M&A and the Rise of Concentration*

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Abstract

This paper provides the first quantification of the contribution of M&A to rising concentration. Using comprehensive data from the U.S. Economic Census, we show that M&A has contributed to rising concentration in every sector and that M&A contributes 44% of the increase in aggregate concentration. We present an empirical decomposition of changes in concentration that further accounts for the effects of entry and exit. Last, we present analysis designed to help us understand the possible extent to which the relaxing of merger guidelines or lax government enforcement of existing guidelines contributed to the rise in concentration.

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The results of our empirical decomposition as well as the results of our analysis of the merger guidelines are currently being reviewed by the U.S. Census Bureau to ensure appropriate access, use, and disclosure avoidance protection of the confidential source data used to produce this product. We expect the results to be approved for release in the coming weeks.

1 Introduction

Over the past 40 years, industry concentration in the U.S. has risen in all major industrial sectors. There is a recent and growing academic literature that focuses on the measuring the extent of the rise in concentration and its consequences. This literature is divided on whether the increase in concentration is a sign of lessening competition or whether it is in fact a sign of intensifying competition. Both are theoretically possible. It is commonly thought that increases in concentration stemming from mergers and acquisitions are likely associated with lessening competition, whereas increases in concentration stemming organic growth of the largest firms could be the result of the removal of frictions that intensifying competition.

In this paper, we provide the first quantification of the contribution of M&A to rising concentration in US industries. We separate out changes in concentration that are due to growth of the largest firms from those changes in concentration that are due to Mergers and Acquisitions (M&A). Throughout the paper, concentration is measured as the sales share of the largest four firms in each industry and is then aggregated up to the level of a major sector and to an aggregate of all these sectors. Using comprehensive data from the U.S. Economic Census that cover six major sectors of the economy from 1982 to 2012, we present three new findings:

1. M&A has contributed to rising concentration in each sector. Measured as a percentage of each sector's cumulative increase in concentration, M&A has contributed most in Manufacturing (78.6%) and contributed least in Wholesale Trade (18.3%).

2. In the unbalanced panel of sectors over the full time-period 1982 to 2012, M&A contributes 43.8% of the increase in aggregate concentration. In the balanced panel of sectors over the time-period 1992 to 2012, M&A contributes 38.5% of the increase in aggregate concentration.

3. The increase in aggregate concentration (the denominator) is moderated by the the gradual rise of Services and the decline of Manufacturing. At the same time, this change in relative importance of sectors does not impact our percentage point estimates of the contribution of M&A to rising concentration (the numerator). Therefore, when we strip out this moderating effect by measuring aggregate within-sector changes in concentration, we find that M&A contributes 32%-33% to the aggregate within-sector increase in concentration.

In broad terms, concentration in an industry can change for one of two reasons. The first possible reason is the organic growth of firms. If the largest firms grow more rapidly then the other firms in the industry then concentration will increase. Conversely if the largest firms grow more slowly then the other firms in the industry then concentration will decrease. The second possible reason is not related to growth but instead to a change in the firm boundaries of existing economic activity. When one the largest firms acquire other firms or merge with one-another, this redrawing of firm boundaries increase the size of the largest firms and therefore increases concentration.

In the first part of the paper, we measure the contribution of M&A to changes in concentration in each industry and in each 5-year period (from year t to $t+5$). This measure fixes the economic activity to the base year (t) and asks how concentration changes in that same year when we redraw the ownership boundaries to account for all M&A over the subsequent five years. If the largest firms purchase one/some of their competitors then the redrawing of firm boundaries to reflect these acquisitions increases concentration. We call this change the contribution of M&A.

We present results on changes in concentration and the contributions of M&A for each of our six major sectors. To start, we present our estimates of 5-year changes in concentration and the 5-year contributions of M&A for each of our six major sectors and these show three clear features. First, concentration is increasing in nearly every 5-year period in every sector. Second, the contribution of M&A to rising concentration is positive in nearly every 5-year period in every sector. The contribution of M&A can turn negative when large firms spin off some of their establishments or sell these establishments to smaller competitors. While this does occur in the data, the increases in concentration that results from M&A activity far outweigh the reductions in concentration that results from large firms spinning off or selling some of their business to smaller competitors. Third, those 5-year periods with large increases in concentration coincide with large contributions of M&A to concentration, but at the same time, in nearly all 5-year periods and sectors the increase in concentration exceeds the contribution of M&A.

Turning to the the cumulative changes in concentration across all census years, we highlight three results. First, all sectors exhibit a significant increase in concentration (this result is not new to the literature). Second, all sectors exhibit a positive contribution of M&A to concentration. Last, measured as a percentage of each sectors cumulative increase in concentration, M&A has contributed most in Manufacturing (78.6%) and has contributed least in Wholesale Trade (18.3%).

We find similar results in the aggregate data. First, aggregate concentration is increasing in every 5-year period and the contribution of M&A to rising aggregate concentration is positive in every 5-year period. Second, those 5-year periods with large increases in aggregate concentration coincide with large aggregate contributions of M&A. Last, in the unbalanced panel of sectors over the full time-period 1982 to 2012, aggregate concentration increases 9.1pp and the cumulative aggregate contribution of M&A is 4.0pp, which is equal to 43.8% of the increase in aggregate concentration. In the balanced panel of sectors over the shorter time-period 1992 to 2012, aggregate concentration increases 7.5pp and the cumulative aggregate contribution of M&A is 2.9pp, which is equal to 38.5% of the increase in aggregate concentration.

Even though concentration is increasing in all sectors, the gradual increase in the weight of the Services sector (the sector with lowest level of concentration) and the decline in the weight of the Manufacturing sector (the sector with highest level of concentration) help to moderate the increase in aggregate concentration over time. As a consequence, if (as a relevant example) M&A contributes 33% to the rise in concentration in each and every sector, we would find that contribution of M&A is equal to 45% of the increase in aggregate concentration. For this reason, we report an additional set of aggregate results in which we strip out the changing weights of sectors over 5-year intervals.

Extending our analysis into a framework that further accounts for the effects of entry and exit on concentration, we present an empirical decomposition of changes in concentration into (1) changes resulting from organic growth, (2) changes resulting from M&A, and (3) changes resulting from entry and exit. We express our concentration ratio as a sales-weighted average across all establishments of an indicator function equal to one if the establishment is owned by one of the largest four firms in the industry. Once presented in this form we present an empirical decomposition of changes in concentration in the style of Foster, Haltiwanger and Krizan (2001).

Unique to our setting, this standard decomposition structure warrants some caution in interpretation: at all times four firms are necessarily the largest in their industry and therefore the rising of any firm into the top four is necessarily accompanied by falling of another firm out of the top four. We refer to this feature as *Rivalry in Ranking*. In this setting, small changes that cause one firm to overtake the fourth largest firm will lead to "large" changes in the indicator function that nearly fully offset. More generally, the decomposition can potentially show large offsetting contributions, thereby making it challenging to cleanly assign attribution to one of the three terms (Growth,

M&A, and Net Entry). To address the challenge of Rivalry in Ranking, we use the coefficients estimated from Ordinary Least Square (OLS) regressions to scale the three decomposition terms.

