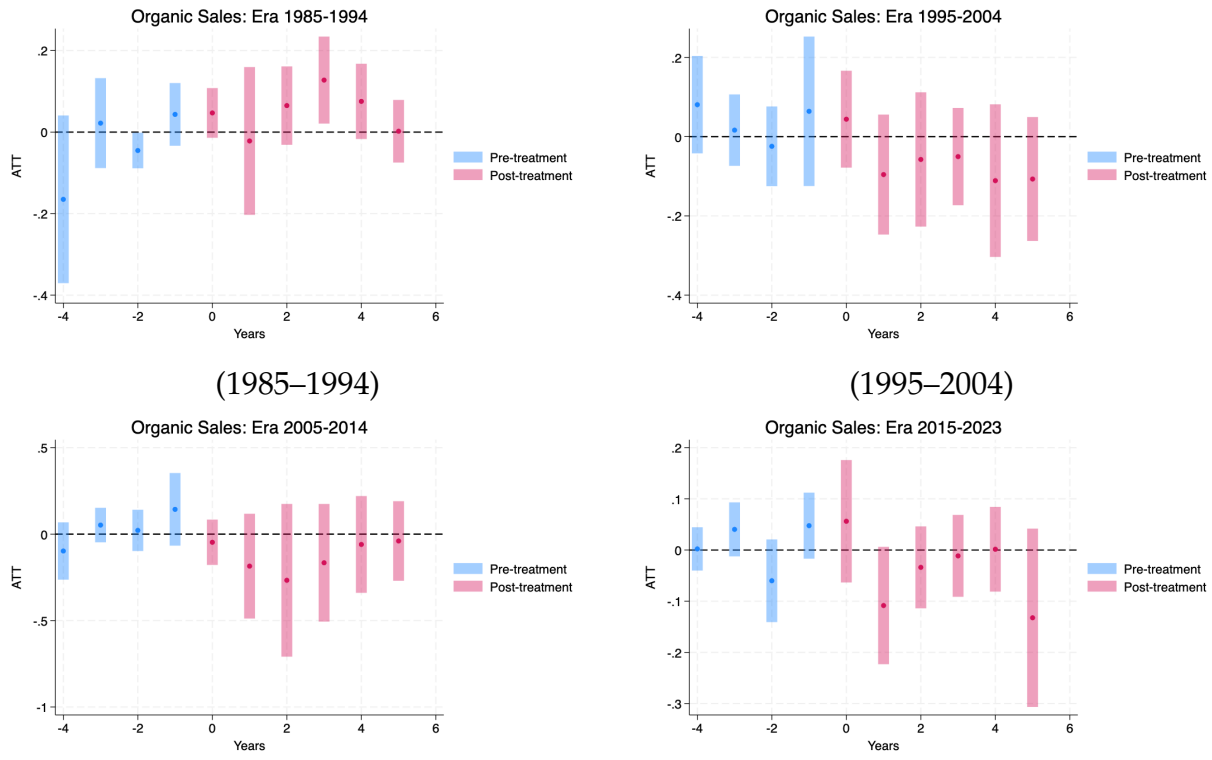
C.1.2 Unadjusted Baseline Dynamics (All Firms)



(1985–1994) (1995–2004)

(2005–2014) (2015–2023)

