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Common ownership and competition in product markets☆

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ABSTRACT

We investigate the relation between common institutional ownership of the firms in an industry and product market competition. We find that common ownership is neither robustly positively related with industry profitability or output prices nor is it robustly negatively related with measures of nonprice competition, as would be expected if common ownership reduces competition. This conclusion holds regardless of industry classification choice, common ownership measure, profitability measure, nonprice competition proxy, or model specification. Our point estimates are close to zero with tight bounds, rejecting even modestly sized economic effects. We conclude that antitrust restrictions seeking to limit intra-industry common ownership are not currently warranted.

1. Introduction

Inherent market frictions have created opportunities for intermediaries, namely institutional investors, to pool funds from individuals and form large-scale, well-diversified portfolios, thereby simultaneously allowing individuals to diversify at low cost and creating incentives for institutional investors to monitor managers of portfolio firms. Given the tremendous benefits to individual investors of low-cost portfolio diversification and delegated monitoring, investment via institutions has increased dramatically over time (see, e.g., Gompers and Metrick, 2001; Gillan and Starks, 2007). Coincident with this increase, there has also been a dramatic rise in the frequency with which large diversified institutional investors own shares in multiple firms in the same industry, as evidenced in Fig. 1 and further characterized in Azar (2016) and Backus et al. (2019).

Theoretical research has raised the possibility that the increase in common ownership is not without substantial attendant costs. Specifically, when product market rivals' strategic actions impose negative externalities on one another, an institution that owns stakes in multiple rivals may prefer that the firms' managers make choices that maximize the value of a portfolio comprised of the rivals

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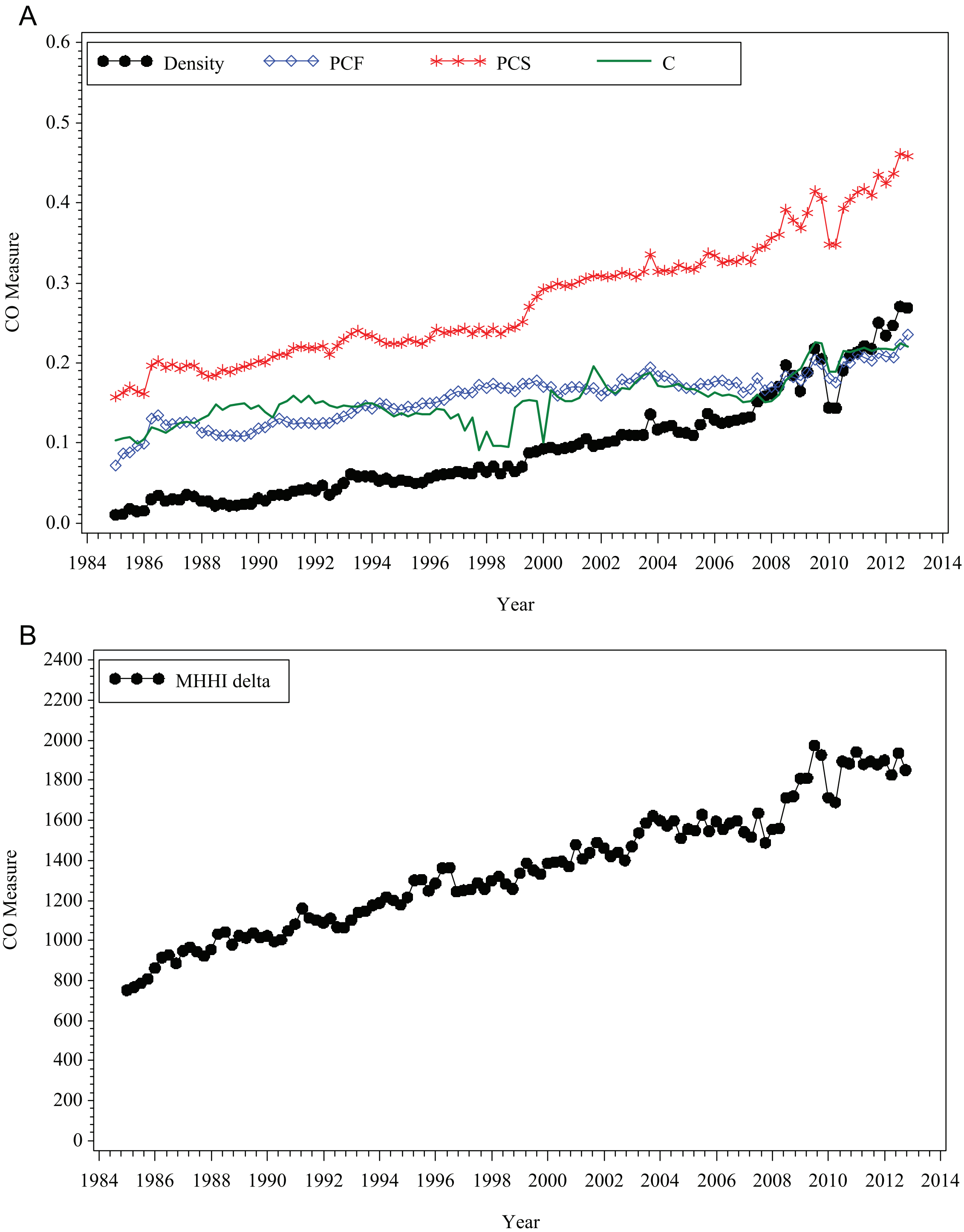

Fig. 1. Common ownership time series.
Data are from Thomson Reuters 13F, CRSP, and Compustat for the period starting with the first quarter of 1985 and ending with the fourth quarter of 2012. At the firm level, we require firms to have total assets of at least $1 million, net sales of at least $250,000, and net sales greater than EBIT. Industries are defined using four-digit NAICS codes. We require industries to have at least two firms in every industry-quarter for a minimum of 20 consecutive quarters to remain in the sample. There are 269 industries that meet the sample screen. Variables are defined in Appendix A. Panel A: Density, PCF, PCS, and C and Panel B: MHHI delta, respectively. Currently, there is just an A and a B near each panel.

as opposed to choices that maximize the values of the individual firms (see, e.g., Hansen and Lott, 1996; Gordon, 2003; Rubin, 2006; Azar, 2011; Azar, 2016; López and Vives, 2019; Azar and Vives, 2018). In other words, institutions with holdings across rival firms may want individual firm managers to make decisions on output, pricing, capacity, advertising, research and development, etc. as if the firms were members of a cartel.

We refer to the possibility that greater institutional common ownership incentivizes and perhaps facilitates reduced competition among rivals as the common ownership concentration (COC) hypothesis (see, e.g., Schmalz, 2018). Consistent with this hypothesis, two recent empirical papers conclude that increased common ownership has reduced competition and caused consumers to pay higher airline ticket prices (Azar et al., 2018) and higher interest rates on loans (Azar et al., 2016). These provocative findings have garnered the attention of market participants, academics, and policymakers and started an important debate about the relative costs and benefits associated with common ownership, including the potential need for antitrust remedies similar to those used in the context of full or partial horizontal mergers or cartels.