Our decomposition results are currently being reviewed by the U.S. Census Bureau to ensure appropriate access, use, and disclosure avoidance protection of the confidential source data used to produce this product. We expect the results to be approved for release in the coming weeks.

Last, we present analysis designed to help us understand the possible extent to which the relaxing of merger guidelines or lax government enforcement of existing guidelines contributed in a significant manner to the rise in concentration. In every five-year period we evaluate each observed merger and acquisition in order to determine whether, according to the merger guidelines, it should be permitted or whether it should be challenged in court. We then measure the *Preventable Change in Concentration* (almost always a prevented increase in concentration) due to the enforcement of merger guidelines. We carry out the analysis separately for the 1982 merger guidelines, which speaks to the potential role of lax enforcement, and for the 1968 guidelines, which speaks to the potential role of the relaxing of the merger guidelines.

We note that this last analysis requires the greatest number of assumptions and some readers might find the assumptions too strong to accept. We discuss these assumptions under the headings of: Should a merger be challenged? Will the courts block the merger? What will happen once a merger is blocked? Whether or not one accepts our assumptions, the analysis does provide us with an understanding and quantification of the extent to which our measured contribution of M&A is the results of mergers and acquisitions that involve large acquirers purchasing sizable targets in the same industry.

Our merger guideline and Preventable Change in Concentration results are currently being reviewed by the U.S. Census Bureau to ensure appropriate access, use, and disclosure avoidance protection of the confidential source data used to produce this product. We expect the results to be approved for release in the coming weeks.

1.1 Literature Review - Unwritten and Incomplete – Will be Updated Shortly

This paper contributes to a recent and growing literature on rising concentration in US industries.

This literature has focused on

1. Extent: (Grullon, Larkin and Michaely, 2019; Barkai, 2020; Autor et al., 2020; Rossi-Hansberg, Sarte and Trachter, 2021; Benkard, Yurukoglu and Zhang, 2021; Affeldt et al., 2021; Neiman and Vavra, 2023; Amiti and Heise, 2024; Kwon, Ma and Zimmermann, 2024)

2. Consequences: (Gutiérrez and Philippon, 2017; Barkai, 2020; Autor et al., 2020)

3. Rising concentration and competition: (Peltzman, 2014; Syverson, 2019; Valletti and Zenger, 2019; Covarrubias, Gutiérrez and Philippon, 2020; Gutierrez and Philippon, 2023; Koltay, Lorincz and Valletti, 2023; Shapiro and Yurukoglu, 2024). Echos and earlier theoretical and empirical debates on the relationship between concentration and competition with implications for antitrust policy (Peltzman, 1977; Scherer, 1979)

4. Statistical decomposition of rising concentration: (Autor, Patterson and Van Reenen, 2023)

5. Proposed explanations: (Bessen, 2020; Akcigit and Ates, 2023; Brynjolfsson, Jin and Wang, 2023)

6. Quantification of the causes of rising concentration in particular settings: (Argente et al., 2021; Einav et al., 2021; Smith and Díaz, Forthcoming)

7. Antitrust evaluation of mergers and potentially lax enforcement: (Shapiro, 2019; Valletti and Zenger, 2019; Wollmann, 2019; Nocke and Whinston, 2022)

2 Data and Concentration

2.1 Data

Our main data source is the U.S. Census Bureau's Economic Census. The Economic Census provides us with establishment-level information on sales, geographic location, and firm identifiers that link together all establishments owned by each firm. Our sample from the Economic Census covers six major sectors of the economy: Manufacturing, Wholesale Trade, Retail Trade, Transportation and Warehousing, FIRE (finance, insurance, and real estate), and Services. We observe each establishment in these sectors in Economic Census years, which are those years ending in 2 and 7. In the sectors Manufacturing, Wholesale Trade, Retail Trade, and Services our data cover the years 1982 to 2012 and in the sectors FIRE and Transportation and Warehousing our data cover the years 1992 to 2012.

We supplement the Economic Census with two variables constructed from the Longitudinal Business Database (LBD). First, we use the time-consistent six-digit North American Industry Classification System (NAICS) industry codes provided in the LBD, which build on the work of Fort and Klimek (2018).[1] Second, we use the LBD to determine the birth year of a firm. Following the standard construction in the literature, the birth year of a firm is the birth year of the oldest establishment of the firm in the first year that it appears in the LBD data. This construction of firm birth year requires that we observe the firm (and its establishments) in the year in which it first appears in the data, something that is not possible in the Economic Census since most firms are not born in years ending in 2 or 7. For these purposes, we use the most recent version of the LBD, as constructed by and described in Chow et al. (2021), which has placed great emphasis on time-consistent measures of industry and on identifying new business formation.

Last, as part of the merger review analysis in Section 5, we use the classification of industries into tradable and non-tradable provided by Barkai and Karger (2020).

[1] For any establishment in the Economic Census without a longitudinal link to the LBD, we fill in this time-consistent industry classification using the most common time-consistent industry in the same year for other establishments in the same time-inconsistent industry variable reported by the Economic Census.

2.2 Industry Concentration and Aggregation

At the level of a six-digit NAICS industry we measure concentration as the sales share of the largest four firms (C4):

$$\text{C4}_{j,t} = \frac{\text{Sales of the Largest Four Firms}_{j,t}}{\text{Total Industry Sales}_{j,t}} \tag{1}$$

where j indexes industries and t indexes time. We aggregate industry-level concentration to the level of a sector using industry sales weights:

$$\text{C4}_{S,t} = \sum_{j \in S} \frac{\text{sales}_{j,t}}{\text{sales}_{S,t}} C4_{j,t} \tag{2}$$

where S indexes sectors and $\frac{\text{sales}_{j,t}}{\text{sales}_{S,t}}$ is the sales weight on industry j in sector S in year t. This is equivalent to adding up the sales of the largest four firms of each industry in the sector and dividing this sum by total sales in the sector.

We construct changes in concentration at the level of a sector as:

$$\text{dC4}_{S,t \to t+5} = \text{C4}_{S,t+5} - \text{C4}_{S,t}. \tag{3}$$

This is distinct from the sales-weighted aggregation of industry-level changes in concentration, which would measure the sectoral with-industry change in concentration. The difference is due to the changes in industry sales weights from year t to $t+5$: an increase in the weight of industries with low levels of concentration will reduce concentration, whereas an increase in the weight of industries with high levels of concentration will increase concentration.

When reporting cumulative sector-level changes in concentration over time, we sum the five-year changes in concentration. In the four sectors with complete time series coverage (Manufacturing, Wholesale Trade, Retail Trade, and Services) this corresponds to changes in concentration from 1982 to 2012 and in the other two sectors (FIRE and Transportation and Warehousing) this corresponds to changes in concentration from 1992 to 2012.