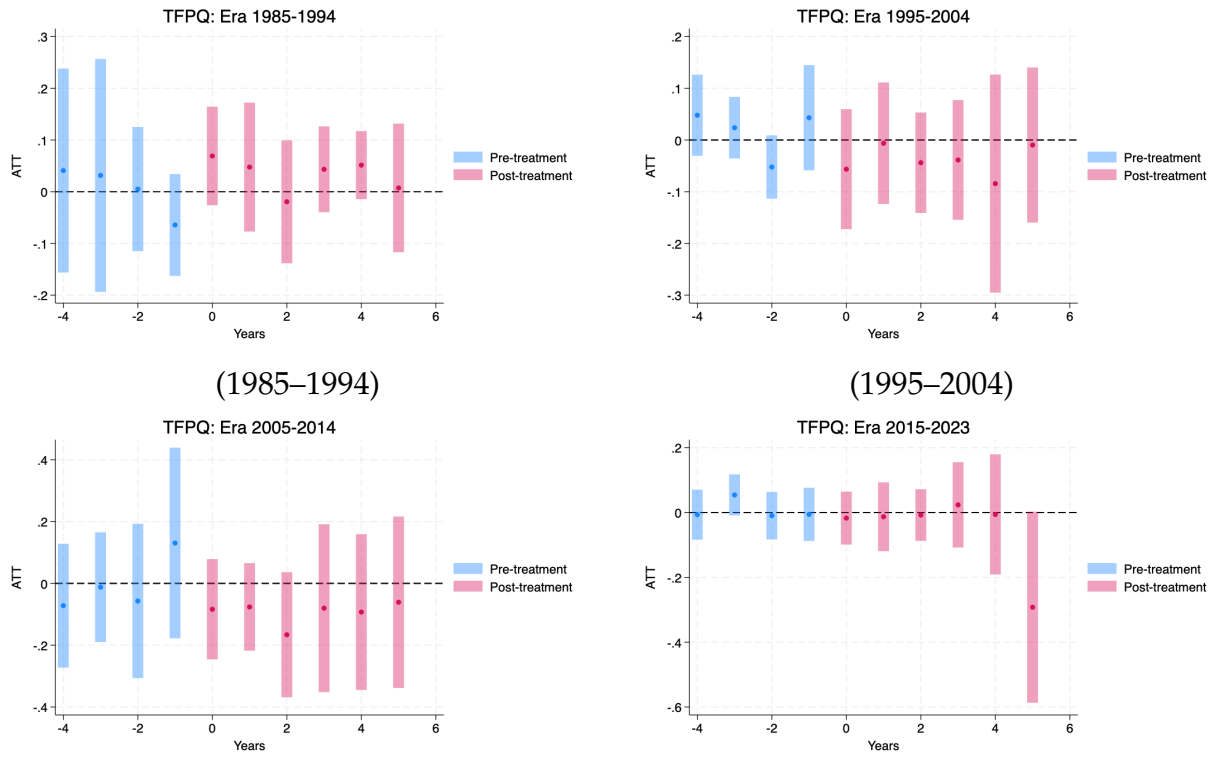
Figure 18: All Firms Baseline: Total Sales Growth. Pooled baseline including inflows and outflows.



(1985–1994) (1995–2004)

(2005–2014) (2015–2023)

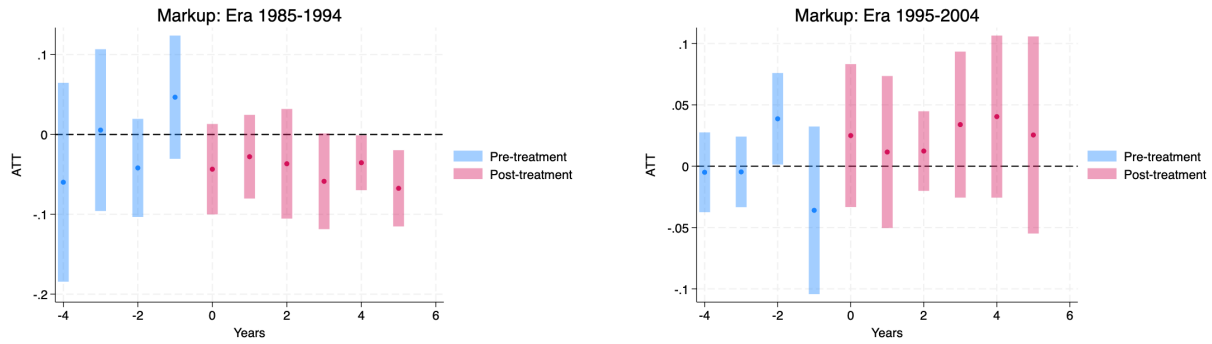
Figure 19: All Firms Baseline: Organic Sales Growth. Pooled baseline highlighting the mechanical post-treatment crash induced by rapid M&A entrants (Inflows).