Given the immense benefits to individuals of investing via institutions, any potential antitrust-based restrictions on institutions' ability to diversify should clearly take into consideration the overall empirical relevance of any anticompetitive effects of common ownership. Azar et al. (2016, 2018) each analyzes a single, highly regulated industry, and it is not clear whether these results are generalizable. Echoing this sentiment, Noah Phillips, commissioner at the U.S. Federal Trade Commission, recently stated, "I am interested, in particular, to see how common ownership impacts a broad set of industries, whether a clear mechanism of harm can be identified, a rationale for why managers put the interests of one set of shareholders above the others and a rigorous weighing of the pro-competitive effects of institutional shareholding."[1]

In this paper, we empirically investigate whether greater common institutional ownership within industries is systematically associated with decreased competition. Our analysis is designed to be as comprehensive as possible in terms of how rival firms are identified, how common ownership is measured, how reduced competition is manifested in industry outcomes, and how tests are structured to identify economic relations. We find that common ownership is neither robustly positively related with industry profitability and output prices nor robustly negatively related to nonprice competition measures. For instance, across the 534 test statistics reported below, and in the Internet Appendix, regarding the relation between common ownership and industry profitability, 283 are positive with 50 significant at conventional levels, and 251 are negative with 33 significant at conventional levels. Failing to reject the null does not seem to be due to low power. Our point estimates are, on average, close to zero with relatively tight bands. We estimate that a one standard deviation increase in common ownership has an effect of a few hundredths of one standard deviation of profitability and is indistinguishable from zero. The tight bands allow us to reject even modestly sized economic effects. Our interpretation is further supported by prior literature that argues the primary econometric concern in detecting reduced competition is not low power but is rather false positives (i.e., type I error) (Harrington Jr, 2006; Kaplow, 2013). Overall, our findings suggest that proposed policies to limit intra-industry institutional common ownership are not currently warranted.

In the context of common ownership, any reduction in competition should be observable in industry profitability, i.e., the ultimate objective of reduced competition, regardless of the specific mechanisms by which reductions in competition are achieved. For instance, Azar et al. (2016, 2018) contend reduced competition occurs organically as managers' preferences for quiet lives coincide with common owners' preferences for less aggressive behavior in product markets. Thus, we do not need pristine, local market data regarding private communications between participants, transactions prices, marginal costs, demand conditions, etc. Even if institutions "doing nothing" is the mechanism, then the end result should be a positive relation between common ownership and industry profitability. Further, the parties involved have nothing to conceal. If the primary benefit to the institutions are high returns from portfolio firms that can be used to increase assets under management and compensation, then the portfolio firms cannot understate their profitability and these benefits fully accrue to the institutions' managers.

Our initial tests identify structural breaks in the time series of industries' common ownership and examine changes in profitability around such breaks. If one views sharp and persistent increases in common ownership as analogous to the establishment of other coordination mechanisms, e.g., trade associations, then this approach is similar to that of prior literature investigating formations of cartels (see, e.g., Levenstein and Suslow, 2006). The COC hypothesis predicts increases (decreases) in profitability following increases (decreases) in common ownership, perhaps from an increase in coordination (the collapse of prior coordination). We find that industries exhibiting dramatic increases or decreases in common institutional ownership do not systematically subsequently experience significant changes in markups or price-cost margins (PCMs). We also examine changes in capacity investment and market share investment (see, e.g., Stigler, 1968; Spence, 1977; Dixit and Norman, 1978; Fudenberg and Tirole, 1984; Shapiro, 1989; Bagwell, 2007) and find no effect.[2] We extend the analysis to a multivariate setting with industry-level regressions of profitability or non-price competition proxies on common ownership, controls for other aspects of institutional ownership, and controls for differences in industry structure. The results reveal that greater common ownership is, all else equal, not robustly related to industry outcomes in a manner consistent with reduced competition.

[1] https://www.ftc.gov/public-statements/2018/06/taking-stock-assessing-common-ownership.

[2] We also do not find evidence that greater common ownership reduces input prices via increased collective bargaining power over supplier industries (see, e.g., Chipty and Snyder, 1999).

One potential concern is that our initial tests are not well-specified. For example, some omitted variable may be correlated with both common ownership and profitability in such a way that its omission obscures the true relation between common ownership and competition. Further, the COC hypothesis proposes a causal effect of common ownership, and our analysis described above estimates associations. Thus, we exploit mergers among large institutional investors as sources of plausibly exogenous variation in common ownership (see, e.g., He and Huang, 2017; Lewellen and Lowry, 2018). We find little evidence of a robust causal effect of common ownership on industry profitability or nonprice competition proxies.

An additional potential concern is that there is a true relation between common ownership and competition, but it is too weak to be identified by our initial tests. For example, the magnitudes of the effect may be too small to detect in an average effect estimated across all industries, or similarly, measurement error may bias estimates toward zero. Thus, we repeat our tests in subsamples of industries where reduced competition via common ownership is expected to be facilitated (i.e., concentrated industries, industries in which firms were prosecuted for collusion during the sample period, and industries without firms that have less incentive to coordinate, namely, large private, family, or dual class firms).

We also repeat our tests on the subsample of industries for which there have not been substantive changes to industry classification codes over long periods of time. This both reduces measurement error and focuses the analysis on a setting in which reduced competition is facilitated, as cartels are more likely to persist in stable industries (Levenstein and Suslow, 2006). We also conduct analysis on a subsample of industries for which any potential selection bias due to requiring firms to have public equity is smaller (i.e., a subsample of industries for which at least 95% of the firms with publicly traded equity or publicly traded debt are included). Given the alternative possibility that our subsample characteristics instead function as substitutes for common ownership, we also repeat our analysis on the complementary subsamples (e.g., unconcentrated industries, etc). Across these analyses, we find no robust evidence of a relation between common ownership and industry profitability.

In addition to selecting ex-ante subsamples of industries for analysis, we also generate industry-specific estimates. Across these 7,738 estimates, we find that a one standard deviation increase in common ownership increases profitability by 0.016 standard deviations, on average. The median effect, 0.003, is even smaller. The t-statistics distribution is symmetric but has heavy tails, with 857 of the 7,738 estimates (11%) having t-statistics > 1.96 and 813 (11%) having t-statistics < -1.96. As such, if one argues that common ownership should be discouraged among a specific set of industries, there is a roughly equally sized set for which we should apparently encourage common ownership.

To include as many industries as possible in our study, we necessarily compromise on the fineness of our product market definitions relative to the single-industry studies. Thus, it is possible that our conclusions differ from those in Azar et al. (2018) and Azar et al. (2016) because we do not always measure common ownership or profitability at the product market level.[3] We investigate this possibility by examining results for subsamples where our industry definitions most accurately represent relevant product markets and by assessing whether the results vary systematically with the extent of how accurately our industry definitions correspond to relevant product markets. Specifically, we examine results in industries where geographic overlap of firms' operations is highest and industries where markets are national in nature, as evidenced by low costs of shipping output. Results for the subsamples are not consistent with the COC hypothesis. Additionally, the coefficients and associated standard errors across the continuums of overlap or shipping distance do not vary in a manner suggesting that a significant positive relation is being obscured by combining industries for which industry codes are not good representations of product markets with industries for which industry codes are good representations. In sum, conditional on our geographic overlap and shipping costs variables being good proxies for the degree of correspondence between industry codes and product markets, it does not appear that our overall conclusions are due to a lack of precision in defining product markets via industry definitions.