Due to the unbalanced nature of our data, we measure the change in aggregate concentration from year t to $t+5$ using the sectors that report in both economic census years. This means that the changes in aggregate concentration from 1982 to 1987 and from 1987 to 1992 are only for

the sectors Manufacturing, Wholesale Trade, Retail Trade, and Services and changes in aggregate concentration for later years include all six sectors. When reporting cumulative changes in aggregate concentration over time, we sum the five-year changes in aggregate concentration.

3 The Contribution of M&A to Rising Concentration

3.1 Framework for the Contribution of M&A to Rising Concentration

We measure the contribution of M&A to changes in concentration, holding fixed the level of economic activity, in the following manner: (i) fix the sales of all establishments of industry j in year t, (ii) assign establishments to firms using the ownership structure from year $t+5$,[2] and (iii) measure the sales share of the largest four firms using the sales reported in year t and firm boundaries determined by the ownership structure in year $t+5$. The resulting concentration measure, combining year t sales and year $t+5$ ownership, is

$$\text{C4}_{j,t}^{\text{Future Ownership}} = \frac{\text{Sales of the Largest Four Firms}_{j,t}^{\text{Future Ownership}}}{\text{Total Industry Sales}_{j,t}}. \tag{4}$$

We then measure the increase in concentration attributed to M&A as

$$\text{Contribution of M\&A}_{j,t\to t+5} = \text{C4}_{j,t}^{\text{Future Ownership}} - \text{C4}_{j,t}. \tag{5}$$

This measure fixes the economic activity to year t and asks how concentration in that one year changes if we change the ownership structure to account for M&A over the subsequent five years. Note that in the absence of any change in the ownership structure, the sales of the largest four firms is the same, whether we construct firms based on ownership in year t or in year $t+5$, and therefore in such a case our metric of Contribution of $\text{M\&A}_{j,t\to t+5}$ would equal zero.

Aggregation of industry-level measures to the level of a sector is straightforward (since the measure only uses sales data in year t) and is constructed as a sales-weighted average.

[2] We assign to all exiting establishments their firm identifier from year t.

3.2 Results on the Contribution of M&A to Rising Concentration

This subsection presents our sectoral and aggregate results on the contribution of M&A to rising concentration.

Figure 1 presents the 5-year changes in concentration and the 5-year contributions of M&A for each of our six major sectors. Several features stand out clearly in the data. First, concentration is increasing in nearly every 5-year period in every sector. The only 5-year periods that display a decline in concentration are Services from 1982 to 1987 (-0.3pp), Services from 2007 to 2012 (-0.01pp), Wholesale Trade from 1987 to 1992 (-0.1pp), and Wholesale Trade from 2002 to 2007 (-2.3pp) and only one of these exceeds in absolute value even half a percentage point. Second, the contribution of M&A to rising concentration is positive in nearly every 5-year period in every sector. The contribution of M&A can turn negative when large firms spin off some of their establishments or sell these establishments to smaller competitors. While this does occur in the data, the increases in concentration that results from M&A activity far outweigh the reductions in concentration that results from large firms spinning off or selling some of their business to smaller competitors. Third, those 5-year periods with large increases in concentration coincide with large contributions of M&A to concentration, but at the same time, in nearly all 5-year periods and sectors the increase in concentration exceeds the contribution of M&A.

Figure 2 presents the cumulative changes in concentration across all census years. In most major sectors these changes are measured from 1982–2012, but in two sectors (FIRE and Transportation & Warehousing) the data only cover 1992-2012. We want to highlight three results shown in this figure. First, all sectors exhibit a significant increase in concentration. Concentration rises the least in Manufacturing (7.6pp increase) and the most in Retail Trade (23.7pp). This result is not new to the literature. Second, all sectors exhibit a positive contribution of M&A to concentration, ranging from 1.6pp in Wholesale Trade to 6pp in Manufacturing. Third, measured as a percentage of each sectors cumulative increase in concentration, M&A has contributed most in Manufacturing (78.6%) and has contributed least in Wholesale Trade (18.3%). Manufacturing is the only sector in which M&A has contributed more than half of the increase in concentration and the next largest contribution is in the Services sector (37.4%).

Figures 3 and 4 present our aggregate results. Panel A of Figure 3 presents the 5-year changes

in aggregate concentration and the 5-year aggregate contribution of M&A. The panel clearly shows that (i) aggregate concentration is increasing in every 5-year period, (ii) the contribution of M&A to rising aggregate concentration is positive in every 5-year period, and (iii) those 5-year periods with large increases in aggregate concentration coincide with large aggregate contributions of M&A. Panel A of Figure 4 presents the cumulative changes in aggregate concentration and the cumulative aggregate contribution of M&A. In the unbalanced panel of sectors over the full time-period 1982 to 2012, aggregate concentration increases 9.1pp and the cumulative aggregate contribution of M&A is 4.0pp, which is equal to 43.8% of the increase in aggregate concentration. In the balanced panel of sectors over the shorter time-period 1992 to 2012, aggregate concentration increases 7.5pp and the cumulative aggregate contribution of M&A is 2.9pp, which is equal to 38.5% of the increase in aggregate concentration.

Even though concentration is increasing in all sectors, the gradual increase in the weight of the Services sector (the sector with lowest level of concentration) and the decline in the weight of the Manufacturing sector (the sector with highest level of concentration) help to moderate the increase in aggregate concentration over time. As a consequence, if (as a relevant example) M&A contributes 33% to the rise in concentration in each and every sector, we would find that contribution of M&A is equal to 45% of the increase in aggregate concentration. This moderation is greater in the first two periods 1982–1987 and 1987–1992, at which time (due to limited coverage of sectors) Services and Manufacturing have larger sales weights and therefore also larger changes in sales weights.

We report an additional set of aggregate results in which we compare the contribution of M&A to the aggregate within-sector change in concentration. The aggregate within-sector change in concentration from year t to year $t+5$ is defined as the weighted average of the sectoral changes in concentration using sales weights in year t. By fixing the weights in one year, rather than using different sectoral weights for concentration in years t and $t+5$, the within-sector estimates exclude the 5-year reductions in concentration that are the result of rising Services and declining Manufacturing. There is no need to adjust the contribution of M&A because it was already constructed using sales weights in a single year t.

Panel B of Figure 3 presents the 5-year aggregate within-sector change in concentration and the 5-year aggregate contribution of M&A. In each and every 5-year period, the aggregate within-sector change in concentration exceed the change in aggregate concentration. This difference is

primarily due to the moderating effect of rising Services and declining Manufacturing on aggregate concentration. Panel B of Figure 4 presents the cumulative aggregate within-sector change in concentration and the cumulative aggregate contribution of M&A. In the unbalanced panel of sectors over the full time-period 1982 to 2012, the cumulative aggregate within-sector change in concentration is 12.4pp and the cumulative aggregate contribution of M&A is 4.0pp, which is equal to 32.1% of the aggregate within-sector increase in concentration. In the balanced panel of sectors over the shorter time-period 1992 to 2012, the cumulative aggregate within-sector change in concentration is 8.8pp and the cumulative aggregate contribution of M&A is 2.9pp, which is equal to 32.8% of the aggregate within-sector increase in concentration.