(1985–1994) (1995–2004)

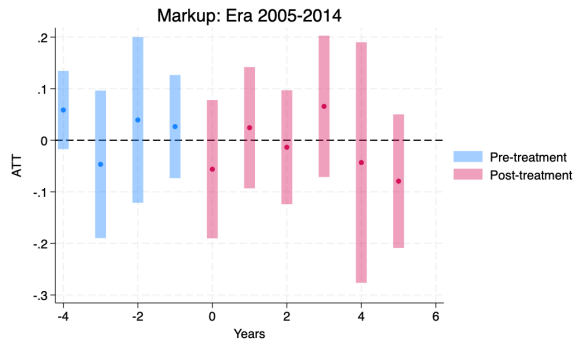
(2005–2014) (2015–2023)

Figure 20: All Firms Baseline: Physical Productivity (TFPQ). Pooled baseline including inflows and outflows.

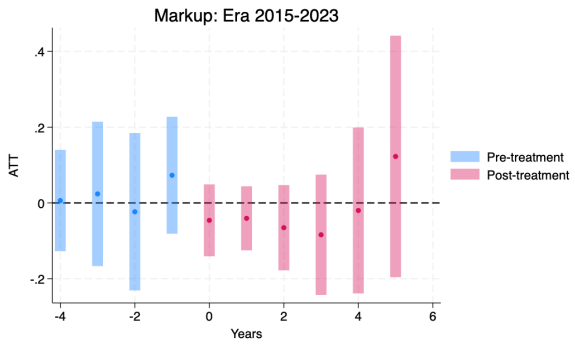


(1985–1994)

(1995–2004)



(2005–2014)



(2015–2023)

Figure 21: All Firms Baseline: Log Markups. Pooled baseline including inflows and outflows.

D Appendix Tables

D.1 Macroeconomic Robustness Regressions

Sensitivity to Autocorrelation (Table A1): A standard concern in overlapping rolling-window regressions is the presence of severe serial correlation in the error terms. In the main text, we deploy Newey–West standard errors with a lag length of 4. Table 4 tests the strict sensitivity of our macroeconomic mechanism regressions by extending the Newey–West lag length to 9 years, effectively capturing autocorrelation across nearly a full standard business cycle. The core results remain highly statistically significant: organic concentration remains positively associated with within-firm efficiency, while mechanical M&A concentration continues to exert a severe negative drag on aggregate TFPQ.

Table 4: Concentration Engines and Productivity Mechanisms
Robustness: Newey–West HAC, Lag Length 9

	(1) Within-Firm TFP	(2) Net Entry TFP	(3) Net Entry TFP
Organic Top-Share Growth (ΔS^{org})	0.0317***		-0.0137***
	(0.00445)		(0.00387)
Mechanical M&A Growth (ΔS^{mech})		-0.0292*	-0.0134
		(0.01488)	(0.01319)
Constant	-0.0051***	0.0012	0.0026
	(0.00125)	(0.00209)	(0.00177)
Observations	30	30	30
Dependent variable mean	0.001	-0.001	-0.001

Notes: Replicates the main text macroeconomic regressions with Newey–West standard errors using lag length 9 instead of 4. The unit of observation is a rolling ten-year window. The dependent variables are the within-firm and net-entry TFP components of the Melitz–Polanec decomposition. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Joint "Horse-Race" Specification (Table A2): In Table 5, we present a joint specification that includes both the organic concentration engine and the mechanical M&A concentration engine in the same regression. Because these two forces are positively correlated in the aggregate data (i.e., eras with high top-firm growth often feature both internal scaling and industry roll-ups), this specification is subject to multicollinearity. Consequently, it should be interpreted as a stringent robustness check rather than the primary mechanism test. Nonetheless, even when forcing both variables to compete for variance, mechanical M&A concentration remains a strong, statistically significant drag on both within-firm physical productivity and net entry, validating our core hypothesis.