Last, using a subsample of manufacturing industries for which we can obtain data on output prices, input costs, and quantities produced, we examine the link between changes in common ownership and output prices. Analyses using similar data sources and empirical specifications have shown significant industry price increases following large changes in leverage (Phillips, 1995), horizontal mergers (Bhattacharyya and Nain, 2011), and partial acquisitions (Nain and Wang, 2018). We find no consistent evidence that increased common ownership is, all else equal, associated with larger increases in industry prices.

Taken together, our results are inconsistent with increased common ownership generally resulting in reduced competition. Despite reaching a different overall conclusion than recently published research, this finding is plausible for several reasons. First, it is consistent with theoretical research predicting no relation under certain conditions (see, e.g., Malueg, 1992; Davidson and Deneckere, 1984; López and Vives, 2019). Second, potential prosecution under existing antitrust laws should have a strong deterrent effect, as would reputational concerns.[4] Third, un-

[3] Our approach is consistent with the literature. For other examples of multiple industry studies investigating common ownership in industries and product markets defined using North American Industry Classification System (NAICS) or Standard Industrial Classification (SIC) codes, see Azar (2011), Antón et al. (2016), Antón et al. (2018), Gutiérrez and Philippon (2016), and Backus et al. (2019).

[4] If communications between firms took place through common institutional owners, then these institutions would be violating the Sherman Act. Corporate law firms are apparently aware of the potential exposure of their institutional investor clients to price fixing charges when these clients hold positions in multiple firms in the same industry (e.g., see http://www.kirkland.com/siteFiles/kirkexp/publications/2375/Document1/FTC%20Examines%20Interlocking%20Directorates.pdf and https://corpgov.law.harvard.edu/2016/05/24/antitrust-executive-order-and-common-ownership). To the best of our knowledge, no common institutional blockholder of U.S. firms has been

like in full or even partial horizontal mergers, coordination problems in common-ownership-based cartels would appear so large as to make their widespread implementation difficult to initiate and sustain in many industries. Fourth, institutional investors are heterogeneous in how they create value for shareholders. Some institutions, e.g., passive index funds, are less likely to engage and take strategic actions that facilitate reduced competition among portfolio firm managers (see, e.g., Lewellen and Lewellen, 2018; Bebchuk et al., 2017; Bebchuk and Hirst, 2018).

Our findings are important for both academic researchers and policymakers. In April 2016, the Obama administration's Council of Economic Advisers issued a brief citing increased common ownership as an area of concern meriting future consideration by U.S. antitrust authorities.[5] The Organisation for Economic Co-operation and Development has also issued a brief to member countries citing increased concerns regarding common ownership.[6] Elhauge (2015) concludes that "horizontal shareholdings" are likely to lead to anticompetitive practices and should be undone. Posner et al. (2017) propose a policy limiting institutions' holdings in an industry to small stakes or to only a large stake in a single firm.

Our results provide evidence on the systematic empirical relation between common ownership and industry competitiveness. The implications of our results are consistent with O'Brien and Waehrer (2017), Patel (2018), Rock and Rubinfeld (2017), Ginsburg and Klovers (2018), Hemphill and Kahan (2018), and Lambert and Sykuta (2018), who conclude that, based on the evidence to date, it would be premature to establish policies limiting the extent to which institutional shareholders can diversify. Institutional investors have also recently voiced opposition to claims by academics that common ownership and portfolio diversification should be limited on the basis of antitrust concerns (see, e.g., Novick, 2017). Based on our findings of no widespread influence of common ownership on industry competition, policies limiting common ownership do not currently appear warranted. Of course, it would be a mistake to extrapolate our findings to substantially higher levels of common ownership than in our sample. In the limit, if all firms become commonly owned by one institution, then the anticompetitive behavior predicted by the COC hypothesis should clearly become apparent.

2. Contribution and related literature

Our paper primarily contributes to the literature investigating the effects of ownership structure on product market competition. We extend the empirical results in Azar (2011) by examining the effect of common ownership on not only markups but also on PCMs, industry-level output prices, and nonprice competition. We show that increased common ownership is associated with higher industry profitability in a few isolated instances but this relation is not robust to many reasonable alternatives or to using a quasi-natural experiment to address endogeneity concerns. Our results also relate to those of Azar et al. (2018, 2016), Kennedy et al. (2017), Dennis et al. (2017), and Gramlich and Grundl (2018). One important contribution of our paper is ascertaining how well the results of these single-industry studies generalize to industries beyond banking and airlines, especially those industries where there are fewer barriers to entry, less variability and discrimination in pricing, and less regulatory oversight.[7] Our results are more consistent with those of Kennedy et al. (2017), Dennis et al. (2017), and Gramlich and Grundl (2018) in that we find the significant relations between common ownership and industry competition are not robust.

Our results illustrate that it is important to assess robustness of reported results to specific choices of industry classification, common ownership measure, profitability measure, and empirical specification. There are a few reasonable combinations of these choices that generate results consistent with common ownership being positively related to profitability. However, there are many more equally reasonable combinations of choices of industry definition, common ownership measure, and profitability measure that generate results inconsistent with common ownership relating positively to profitability. Lewellen and Lowry (2018) reach a similar conclusion regarding the robustness of results to the alternative approaches used to isolate exogenous variation in common ownership. Thus, "cherry picking" of reported results is clearly a potential concern in the common ownership literature.

He and Huang (2017) investigate whether same-industry firms cross-held by institutional investors gain competitive advantages relative to other firms in the industry that are not cross-held. They find that cross-held firms experience significantly greater growth in market share. Further, cross-held firms also exhibit higher PCMs than competitors that are not cross-held. Semov (2017) finds that pairs of commonly held firms within an industry hold less cash, use more debt, and increase product similarity, consistent with common ownership reducing the aggressiveness of competition between pairs of commonly owned firms. Given that the analyses in He and Huang (2017) and Semov (2017) are at the firm-pair level, the implications of the observed relations between cross-holdings, market share growth, and PCMs for the overall level of competition and profits in the industry are not apparent, as these relations are entirely consistent with both increased and decreased industry-level competition and profits. Thus, our results complement and substantially augment those of He and Huang (2017) and Semov (2017) by examining industry-level effects of common ownership.

party to a case filed by the U.S. Department of Justice due to violations of antitrust laws (http://www.justice.gov/atr/antitrust-case-filings).

[5] https://obamawhitehouse.archives.gov/sites/default/files/page/files/20160414_cea_competition_issue_brief.pdf.

[6] http://www.oecd.org/competition/common-ownership-and-its-impact-on-competition.htm.

[7] U.S. government agencies charged with the dual mandates of promoting and regulating air travel and banking are often cited as examples of "regulatory capture"(see, e.g., Stigler, 1971). Thus, firms in these industries may also enjoy greater latitude to reduce competition on prices due to expectations that their regulators may intervene on their behalf to prevent price-fixing charges by antitrust authorities.