In summary, this section presents three main findings. First, M&A has contributed to rising concentration in each sector. Measured as a percentage of each sector's cumulative increase in concentration, M&A has contributed most in Manufacturing (78.6%) and contributed least in Wholesale Trade (18.3%). Second, in the unbalanced panel of sectors over the full time-period 1982 to 2012, M&A contributes 43.8% of the increase in aggregate concentration. In the balanced panel of sectors over the shorter time-period 1992 to 2012, M&A contributes 38.5% of the increase in aggregate concentration. Third, the increase in aggregate concentration is moderated by the the gradual rise of Services and the decline of Manufacturing. When we strip out this moderating effect by measuring aggregate within-sector changes in concentration, we find that M&A contributes 32%-33% to the aggregate within-sector increase in concentration.

4 Empirical Decomposition of Rising Concentration

This section presents our empirical decomposition of changes in concentration into (1) changes resulting from organic growth, (2) changes resulting from M&A, and (3) changes resulting from entry and exit.

4.1 Framework for Empirical Decomposition

While the measurement of concentration only depends on firm-industry sales rather than on the underlying sales of all establishments of the firm in the industry, we choose to present the decomposition equations in terms of establishments to highlight and make fully transparent the measurement

of M&A and its impact on concentration.

Concentration Ratio as a Sales-Weighted Average. We can present the concentration ratio $C4_{j,t}$ as a sales-weighted average across all establishments of an indicator function equal to one if the establishment is owned by one of the largest four firms in the industry:

$$\text{C4}_{j,t} = \sum_{i \in j} \omega_{i,j,t} \mathbb{1}\left\{\text{Largest Four Firm}_{j,firm(i,t),t}\right\} \tag{6}$$

where i indexes establishments, j indexes industry, t indexes years, $\omega_{i,j,t}$ is the sales weight of establishment i in industry j in year t, $firm(i,t)$ is the firm that owns establishment i in year t, and $\mathbb{1}\left\{\text{Largest Four Firm}_{firm(i,t),t}\right\}$ is an indicator function equal to one if $firm(i,t)$ is one of the largest four firms in industry j in year t.

Uncorrected Decomposition. By presenting the concentration ratio $C4_{j,t}$ as a sales-weighted average across all establishments of an indicator function, we can present an empirical decomposition of changes in concentration in the style of Foster, Haltiwanger and Krizan (2001). To keep the equations clearly readable, we omit from the summation the indices i and j and use the abbreviation "L4" instead of "Largest Four Firms":

$$\begin{aligned}
\text{dC4}_{j,t\to t+5} = & \sum_{i \in C_{t\to t+5}} \omega_{t+5} \mathbb{1}\left\{\text{L4}_{firm(t+5),t+5}\right\} - \sum_{i \in C_{t\to t+5}} \omega_t \mathbb{1}\left\{\text{L4}_{firm(t+5),t}\right\} && \text{(UC-Growth)} \\
& + \sum_{i \in C_{t\to t+5}} \omega_t \mathbb{1}\left\{\text{L4}_{firm(t+5),t}\right\} - \sum_{i \in C_{t\to t+5}} \omega_t \mathbb{1}\left\{\text{L4}_{firm(t),t}\right\} && \text{(UC-M\&A)} \\
& + \sum_{i \in N_t} \omega_{t+5} \mathbb{1}\left\{\text{L4}_{firm(t+5),t+5}\right\} - \sum_{i \in X_t} \omega_t \mathbb{1}\left\{\text{L4}_{firm(t),t}\right\} && \text{(UC-Net Entry)}
\end{aligned}$$

where $C_{t\to t+5}$ is the set of all establishments in industry j that belong to continuing firms (those firms that operate in years t and $t+5$), N_t is the set of all establishments in industry j that belong to firms born after year t, and X_t is the set of all establishments in industry j that belong to firms that exit before year $t+5$.[3]

[3] In line with the literature, a firms that operates in year t is said to exit before year $t+5$ if all of its establishments exit before year $t+5$.

As described below, we view these terms as uncorrected (and in need of correction) and therefore they are labeled with the prefix "UC". The first term (UC-Growth) measures the change in concentration coming from continuing firms using fixed (year $t+5$) firm boundaries and only changing the sales shares of the firms. The second term (UC-M&A) measures the change in concentration coming from continuing firms using fixed sales share (in year t) and only changing the firm boundaries. The last term (UC-Net Entry) measures the change in concentration coming from large entering firms (those that reach the top four in year $t+5$) less the change in concentration coming from large exiting firms (those that were in the top four in year t).

Aggregation of the Decomposition Terms. We aggregate each of the five distinct terms in the decomposition equation from industry level to the sector and aggregate level using sales weights. The two terms $\sum_{i \in N_t} \omega_{t+5} \mathbb{1}\left\{\text{L4}_{firm(t+5),t+5}\right\}$ and $\sum_{i \in C_{t \to t+5}} \omega_{t+5} \mathbb{1}\left\{\text{L4}_{firm(t+5),t+5}\right\}$ are aggregated using sales weights in year $t+5$ and the other terms are aggregated using sales weights in year t. We then construct the aggregate equivalents of the three terms.

Rivalry in Ranking. The presentation of changes in concentration in terms of a weighted-average of an indicator function (equal to one for the largest firms), allows us to implement a commonly used decomposition. But at the same time, some caution in interpretation is necessary: at all times four firms are necessarily the largest in their industry and therefore the rising of any firm into the top four is necessarily accompanied by falling of another firm out of the top four. We refer to this feature as *Rivalry in Ranking*.

Rivalry in Ranking poses a measurement and interpretation challenge: small changes that cause one firm to overtake the fourth largest firm will lead to "large" changes in the indicator function that nearly fully offset. More generally, the decomposition can potentially show large offsetting contributions, thereby making it challenging to cleanly assign attribution to one of the three terms (Growth, M&A, and Net Entry).

As an example, the entrance of a large firm can generate a positive value for the UC-Net Entry term at the expense of the UC-Growth term. This can occur even if the change in concentration is very small and even if the large continuing firms are not growing slower than the industry. Rather, this negative value for the UC-Growth term is the result of removing from one of the continuing

firms the designation of Largest Four.[4] Similarly, the exit of a large firm can generate a negative value for the UC-Net Entry term and at the same time a positive value for the UC-Growth term. This can occur even if the change in concentration is very small and even if the large continuing firms are not growing faster than the industry. Rather, the positive value for the UC-Growth term is the result of adding to one of the continuing firms the designation of Largest Four.