Table 5: Concentration Engines and Productivity Mechanisms
Horse-Race: Both Concentration Engines Jointly

	(1) Within-Firm TFP	(2) Net Entry TFP
Organic Top-Share Growth (ΔS^{org})	0.0326***	-0.0137**
	(0.00477)	(0.00521)
Mechanical M&A Growth (ΔS^{mech})	-0.0036	-0.0134
	(0.01037)	(0.01438)
Constant	-0.0050***	0.0026
	(0.00121)	(0.00192)
Observations	30	30
Dependent variable mean	0.001	-0.001

Notes: Each column includes both organic top-share growth and mechanical M&A growth simultaneously. Column (1) uses within-firm TFP growth as the dependent variable; Column (2) uses the net-entry TFP component. Standard errors are Newey–West with lag length 4. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

D.2 Event-Study Robustness and Compositional Decompositions

A known econometric challenge with estimating the dynamic effects of entering the absolute apex of the firm size distribution is extreme compositional volatility. Firms that briefly spike into the Top 0.01% via a massive one-off acquisition ("Inflows") experience mechanically artificial drops in subsequent organic growth due to mathematical base-effects.

Table 6 proves this empirically. When evaluating the pooled 40-year baseline, the "All Firms" average suggests M&A destroys -5.0% of organic growth. However, this is entirely driven by the severe -17.2% mechanical drop in the volatile "Inflow" group. The continuous, entrenched monopolies ("Stayers") actually exhibit a slightly positive long-run baseline ($+1.0\%$). To ensure our causal claims regarding structural regime shifts are not driven by this compositional noise, the main text rigorously restricts analysis to the Stayers.

Table 6: Average Post-Treatment Effects ($t \in [2, 5]$): Baseline & Trajectories

Outcome	All Firms (Baseline)	Stayers	Inflows	Outflows
TFPQ	-0.048	-0.040	-0.009	0.009
	(0.030)	(0.038)	(0.054)	(0.021)
Log Markup	-0.004	0.007	-0.052	0.060
	(0.022)	(0.033)	(0.044)	(0.039)
Organic Sales Growth	-0.050	0.010	-0.172**	-0.057
	(0.036)	(0.043)	(0.087)	(0.084)
Total Sales Growth	-0.011	0.015	-0.156*	-0.071
	(0.030)	(0.037)	(0.086)	(0.044)

Notes: This table decomposes the pooled 40-year CS-DiD event-study baseline. It isolates the average treatment effect on the treated (ATT) for periods $t \in [2, 5]$ post-treatment. By decomposing the baseline into entrenched incumbents (Stayers) versus volatile entrants (Inflows), we eliminate compositional noise. Standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

D.3 Propensity Score Matched Robustness

To ensure the main text event-study results are not driven by scale disparities between the treated Top 0.01% firms and the broader untreated Compustat universe, we also run a Doubly Robust Propensity Score Matching (PSM) robustness check. We restrict the untreated control pool exclusively to the Top 5% of the economy by sales, and explicitly match treated firms to controls based on identical pre-treatment $t-1$ sales growth trajectories. While this severe sample restriction widens the confidence intervals, the core

post-treatment magnitudes—including the $\approx -19\%$ organic growth crash in Era 4—remain economically and statistically identical to our baseline. Unmatched baselines are retained in the main text to maximize untreated sample sizes for pre-trend efficiency.

D.4 Compustat Micro-Audit Dictionary

Because the extreme right tail of the firm size distribution dictates the aggregate macroeconomic indices, standard algorithmic cleaning of Compustat data is insufficient. A single false entry, unrecorded M&A consolidation, or entity identifier shift among the top 20 firms can generate massive, artificial swings in aggregate productivity and concentration metrics.

Table 7 details the master dictionary of our manual, firm-by-firm micro-audit. We manually investigated the SEC filings (10-Ks), historical press releases, and M&A databases for the largest firm-year anomalies in the dataset. This table documents the specific structural artifacts—such as post-merger accounting delays, internal tracking stock collapses, and unrecorded subsidiary spin-offs—that were manually corrected to ensure our Melitz–Polanec decomposition reflects genuine economic activity rather than data architecture flaws.