Our paper is also related to the growing literature on the mechanisms through which increased common ownership may influence competition. Recent evidence suggests that common owners increase the benefits to individual managers from competing less aggressively. Market-based tests for reduced competition do not generally reveal the specific mechanisms used to reduce competition (e.g., the content and nature of any communications between firms). Antón et al. (2016) find that greater common ownership in an industry is more frequently accompanied by CEO compensation contracts that place less weight on own-firm performance and place more weight on rival-firm performance, consistent with common owners incentivizing CEOs to compete less aggressively (see, e.g., Kraus and Rubin, 2010). However, it should be noted that Kwon (2016) reaches the exact opposite conclusion. He et al. (2017) find evidence consistent with common owners reducing the negative governance externalities present among firms that compete to attract and retain managerial talent via increased monitoring. Edmans et al. (2019) show that increased common ownership can also strengthen corporate governance by enhancing the effectiveness of both voice and exit mechanisms.

Our paper is also related to the literature on the effects of increased common ownership on other corporate policy choices. Kini et al. (2018) find that greater common ownership prompts firms in an industry to alter their respective products so that they are closer substitutes. Xie and Gerakos (2018) find that common ownership facilitates agreements between brand-name and generic drug manufacturers where the generic manufacturer delays introducing a generic substitute for the brand-name drug. Kostovetsky and Manconi (2017) find that greater common ownership among firms is associated with a higher intensity of patent citations among firms, consistent with common ownership facilitating the diffusion of innovation. Freeman (2016) shows that greater common ownership of customer and supplier firms is associated with greater trading relationship longevity. Sertsios et al. (2018) note that firms generally reduce leverage to increase the stability of collusive arrangements, including potentially those coordinated via common ownership.

Given the potential parallels between increased concentration via common ownership and via horizontal mergers, our paper is related to the literature examining horizontal mergers (see, e.g., Farrell and Shapiro, 1990b; Eckbo, 1983; Fee and Thomas, 2004; Shahrur, 2005). Similarly, our findings are also related to the literature examining firm-level cross-holdings of rival firms (see, e.g., Reynolds and Snapp, 1986; Farrell and Shapiro, 1990a; Flath, 1991; Malueg, 1992; Reitman, 1994; O'Brien and Salop, 1999; Gilo et al., 2006; Nain and Wang, 2018). Our paper is also related to the literature on institutional cross-ownership in mergers and acquisition transactions (see, e.g., Matvos and Ostrovsky, 2008; Harford et al., 2011).

Our findings are relevant to the literature investigating the causes of the observed slowdown in productivity in the U.S. since the early 2000s (see, e.g., Fernald, 2015; Syverson, 2017). Attendant with this slowdown has been a substantial weakening over recent decades in the relation between corporate investment and measures of profitability and valuation. Gutiérrez and Philippon (2016) empirically investigate several explanations for the seeming reluctance of firms to invest despite high valuations and profitability. They conclude that increased common ownership of an industry (and an associated reduction in competition) is a factor in the apparent underinvestment. Our findings suggest that common ownership is not associated with significant reductions in net capacity investment, even in concentrated industries.

3. Hypotheses development and empirical design

Hansen and Lott (1996) demonstrate that investors who hold completely diversified portfolios of firms operating in imperfectly competitive product markets may reject individual-firm share value maximization as a corporate policy. Instead, investors with holdings of rival firms prefer a policy of portfolio value maximization in which individual firm managers internalize negative between-firm externalities, in particular, those associated with output prices, marketing expenditures, investments in capacity, etc. Gordon (2003), Azar (2011), and Azar (2016) extend this framework to situations where shareholders are not completely diversified and their portfolios differ from each other as well as to situations where shareholders are also consumers. Even under such circumstances, and given certain maintained assumptions, shareholders may prefer in equilibrium that individual firm managers jointly pursue corporate policies similar to those pursued by a monopolist that maximizes a weighted average of individual shareholder utilities. As noted by Azar et al. (2016, 2018), reduced competition could occur organically as managers' preferences for quiet lives coincide with common owners' preferences for less aggressive behavior in product markets. Reynolds and Snapp (1986), Farrell and Shapiro (1990a), and O'Brien and Salop (1999) also demonstrate that greater common ownership of industry rivals can yield more collusive product market outcomes.[8]

In short, common institutional owners appear to have both the incentives and the means, i.e., direct access to top executives, voting power, and influence over CEO compensation, to convey information regarding rivals to individual firm managers and to influence managerial choices toward less competitive outcomes. Alternatively, institutions can also induce reduced competition among rivals by "doing nothing" (i.e., failing to push managers toward individual firm-value maximization). Hence, greater common ownership among rival firms by institutions could lead to reduced competition among the rivals, a possibility that we refer to as the COC hypothesis.

Malueg (1992) demonstrates that cross-ownership may not actually facilitate collusion, depending on the demand structure in the product market. Specifically, cross-ownership of rivals is shown to not only reduce the gains from deviating from a collusive arrangement but

[8] Brander and Lewis (1986) show that in an oligopoly setting where firms use increased financial leverage to strategically commit to aggressive behavior in the product market, lenders also have incentives to act as coordinating agents so that firm managers internalize the negative intra-industry externalities associated with increased leverage.

also to soften the punishment in the event of a deviation. Davidson and Deneckere (1984) show a similar result in the context of full horizontal mergers. López and Vives (2019) demonstrate that, in industries exhibiting sufficiently large research and development (R&D) spillovers, greater common ownership may increase competition via enhanced incentives for firms to invest in cost-reducing R&D. Thus, greater common ownership creates conflicting forces for colluding, and the null to the COC hypothesis is meaningful (i.e., theory also predicts that modest increases in common ownership may not significantly alter product market competition).

The COC hypothesis predicts that greater common ownership among institutions will be associated with higher industry profitability, a proposition we test below. Increased profitability could result from industry participants restricting output and raising prices to monopoly levels (see, e.g., Stigler, 1964). Alternatively or additionally, increased profitability could result from rivals reducing spending on nonprice competition (see, e.g., Shapiro, 1989). Thus, the tests below examine profitability, expenditures typically associated with nonprice competition, and output prices.

Nonprice, strategic interactions among firms in imperfectly competitive product markets include actions taken over capacity investment, inventories, product choice and quality, R&D, advertising, extension of trade credit, and distribution (see, e.g., Sutton, 1991). For instance, expenditures on advertising and selling have long been characterized as having both a constructive function, i.e., informative to customers and reducing search costs, as well as a combative function (i.e., socially wasteful, serving only to redistribute customers from one firm to another). As Dixit and Norman (1978) note, “to the extent that the oligopoly is noncooperative, we should expect advertising levels chosen by sellers to be even more excessive than is the case with monopoly since advertising under oligopoly to some extent simply shifts demand from one seller to another. This demand-diverting effect is formally like an external diseconomy for group profits; competing oligopolists neglect the effect and advertise more than their joint interests warrant.” The COC hypothesis predicts that greater common ownership will incentivize reduced spending on purely combative advertising (i.e., market-share competition). All else equal, industry firms have an incentive to maintain constructive advertising. Thus, we expect that any observed negative relation between common ownership and advertising should be modest in magnitude, as it is primarily just the combative expenditures that are predicted to be reduced.