Said differently, it is easy to write down a simple toy-model in which the size distribution of firms is both deterministic and stationary but the three UC-terms of the decomposition have large values (in absolute terms) that offset by summing to zero. Moreover, small changes in the parameters of the model can lead to large and discontinuous changes in the values of three decomposition UC-terms, while still summing to zero. The interpretation challenge is similar, and in our eyes even larger, when one continuing firm slightly overtakes another to receive the designation of Largest Four and for this reason we do not present a further Within-Between decomposition of the UC-Growth term.

We introduce below our correction method that is designed to correct the potentially large offsetting contributions to the different terms in the decomposition.

Regression Correction In order to address the challenge of Rivalry in Ranking, we use the coefficients estimated from Ordinary Least Square (OLS) regressions to scale the three decomposition UC-terms (UC-Growth, UC-M&A, and UC-Net Entry). Specificlly, for each of the three UC-terms we seperately run the regression:

$$\text{dC4}_{j,t\to t+5} = \text{intercept} + \beta^{\text{UC-Term}} \times \text{UC-Term}_{j,t\to t+5} + \varepsilon_{j,t\to t+5}. \tag{7}$$

The unit of observation is an industry-base year (base year in the regression is t and an observation requires that we have data in years t and $t+5$). Consistent with aggregation, we weigh observations in this regression in proportion to their sales share in the base year. We then construct our corrected decomposition C-terms ("C" for corrected) as the product of (i) the uncorrected decomposition UC-terms, (ii) the regression coefficients, and (iii) a scaling parameter included to ensure that the

[4]For example, if the new firm is the fourth largest at a sales share of 12.4% and the next largest continuing firm has a sales share of 12.2% the decomposition will assign to the UC-Net Entry share a value of +12.4% and a large negative value to UC-Growth, whereas we would likely as researchers prefer to attribute a much lower positive contribution to UC-Net Entry (closer to 0.2%) and shrink the negative contribution of the UC-Growth term towards zero.

three corrected terms add up to the observed change in aggregate concentration. For example, C-Growth = scale parameter $\times$ β^{Growth} $\times$ UC-Growth.

4.2 Results of Empirical Decomposition

Our decomposition results are currently being reviewed by the U.S. Census Bureau to ensure appropriate access, use, and disclosure avoidance protection of the confidential source data used to produce this product. We expect the results to be approved for release in the coming weeks.

5 Merger Guidelines and Preventable Change in Concentration

The analysis in this section is designed to help us understand the possible extent to which the relaxing of merger guidelines or lax government enforcement of existing guidelines contributed in a significant manner to the rise in concentration.

5.1 Framework for Merger Guidelines and Preventable Change in Concentration

Preventable Change in Concentration. In every five-year period (from t to $t+5$) we evaluate each observed merger and acquisition in order to determine whether, according to the merger guidelines, it should be permitted or whether it should be challenged in court. For the purpose of this evaluation, we use our six-digit NAICS industry as the competition market, and in the case of non-tradable industries we use our six-digit NAICS industry separately in each state. Throughout the analysis we measure firm size using sales in the base year (year t).[5] With annual sales data we would prefer to measure size using data on sales in the year prior to the proposed merger or acquisition, but annual sales data are not available at the level of the establishment, which is needed to complete our analysis.

[5]Sales is the most common measure of firm size used by enforcement agencies to evaluate mergers. There are unique cases in which other metrics are used instead. As described in the 1968 merger guidelines: "The market is ordinarily measured primarily by the dollar value of the sales or other transactions (e.g., shipments, leases) for the most recent twelve month period for which the necessary figures for the merging firms and their competitors are generally available. Where such figures are clearly unrepresentative, a different period will be used. In some markets, such as commercial banking, it is more appropriate to measure the market by other indicia, such as total deposits."

We review and evaluate all mergers and acquisitions as bundles. This means that when one firm acquires several different firms in the same five-year period, we review the acquisition as if the firm had acquired all of these firms at once and as one. Therefore, when the merger guidelines set criteria that depend on the size of the acquired firm, we use the combined size of the several different acquired firms.

After evaluating each merger and acquisition, we re-calculate a contribution of M&A to concentration statistic after blocking all of the mergers and acquisitions that should be challenged in court under the merger guidelines. This leads to the following modification of Equations 4, which only accepts some of the changes in ownership from year t to $t+5$ (those that are permitted under the merger guideline):

$$\text{C4}_{j,t}^{\text{Permitted Future Ownership}} = \frac{\text{Sales of the Largest Four Firms}_{j,t}^{\text{Permitted Future Ownership}}}{\text{Total Industry Sales}_{j,t}} \tag{8}$$

where Permitted Future Ownership is the ownership reported in year $t+5$, except in cases of a blocked merger where we assign to establishments the ownership reported in year t. We then measure the Preventable Change in Concentration (almost always a prevented increase in concentration) due to the enforcement of merger guidelines as:

$$\text{Preventable Change in Concentration}_{j,t\to t+5} = \text{C4}_{j,t\to t+5}^{\text{Future Ownership}} - \text{C4}_{j,t\to t+5}^{\text{Permitted Future Ownership}} \tag{9}$$

which measures the change in concentration coming from those mergers and acquisitions that should have been challenged in court under the merger guidelines. We aggregate Preventable Change in Concentration from industries to sectors and to the aggregate using sales weights and when reporting cumulative changes in concentration over time, we sum the five-year values of Preventable Change in Concentration across years.

1968 and 1982 Merger Guidelines. We carry our the analysis separately for the 1968 and 1982 DOJ merger guidelines. The 1968 merger guideline provides rules that are formulated in terms of the market shares of the acquirer and acquired firm and are presented in Panel A of Table 1. As an example, the guideline states that a merger should be challenged when an acquirer has a market share between 15% and 20% and the acquired firm has a market share greater than 3%.

As the size of the acquirer increases, the guidelines set stricter criteria on the size of the acquired firm. When considering an acquirer that has a market share exceeding 25%, the guideline states that a merger should be challenged if the acquired firm has a market share exceeding 1%.

The 1982 merger guideline provides rules that are formulated in terms of the post-merger HHI and the change in HHI that results from the merger.[6] These criteria are presented in Panel B of Table 1. The guideline states that in highly concentrated markets, those with a post-merger HHI greater than 1800, any merger that results in an increase in HHI exceeding 50 should be challenged. In moderately concentrated markets (post-merger HHI between 1000 and 1800), mergers that results in an increase in HHI exceeding 100 should be challenged. In unconcentrated markets (post-merger HHI below 1000), no mergers should be challenged.

Caution in Interpretation: Approximation and Likely Overstatement. Estimating and interpreting Preventable Change in Concentration under each merger guideline presents three key challenges.