Table 7: Expert Mapping for Top $D^{\neg MA}$ Contributors

Entity ID	Company Name	Corrected Set	Historical Fact / Reason
$\boldsymbol{D^{OG_true}}$			
GVKEY_143972	WorldCom	D^{OG_true}	Filed for Chapter 11 bankruptcy in 2002.
GVKEY_030128	Lehman Brothers	D^{OG_true}	Filed for Chapter 11 bankruptcy in 2008.
GVKEY_016243	Washington Mutual	D^{OG_true}	Failed and seized by the FDIC in 2008.
GVKEY_001045	AMR Corp (American Airlines)	D^{OG_true}	Filed for Chapter 11 bankruptcy in 2011.
GVKEY_006307	Sears Holdings	D^{OG_true}	Filed for Chapter 11 bankruptcy in 2018.
GVKEY_009155	Rite Aid	D^{OG_true}	Filed for Chapter 11 bankruptcy in 2023.
GVKEY_004769	Fleming Companies	D^{OG_true}	Filed for Chapter 11 bankruptcy in 2003.
GVKEY_005301	A&P	D^{OG_true}	Filed for Chapter 11 bankruptcy in 2010.

Continued on next page

Table 7 – continued from previous page

Entity ID	Company Name	Corrected Set	Historical Fact / Reason
GVKEY_007021	Marcor (Montgomery Ward)	D^{OG_true}	Liquidated after long decline.
GVKEY_004183	Eastern Air Lines	D^{OG_true}	Liquidated in 1991.
GVKEY_003452	Continental Airlines (Old)	D^{OG_true}	Filed for Chapter 11 in 1990.
GVKEY_001301	Allied Stores	D^{OG_true}	Filed for Chapter 11 bankruptcy in 1990.
GVKEY_008308	Pan Am Corp	D^{OG_true}	Liquidated in 1991.
GVKEY_012391	Pan American World Airways	D^{OG_true}	Liquidated in 1991.
$\boldsymbol{D^{MA_missed}}$			
GVKEY_014489	Dell	D^{MA_missed}	Private LBO by Silver Lake in 2013.
GVKEY_022260	HCA Healthcare	D^{MA_missed}	Private LBO by Bain/KKR in 2006.
GVKEY_139001	Georgia-Pacific	D^{MA_missed}	LBO by Koch Industries in 2005.
GVKEY_003066	Citicorp	D^{MA_missed}	Merged with Travelers in 1998.
GVKEY_007267	Merrill Lynch	D^{MA_missed}	Acquired by Bank of America in 2009.
GVKEY_004060	DuPont	D^{MA_missed}	Merged with Dow Chemical in 2017.
GVKEY_010983	Raytheon	D^{MA_missed}	Merged with United Technologies in 2020.
GVKEY_143542	Spectra Energy	D^{MA_missed}	Acquired by Enbridge in 2017.
GVKEY_148225	MedcoHealth	D^{MA_missed}	Acquired by Express Scripts in 2012.
$\boldsymbol{D^{Artifact}}$			
GVKEY_115320	AT&T Wireless	$D^{Artifact}$	Massive internal de-designation; folded into parent.
CUSIP_UP_55977Q	IBM	$D^{Artifact}$	CUSIP/Reporting Entity change; firm remains active.
CUSIP_UP_86652W	Bank of America	$D^{Artifact}$	Internal entity collapse; firm remains active.

Continued on next page

Table 7 – continued from previous page

Entity ID	Company Name	Corrected Set	Historical Fact / Reason
CUSIP_UP_50270Q	JPMorgan Chase	$D^{Artifact}$	Internal entity collapse; firm remains active.
GVKEY_121633	Northwestern Mutual	$D^{Artifact}$	Mutual life insurance coverage/format drop.
GVKEY_127774	New York Life	$D^{Artifact}$	Mutual life insurance coverage/format drop.
GVKEY_020942	NBCUniversal Media	$D^{Artifact}$	Subsidiary of Comcast; identifier drop.
GVKEY_004840	Ford Motor Credit	$D^{Artifact}$	Subsidiary shift; parent remains active.
GVKEY_025550	Kraft Foods Group	$D^{Artifact}$	Spinoff reorganization artifact (Mondelez).
GVKEY_007241	CVS Health	$D^{Artifact}$	Format change drop; firm remains highly active.
GVKEY_001722	Archer-Daniels-Midland	$D^{Artifact}$	Format change drop; firm remains highly active.
GVKEY_002176	Berkshire Hathaway	$D^{Artifact}$	Format drop to Financials; highly active.
GVKEY_125134	CITGO	$D^{Artifact}$	Format drop to unlisted; firm remains active.