Strategic considerations are also present for firms' choices of investment in capital stock, and industry spending on capacity is higher than when capital stock can only be used to minimize costs for a given level of own-firm production (see, e.g., Shapiro, 1989). The COC hypothesis predicts that greater common ownership will incentivize reduced spending on additional capacity.

The divergence between shareholders' preferences for individual share value maximization versus portfolio value maximization depends on the negative externalities firms' actions impose on rivals (see, e.g., Hansen and Lott, 1996). Firms in more concentrated industries are generally characterized as facing more frequent strategic interactions with their rivals than in more competitive industries (see, e.g., Spence, 1979; Fresard, 2010; Hoberg and Phillips, 2010). Thus, a further testable implication of the COC hypothesis is that an observed relation between common ownership and product market competition should be stronger in concentrated industries.

Gordon (2003) notes that a closely held firm usually has a small number of owners, each of whom invest a substantial fraction of their portfolio in the firm. Such owners would primarily care only about the value of their firm. Thus, in the cross-section, the effects of common ownership on price and nonprice competition should be, all else equal, more evident in industries without a significant proportion of output by closely held firms (i.e., large privately held firms, family firms, or firms with dual class share structures).

There is a large theoretical and empirical literature investigating the factors that determine the formation and dissolution of cartels. As Levenstein and Suslow (2006) describe, the list of potential factors is quite long. However, in the cross-section, the effects of common ownership on competition should be, all else equal, more evident in industries with more factors favorably inclined toward collusion (i.e., in industries in which individual firms were formally prosecuted for collusion).

4. Sample, variables, and summary statistics

4.1. Sample selection

We obtain quarterly institutional holdings for the sample period starting with the first quarter of 1985 and ending with the fourth quarter in 2012 from the 13F filings in the Thomson Reuters database.[9] We obtain portfolio firms' quarterly financial statement data from the merged CRSP/Compustat database. We require firms to have total assets of at least $1 million, net sales of at least $250,000, and net sales greater than earnings before interest and taxes (EBIT).

We group portfolio firms into industries based on their historic four-digit NAICS codes. Compustat assigns firms NAICS codes (NAICSH) starting in 1985. To ensure that our various measures of common ownership (defined below) can be calculated for a meaningful series of industry quar-

[9] The holdings data used in this paper are as reported by Thomson Reuters on July 22, 2018. We end the sample in 2012 due to problems with the Thomson data after this period; see https://wrds-www.wharton.upenn.edu/pages/support/research-wrds/research-guides/research-note-regarding-thomson-reuters-ownership-data-issues/. We filter out cases in which the manager reports multiple positions in the same stock on the same report date, using only the holdings with the latest filing date. We adjust reported holdings for splits that occur between the report date and filing date. We include hand-collected holdings data for BlackRock 2010Q1 and 2010Q2 and JP Morgan 2003Q4 and 2008Q3. To account for reporting gaps, holdings are carried forward one quarter in cases in which the institution skips a reporting period (Griffin and Xu, 2009). As detailed below (footnote 20), we also assess robustness of reported results to aggregating holdings across related institutions with different manager numbers in Thomson using the mapping provided in the replication packet for Azar et al. (2018).

ters, we require each industry to have a series of at least 20 consecutive quarters with at least two firms.[10] There are 269 industries that meet the sample screens. While in papers with other aims, e.g., investigating firm performance relative to rivals or calculating diversification discounts, it is common to require more firms in an industry for inclusion. However, given that fewer firms in an industry facilitates coordination among the firms including punishment for deviations, we set our screen at the minimum number of firms that allow us to calculate industry averages.

To assess robustness of results to the choice of industry classification method, we replicate our tests using industries defined by three-digit SIC codes from Compustat (see, e.g., Kahle and Walkling, 1996) and the product description industry classifications (300 industries) from Hoberg and Phillips (2016). Historic SIC codes (SICH) are available from Compustat starting in 1988, and Hoberg and Phillips (2016) (H&P) codes are available starting in 1996 when electronic 10-K SEC filings became widely available.[11] Thus, samples based on these codes are shorter time series than those using NAICS codes. There are 264 four-digit SIC industries and 261 H&P industries that meet the sample screens. While NAICS and SIC codes classify firms based on their production processes, H&P codes classify firms based on textual analysis of firms' descriptions of the products they supply to the market. One industry classification method might produce more precise estimates than the others to the extent that production processes or product descriptions better produce groupings of competing firms. Ultimately, this is an empirical question. Given that there are advantages and disadvantages of each classification method in terms of resulting sample sizes, comparability of results with prior papers, and compatibility with other U.S. government data, we repeat all of our main tests for each of the three classification methods.

4.2. Variable descriptions

There are trade-offs associated with different common ownership measures, and there does not seem to be consensus among researchers as to which measure best represents common ownership (see, e.g., Gilje et al., 2018). Thus, we use the five measures used by regulators and in prior literature.[12] First, similar to Azar (2011), the density of common ownership (Density) is defined as the ratio of the number of firm-pairs that are connected in an industry over the maximum possible number of firm-pairs in that industry. Two firms are connected when there is an institutional investor (a blockholder) that owns at least 5% of each of the two firms. This measure captures the intensity of pair connections between firms in the industry. Using 5% blockholdings for some of our measures incorporates institutions' incentives and means to influence corporate policy choices.

Second, percentage of common funds (PCF) is defined as the number of blockholders that own two or more companies in the industry over the total number of blockholders in that industry. If no blockholders own two or more companies, PCF will be zero. This definition of common ownership is similar to those in Cohen and Frazzini (2008) and Antón and Polk (2014) in their analyses of common mutual and institutional funds among firms. PCF reflects the strength of tendencies of institutional blockholders to hold multiple firms in the same industry.

Third, percentage of common stocks (PCS) is defined as the maximum number of stocks in an industry with at least one common blockholder divided by the total number of stocks in the industry.[13] This measure captures the degree of connectivity in each industry resulting from block ownership by a common institution.

Fourth, modified Herfindahl-Hirschman index (MHHI) delta is the measure of common ownership developed in Bresnahan and Salop (1986) and O'Brien and Salop (1999). Our construction of this measure follows Kennedy et al. (2017). While the HHI reflects the number and relative market shares of firms in an industry, MHHI delta reflects the extent to which firms in an industry are connected by common ownership and voting rights among institutional investors. MHHI delta is the marginal increase in industry concentration attributable to common ownership and voting control of the firms in the industry by institutional owners. Specifically, MHHI delta in a given quarter and industry is defined as

$$MHHI\ delta = \sum_{j} \sum_{k \neq j} s_j s_k \frac{\sum_i \gamma_{ij} \beta_{ik}}{\sum_i \gamma_{ij} \beta_{ij}}, \tag{1}$$

where j and k index firms in the industry, i indexes institutions, s is the firm's market share, γ is the fraction of voting rights controlled by the institution, and β is the fraction owned. In calculating MHHI delta and C (defined below), voting rights are based on the sum of the institution's shared and sole voting shares. Furthermore, only institutions' positions (the sum of shared, sole, and nonvoting shares) greater than 0.5% are considered, and positions are rescaled to add up to 100%.