First challenge: Should a merger be challenged? Our implementation of the merger guidelines is likely to contain errors due to (i) mismeasured geography and industry boundaries of the competition market, (ii) additional considerations that may weigh on the decision of the regulator when deciding whether the challenge a merger or acquisition in court, such as "factors... [that] indicate that effective collusion in the market is particularly likely." These may lead us to block some mergers that would not have been challenged in court and to permit other mergers that should have been challenged under the guidelines.

Second challenge: Will the courts block the merger? The merger guidelines are written by the regulatory agencies and serve to describe to the public and to the courts the rules governing their regulatory enforcement. The courts may or may not follow these merger guidelines when deciding on any particular case. Our analysis assumes that all cases brought to court under the guidelines will be decided in the favor of the regulator.

Third challenge: What will happen once a merger is blocked? If a specific merger or acquisition is blocked because it violates the merger guidelines, we don't know if the blocked acquirer will seek a

[6] As described by the 1982 merger guidelines: "An empirical study by the Department of the size dispersion of firms within markets indicates that the critical HHI thresholds at 1000 and 1800 correspond roughly to four-firm concentration ratios of 50 percent and 70 percent, respectively."

smaller target. Similarly, if a specific merger or acquisition is blocked because it violates the merger guidelines, we don't know if the blocked acquirer will grow more slowly (which would be the case if there acquisition generated synergies) or perhaps more rapidly (if acquisition leads to inefficiencies, or if the blocked acquirer would choose to expand their own operations as an alternative to the acquisition), and we do not know if the competitors in the industry would alter their acquisitions or growth in response. Furthermore, the merger guidelines are conditional in the sense that they depend on the size of the merging parties (under the 1968 guidelines) or the concentration of the industry (under the 1982 guidelines) and it is possible that by blocking a merger in early years it would not be necessary to block blocking a merger in some future year.

The first challenge (Should a merger be challenged?) leads to potential error but does not clearly bias the results in one direction.[7] The mismeasrued geography and industry boundaries of the competition market could lead to over-challenging or under-challenging: the market can include few firms and therefore higher market shares and concentration or it can include a greater number of firms and therefore lower market shares and concentration. Excluding additional considerations that weigh on the decision of the regulator could also lead to over-challenging or under-challenging. The second challenge (Will the courts block the merger?) likely leads to an overstatement of Preventable Change in Concentration since it assumes that all challenged mergers and acquisitions that meet the merger guidelines will be blocked by the courts. The Third challenge (What will happen once a merger is blocked?) leaves more open to the interpretation of the reader since no counterfactual is ruled out or ruled in by our analysis. The authors believe that this third challenge likely leads our analysis to overstate Preventable Change in Concentration, because we think it is likely that some blocked acquirers will either find a smaller target or find other ways to gain market share and this will lead so some increase in concentration.

Taken together, we view our results as approximate (due to the first challenge) and likely an overstatement (due to the second and third challenges) of the true Preventable Change in Concentration.

[7] Some might argue that competition markets are typically much narrower and therefore more mergers and acquisitions should be challenged. This is partially offset by the possibility that some of the mergers that we deem as horizontal (because the parties share a six-digit NAICS industry code) may turn out to be vertical (if the parties belong to separate competition markets contained in the same six-digit NAICS industry.

5.2 Results on Merger Guidelines and Preventable Change in Concentration

Our merger guideline and Preventable Change in Concentration results are currently being reviewed by the U.S. Census Bureau to ensure appropriate access, use, and disclosure avoidance protection of the confidential source data used to produce this product. We expect the results to be approved for release in the coming weeks.

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Figure 1: **Concentration of M&A to Rising Concentration: By Sector and Year**
This figure presents the change in concentration and the contribution of M&A to the change in concentration by sector and year. See Section 2 and Equation 3 for the measurement of changes in concentration and Section 3 and Equation 5 for the measurement of the contribution of M&A. See Section 3 for further details.

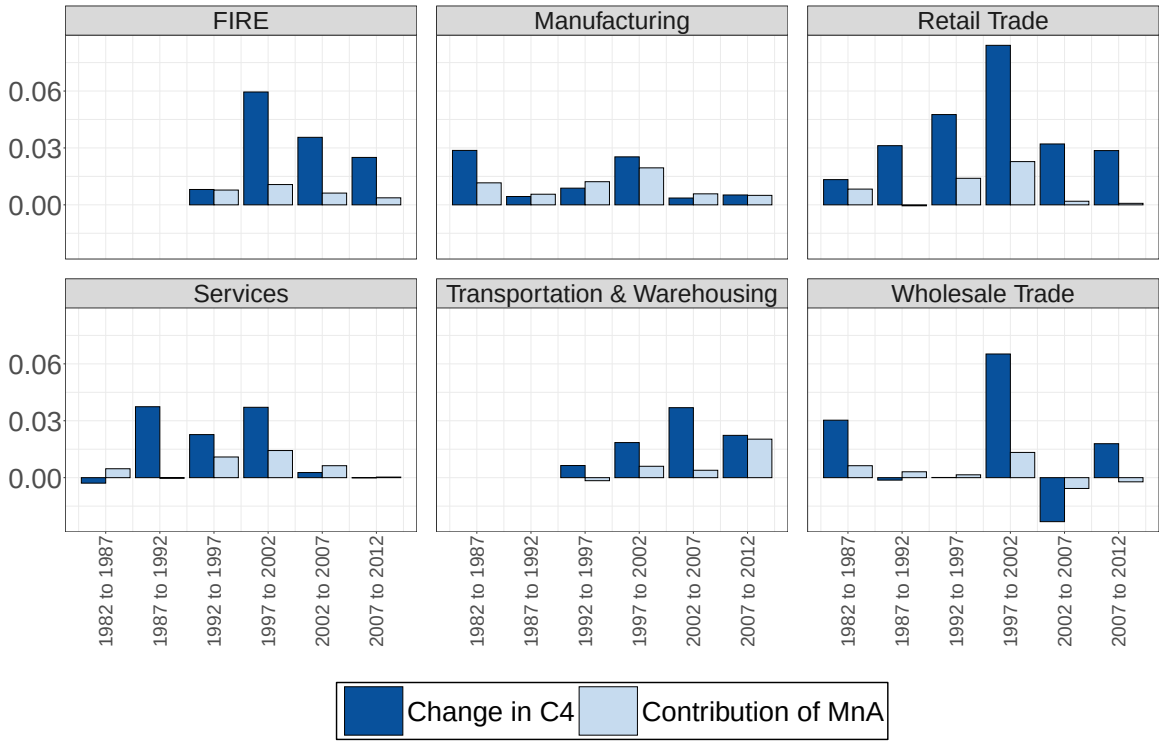


Figure 2: **Concentration of M&A to Rising Concentration: Cumulative by Sector**
This figure presents the cumulative change in concentration and the cumulative contribution of M&A to the change in concentration by sector and year. See Section 2 and Equation 3 for the measurement of changes in concentration and Section 3 and Equation 5 for the measurement of the contribution of M&A. See Section 3 for further details.