Fifth, C is the average across all pairs of firms in an industry of the "common ownership incentive term," which, as defined in Kennedy et al. (2017), equals $\frac{\sum_i \gamma_{ij} \beta_{ik}}{\sum_i \gamma_{ij} \beta_{ij}}$ for the jk firm-pair. The common ownership incentive term reflects the extent to which firms in an industry are connected by common ownership and voting control among

[10] For firm-years with assigned NAICS codes that are less than six digits, we replace the NAICS codes for those years with the most recently reported six-digit code assigned to that firm prior to shortening the code to four digits. Federal statistical agencies in the U.S. formally adopted NAICS for classifying business establishments into industries in 1997. Code definitions are held constant between economic censuses that are conducted in all years ending with a seven or a two. Thus, 20 quarters is the minimum number of quarters for which an industry's definition could not change. We allow industry definitions to change over our sample for one to many and many to one changes. However, we retain earlier industry definitions when there is a one-to-one change to maximize series lengths.

[11] http://hobergphillips.tuck.dartmouth.edu/.

[12] The measures of common ownership used in this paper for each of the three industry definitions are available for download at Andrew Koch's website.

[13] The maximum number of stocks in an industry with at least one common blockholder can be zero if there are no blockholders or one if only one stock has a blockholder.

Table 1
Summary statistics.
This table presents summary statistics for quarterly industry-level common ownership, profitability, and other variables used in our analysis. Variables are defined in Appendix A. Data are from Thomson Reuters 13F, CRSP, and Compustat for the period starting with the first quarter of 1985 and ending with the fourth quarter of 2012. At the firm level, we require firms to have total assets of at least $1 million, net sales of at least $250,000, and net sales greater than EBIT. Industries are defined using four-digit NAICS codes. We require industries to have at least two firms in every industry-quarter for a minimum of 20 consecutive quarters to remain in the sample. There are 269 industries that meet the sample screen.

	Mean	Std. dev.	P25	Median	P75	N
Common ownership measures						
Density	0.094	0.151	0.000	0.040	0.121	24,441
Δ Density	0.002	0.087	- 0.003	0.000	0.006	24,065
PCF	0.157	0.136	0.000	0.154	0.250	24,441
Δ PCF	0.001	0.075	- 0.018	0.000	0.022	24,065
PCS	0.279	0.173	0.154	0.250	0.353	24,441
Δ PCS	0.003	0.082	- 0.011	0.000	0.015	24,065
MHHI delta	1,359.247	993.018	592.683	1,188.514	1,968.982	24,441
Δ MHHI delta	9.229	462.505	-133.913	4.464	161.842	24,065
C	0.155	0.100	0.096	0.142	0.196	24,441
Δ C	0.001	0.056	- 0.013	0.000	0.016	24,065
Other industry variables						
Markup	1.110	0.229	1.026	1.067	1.123	24,441
PCM	0.292	0.172	0.206	0.295	0.387	24,400
Net CAPX	0.004	0.010	- 0.002	0.002	0.008	24,373
Advertising	0.033	0.036	0.011	0.023	0.043	19,756
Off degree (× 1,000)	0.003	0.003	0.000	0.003	0.006	24,441
Firms with blocks	0.675	0.223	0.500	0.682	0.833	24,441
1 / no. firms	0.143	0.136	0.042	0.091	0.200	24,441
HHI	3,269.033	2,159.312	1,650.625	2,726.358	4,450.853	24,441
ln(Assets)	9.146	2.096	7.780	9.060	10.457	24,441
Sales growth	0.749	18.524	- 0.056	0.026	0.117	24,391
Capital intensity	5.732	8.034	2.689	3.735	5.630	24,441
R&D intensity	0.002	0.006	0.000	0.000	0.001	24,441
R&D missing	0.378	0.485	0.000	0.000	1.000	24,441
Leverage	0.297	0.196	0.147	0.261	0.413	24,438
Concentrated	0.283	0.450	0.000	0.000	1.000	24,441
Private, family, or dual	0.761	0.427	1.000	1.000	1.000	24,441
Cartel	0.217	0.412	0.000	0.000	0.000	24,441
Coverage	0.314	0.464	0.000	0.000	1.000	24,441
Balanced panel	0.563	0.496	0.000	1.000	1.000	24,441

institutional investors but does not depend on the respective market shares of firms in the industry.

To measure industry profitability, we use two distinct measures. The first measure, Markup, is computed from quarterly firm-level Compustat information. We calculate Markup as the average for all firms j in industry i in period t where firm-level markup is defined for firm j at time t as

$$Markup_{j,t} = \frac{Sales_{j,t}}{Sales_{j,t} - EBIT_{j,t}}, \tag{2}$$

where $EBIT_{j,t}$ is earnings before interest and taxes for firm j at time t. Thus, Markup is the average within an industry of firms' ratios of revenues over costs.[14] This same definition is also used in Azar (2011).

The second measure, *PCM*, is also computed from quarterly firm-level Compustat information. In particular, following Domowitz et al. (1987) and Phillips (1995), for each industry i for each period t, $PCM_{i,t}$ is defined as

$$PCM_{i,t} = \frac{Sales_{i,t} - Cost\ of\ goods\ sold_{i,t} + \Delta Inventories_{i,t}}{Sales_{i,t} + \Delta Inventories_{i,t}}, \tag{3}$$

where changes in inventory are added back to margins to reflect changes in input prices not yet reflected in current sales.

4.3. Summary statistics

Table 1 presents summary statistics, at the industry level, for the variables used in our study. Average quarterly levels and changes for the five measures of institutional common ownership are reported. As is also evident from Fig. 1, average quarterly changes in common ownership are positive over the sample period regardless of how common ownership is measured. While not reported in the table, the common ownership measures are positively correlated. However, the correlations vary substantially from 0.06 to 0.76 across the five measures. Summary statistics for the remaining industry-level variables used in

[14] It should be noted that the denominator measures average cost and not marginal cost. The measure does not reflect interest expense or the cost of equity capital.

our analyses, including the profitability measures, are also reported. Markups average 1.110. The average PCM is 0.292 over the sample period. The correlation between Markups and PCMs is 0.20. For our regression specifications, we use a number of control variables. These are described in detail in Appendix A. Firm-level scaled financial variables are winsorized at the 1st and 99th percentiles. Summary statistics for the samples formed using alternative industry definitions are reported in the Internet Appendix.

Much of our analysis is also conducted on subsamples of industries in which coordination is, a priori, more likely or certain selection biases are lessened. We identify where collusion via common ownership is expected to be facilitated (i.e., concentrated industries, industries in which firms were prosecuted for collusion during the sample period, and industries without large privately held, family-held, or dual class firms). We define concentrated industries as those in the top tercile of the time-series average HHI and code an indicator variable, Concentrated, to be one for these industries and zero for all others. We identify industries with large private firms using the 2008 list of Forbes' largest private firms. The list contains the 241 private firms in the U.S. with estimated sales greater than $1 billion. We assume that these firms were present in their respective industries for all years in our sample period (e.g., Cargill, Inc).

We identify industries with family firms or dual class firms using the data from Anderson and Reeb (2003), Anderson et al. (2009), and Anderson et al. (2012) that, respectively, identify family firms among the firms in the S&P 500 and family or dual class firms among the largest 2,000 firms in Compustat. The private, family, and dual class identifiers are not available for all firms and all years of our sample. Thus, we use the series for the years they are available, frontfill and backfill data for firms in the series, and classify firms not in the series as not being family or dual class firms. We code an indicator variable that takes a value of one if an industry has any large Private, Family, or Dual Class firms present and zero otherwise. We also identify industries in which individual firms were formally prosecuted for collusion by U.S. authorities using the Private International Cartels (PIC) data set.[15] We code an indicator variable, Cartel, that takes a value of one if an industry participant was prosecuted for collusion sometime during our sample period.

We also conduct our tests in subsamples of industries for which potential selection bias due to requiring firms to have public equity is smaller and in subsamples of industries for which substantive changes have not been made to industry codes (see, e.g., Ali et al., 2008). Given the industries in our sample are defined and constituted by the firms on the merged CRSP/Compustat database, the industries do not generally reflect the actions of firms without public equity. We can observe the operations of some firms without public equity, e.g., those with only public debt, by forming industries requiring that firms only be on Compustat but not on CRSP. To investigate the influence of potential selection bias from excluding firms without public equity, we report results for the subsamples of industries where CRSP/Compustat firms in an industry "cover" at least 95% of the firms in the industry based on Compustat alone. We code an indicator variable, Coverage, that takes a value of one when coverage is at least 95% of firms.[16] Changes in industry classifications codes (one to many and many to one) result in changes in common ownership that are not necessarily driven by changes in institutional holdings. Also, cartelization is positively related to industry stability (see, e.g., Levenstein and Suslow, 2006). Thus, we conduct our tests on the subsample of industries for which changes to NAICS codes across quinquennial economic censuses did not affect a four-digit code during the entire sample period. We code an indicator variable, Balanced Panel, to take a value of one for all four-digit NAICS industries for which code changes were not applicable and the industry has at least 110 consecutive quarters with at least two firms.

4.4. Additional descriptive statistics regarding changes in common ownership

Table 2 reports several details of instances during the sample period in which an industry experienced a significant increase in Density during a particular quarter. We define a significant increase as a quarterly change in Density that exceeds by two standard deviations the industry's average time-series change for the entire sample period. While we use this sample as part of an operating performance event study below, several details for this sample are reported here to further characterize the industries and institutional investors that have contributed to the overall increases in common ownership exhibited in Fig. 1.

Panel A reports the industries and quarters in which large increases in Density occurred for a random sample of ten of these events. We also report the institution(s) deemed "responsible" for the change. Specifically, in the right column of Panel A, we report the institutions with the largest increase in the number of block positions in firms in that industry during that quarter. Panel B reports the institutions that are most frequently responsible for significant increases in common ownership across the entire sample. We also report the institution type following Bushee (1998) and Bushee and Goodman (2007). Not surprisingly, the list includes several of the largest institutions. Fidelity, BlackRock, and Barclays are each present in more than 100 events. As is evident in Panel C, there is considerable variation in the industries involved, with nearly all NAICS two-digit sectors in our sample experiencing significant increases among their four-digit subindustries.[17] Manufacturing industries (sectors 31–33) account for 39% of the observed significant increases.

[15] PIC spreadsheet by John M. Connor, Professor Emeritus, Purdue University, Indiana, U.S. (2018).

[16] As detailed in Section 6, we also use a subsample of manufacturing industries that includes data on many private firms.

[17] NAICS sector "Management of Companies and Enterprises" is the only sector in our sample without a significant increase in common ownership.

Table 2
Descriptive statistics regarding large increases in common ownership.
The table reports the names and characteristics of 13F blockholder institutions that are related to significant quarterly increases in common ownership measured using Density. Our sample consists of 269 industries from 1985–2012. We focus on 651 industry-quarters where the increases in Density are more than two standard deviations beyond the mean quarterly change. Panel A reports the 13F blockholder institutions that caused the increase in common ownership for a random sample of ten events. Panel B reports the frequency with which certain blockholders are identified across all 651 events and the institution type (bank trust, investment company, independent investment advisor) following Bushee (1998 and 2007). Panel C reports the frequency of events by each two-digit NAICS sector.

Panel A: Random sample of 10 large increases in Density

NAICS	Description	Date	Δ Density	Institutions
2131	Support activities for mining	19932	0.1223	FIDELITY UNION TR CO
3321	Forging and stamping	19934	0.1429	DIMENSIONAL FUND ADVS.
2349	Other heavy construction	19972	0.0542	FIDELITY UNION TR CO
				WELLINGTON/THORNDIKE
2131	Support activities for mining	20032	0.0980	FIDELITY UNION TR CO
3371	Household and institutional furniture and kitchen cabinet manufacturing	20053	0.0882	AMVESCAP PLC LONDON
				BRANDES INVESTMENT MGMT
				DIMENSIONAL FUND ADVS.
				FIRST UNION NAT BK N C
				FRANKLIN RESOURCES
				HOTCHKIS & WILEY CAP MGMT, LLC
				MARINE BK SPRINGFIELD
				QUEST ADVISORY CORP.
				TWEEDY BROWNE INC
4541	Electronic shopping and mail-order houses	20054	0.0385	FIDELITY UNION TR CO
3279	Other nonmetallic mineral product mfg.	20104	0.1667	DIMENSIONAL FUND ADVS.
				HARVEY PARTNERS, LLC
4482	Shoe stores	20113	0.2667	FIDELITY UNION TR CO
3255	Paint, coating, and adhesive manufacturing	20114	0.1905	BLACKROCK, INC.
5616	Investigation and security services	20114	0.1667	HOUND PARTNERS, LLC

Panel B: Frequency by institution of large increases in Density

Institution	Type	Frequency
FIDELITY UNION TR CO	INV	187
BARCLAYS BANK LIMITED	BNK	118
BLACKROCK, INC.	IIA	109
DIMENSIONAL FUND ADVS.	IIA	98
WELLINGTON/THORNDIKE	IIA	50
VANGUARD GROUP INC	INV	33
PRICE T ROWE ASSOCIATES	IIA	27
QUEST ADVISORY CORP.	IIA	24
NATIONSBANK CORPORATION	BNK	20
MORGAN STANLEY INC	IIA	18
MELLON NATIONAL CORP	BNK	17
PUTNAM MANAGEMENT	IIA	17
EQUITABLE LF ASSUR/U S	INS	16
FMR CORP	IIA	16
PIMCO ADVISORS L P	INV	16
FRANKLIN RESOURCES	INV	13
GOLDMAN SACHS & CO	IIA	12
CAPITAL RESEARCH + MGMT	INV	11

Panel C: Frequency by NAICS sector of large increases in Density

NAICS Sector	Description	Frequency
11	Agriculture, forestry, fishing and hunting	8
21	Mining, quarrying, and oil and gas extraction	16
22	Utilities	7
23	Construction	24
31	Manufacturing	48
32	Manufacturing	63
33	Manufacturing	140
42	Wholesale trade	31
44	Retail trade	42
45	Retail trade	21
48	Transportation and warehousing	35
49	Transportation and warehousing	4
51	Information	30
52	Finance and insurance	21
53	Real estate and rental and leasing	24
54	Professional, scientific, and technical Services	22
56	Administrative and support and waste management and remediation services	35
61	Educational services	15
62	Health care and social assistance	31
71	Arts, entertainment, and recreation	12
72	Accommodation and food services	4
81	Other services (except public administration)	18

5. Results

5.1. Structural break analysis

We initially investigate whether significant increases and decreases in common ownership of industries are followed by changes in industry participants' operations. We identify significant changes in common ownership in two ways. First, any quarterly change that is more than two standard deviations beyond the industry's mean quarterly change is defined as significant. Second, we identify structural breaks in a simple model in which common ownership is a function of a time-varying level and an error term: $y_t = \mu_t + \epsilon_t$, where y_t is one of the five measures of common ownership, $\mu_t = \mu_{t-1} + \eta_t$, and ϵ_t and η_t are independent identically distributed mean zero random variables. Any level shift that is statistically significant at the 5% level is determined to be a structural break in common ownership. Changes in operations are measured as the industry average over the four quarters subsequent to the ownership change (quarter $t = 1$ to $t = 4$) minus the industry average over the four quarters immediately prior to the change (quarter $t = -4$ to $t = -1$).