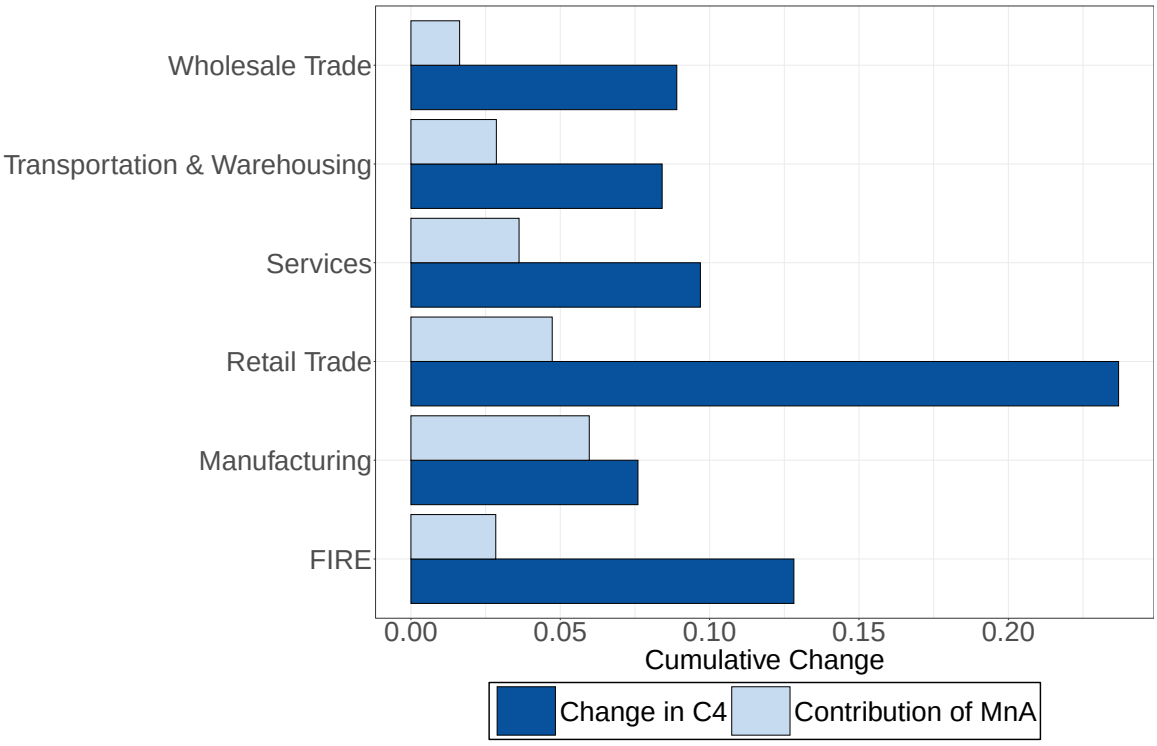
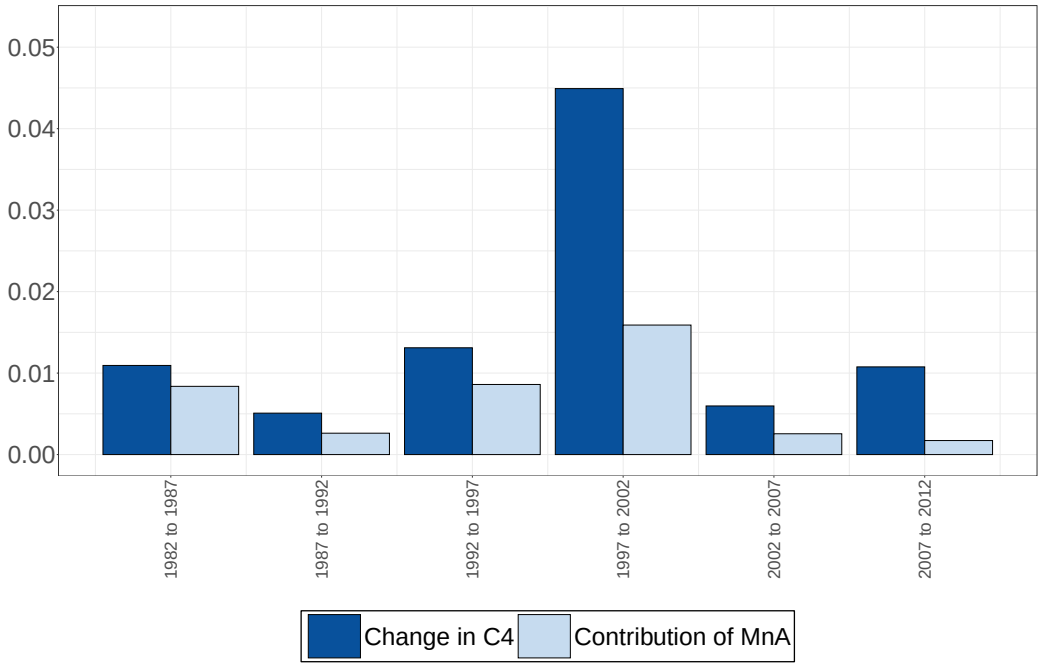


Figure 3: **Concentration of M&A to Rising Concentration: Aggregate by Year**
Panel A reports the statistics of the change in aggregate concentration. Panel B reports the statistics of the aggregate within-sector change in concentration. See Section 2 and Equation 3 for the measurement of changes in concentration and Section 3 and Equation 5 for the measurement of the contribution of M&A. See Section 3 for further details.

(a) Change in Aggregate Concentration



(b) Aggregate Within-Sector Change in Concentration

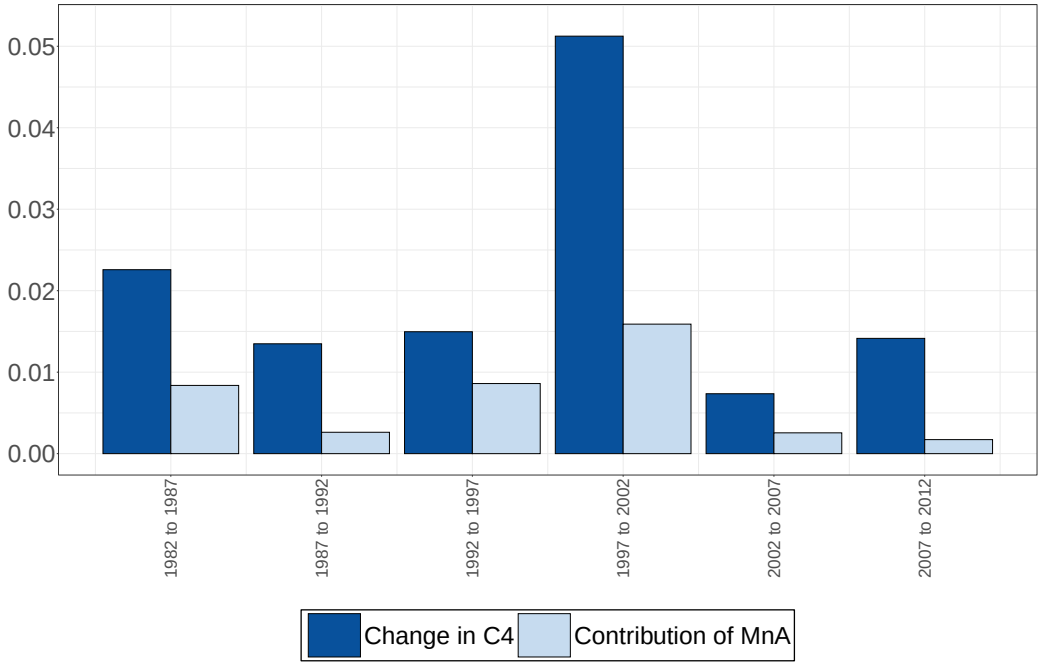
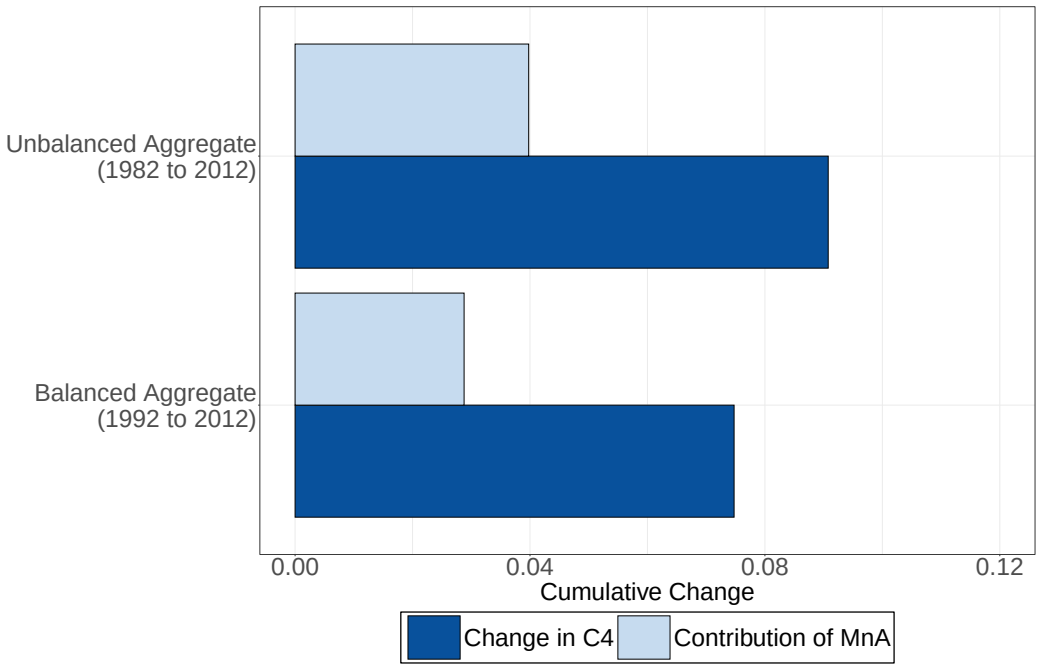


Figure 4: **Concentration of M&A to Rising Concentration: Aggregate**
Panel A reports the statistics of the change in aggregate concentration. Panel B reports the statistics of the aggregate within-sector change in concentration. Results are reported separately for the unbalanced panel of sectors covering the years 1982–2012 and for the balanced panel of sectors covering the years 1992–2012. See Section 2 and Equation 3 for the measurement of changes in concentration and Section 3 and Equation 5 for the measurement of the contribution of M&A. See Section 3 for further details.

(a) Change in Aggregate Concentration



(b) Aggregate Within-Sector Change in Concentration

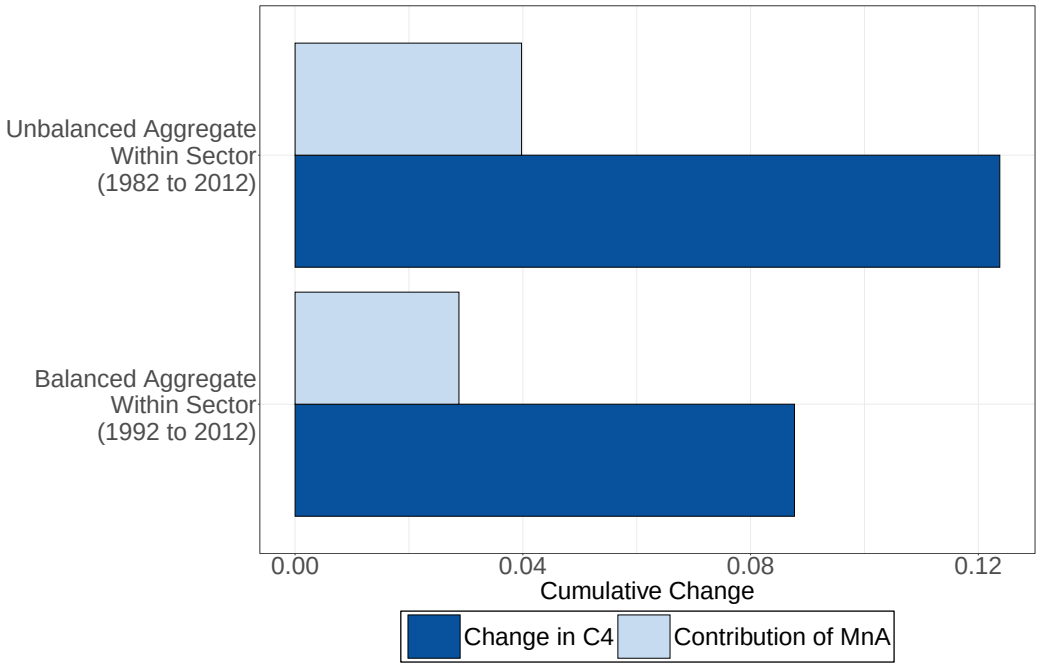


Table 1

Mergers and Acquisitions Challenged Under Merger Guidelines

Panel A presents the 1968 Merger Guideline. These guideline rules are presented in terms of market shares of the acquiring firm and acquired firm. As an example, the guideline states that a merger should be challenged when an acquirer has a market share between 15% and 20% and the acquired firm has a market share greater than 3%. Panel B presents the 1982 Merger Guideline. These guideline rules are presented in terms of post-merger competition-market HHI and the change in HHI that results from the merger. See Section 5 for further details.

(a) 1968 Merger Guideline

Acquiring Firm	Acquired Firm(s)
5%	5% or more
10%	4% or more
15%	3% or more
20%	2% or more
25% or more	1% or more

(b) 1982 Merger Guideline

Post-Merger HHI	Increase in HHI
1000–1800	100 or more
1800+	50 or more