With five measures of common ownership, two measures of industry profitability, and two methods for identifying events, the event study analysis results in 20 test statistics for events involving large increases in common ownership. As reported in Table 3, in only three cases out of 20 do industries that experience large increases in common ownership subsequently exhibit significantly increased markups or PCMs. Thus, while it is possible to observe a relation supportive of the COC hypothesis under several reasonable permutations of ownership measure, etc., the predominant evidence is inconsistent with the COC hypothesis.

While Fig. 1 illustrates that the overall trend has been toward greater common ownership, we also examine events where individual industries experience large decreases in common ownership over a short period. There are indeed somewhat fewer industries that have experienced large decreases than large increases. However, large decreases followed by reduced profitability suggests a breakdown in coordination (i.e., implies the prior existence of coordination). There are 20 test statistics for large decreases. In the only instance in which large decreases in common ownership are significantly related to industry profitability, the relation is positive, contrary to the predictions of the COC hypothesis.[18]

In the Internet Appendix, we report event study results for the various subsamples. Increases in common ownership are not associated with increased profitability in concentrated industries, industries with prosecutions of collusion, etc. Event study results, reported in the Internet Appendix, using industries defined by three-digit SIC codes and H&P 300 fixed industry classifications are quite similar to those for NAICS and lead us to draw similar conclusions.

Taken together, the findings reported in Table 3 and the Internet Appendix indicate that large changes in common ownership over short periods of time are not reliably associated with changes in Markups or PCMs, even in subsamples of industries where conditions favor coordination, in a manner consistent with the predictions of the COC hypothesis.

With the obvious caveat that any changes in the intensity of nonprice competition due to increased common ownership have not apparently resulted in significantly increased industry profitability, we also examine changes in non-price competition. The results of these tests are reported in the Internet Appendix. Following increases in common ownership, we do not consistently observe significant reductions in net capacity investment (i.e., in capital expenditures net of depreciation). This finding is inconsistent with industry participants increasing the stability of collusive arrangements by decreasing participants' abilities to deviate and produce above the collusive quantity (see, e.g., Jacquemin and Slade, 1989). While we observe some instances of significant reductions in advertising following increased common ownership, the results are not robust to seemingly reasonable changes in industry definitions. This finding is inconsistent with industry participants reducing combative advertising, as would be predicted by the COC hypothesis.[19]

5.2. Common ownership and profitability regressions

We estimate multivariate regressions that explain industry-level Markups and PCMs with measures of common ownership, controls for other aspects of institutional ownership, and controls for differences in industry structure. Table 4 reports results of candidate regressions that explain Markups with common ownership, as measured by Density, and using the full sample. All specifications include quarter fixed effects. Industry fixed effects are included where indicated. Standard errors are robust to heteroskedasticity and are clustered at the industry level. The first column reports results where only quarter fixed effects are included. The coefficient on Density is negative and significant at conventional levels. However, as reported in column 2, the relation between Density and Markups is insignificant in the presence of both time and industry fixed effects. Column 3 reports results when the control variables from Azar (2011) are added. Again, the coefficient on density is insignificant in contrast with a significant positive relation between Density and Markups documented in Azar (2011) and thus is inconsistent with the COC hypothesis. Column 4 reports results when the control variables are replaced with those used to explain

[18] In addition to purchases and sales of common stock by institutions, changes in common ownership could be observed due to individual firms entering or exiting an industry, changes to firms' respective industry codes, etc. Thus, we do not assess the joint significance of outcomes within our univariate analysis. However, in the multivariate regressions below, where we can better isolate the effects of changes in institutions' holdings, we conduct extensive joint significance testing of results.

[19] As reported in the Internet Appendix, we confirm that changes in Cost of goods sold (COGS) are not significant. Thus, it does not appear as if greater common ownership of an industry generally results in greater bargaining power with suppliers, as has been documented for horizontal mergers (see, e.g., Fee and Thomas, 2004; Shahrur, 2005; Bhattacharyya and Nain, 2011).

Table 3
Changes in profitability around large changes in common ownership.
This table reports changes in profitability around large quarterly changes in common institutional ownership. We identify large changes in two ways. First, quarterly changes in industry common ownership of more than two standard deviations beyond the mean industry quarterly change are defined as significant. Second, we identify structural breaks using a simple model in which common ownership is a function of a time-varying level and an error term. Any industry-level shift that is statistically significant at the 5% level is determined to be a significant change in common ownership. Changes in profitability are measured as the industry average over the four quarters subsequent to the change (quarter t = 1 to t = 4) minus to the industry average over the four quarters prior to the change (quarter t = - 4 to t = - 1). Variables are defined in Appendix A. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Inc./Dec.	2 S.D./S.B.	Profitability	C.O.	Pre	Post	Diff.	*t*-statistic	N
Increase	2SD	Markup	Density	1.111	1.109	- 0.001	(- 0.47)	651
Increase	2SD	Markup	PCF	1.097	1.096	- 0.001	(- 0.17)	586
Increase	2SD	Markup	PCS	1.116	1.115	- 0.002	(- 0.72)	722
Increase	2SD	Markup	MHHI delta	1.110	1.115	0.005	(2.00)**	619
Increase	2SD	Markup	C	1.098	1.101	0.003	(0.81)	587
Increase	2SD	PCM	Density	0.311	0.309	- 0.003	(- 0.90)	651
Increase	2SD	PCM	PCF	0.283	0.288	0.005	(1.58)	586
Increase	2SD	PCM	PCS	0.306	0.309	0.003	(1.00)	722
Increase	2SD	PCM	MHHI delta	0.287	0.292	0.005	(1.72)*	617
Increase	2SD	PCM	C	0.280	0.281	0.002	(0.42)	586
Increase	SB	Markup	Density	1.113	1.118	0.005	(0.58)	102
Increase	SB	Markup	PCF	1.116	1.128	0.012	(1.57)	98
Increase	SB	Markup	PCS	1.096	1.109	0.013	(2.20)**	118
Increase	SB	Markup	MHHI delta	1.137	1.145	0.008	(0.77)	90
Increase	SB	Markup	C	1.087	1.095	0.008	(0.87)	77
Increase	SB	PCM	Density	0.317	0.317	0.000	(- 0.04)	102
Increase	SB	PCM	PCF	0.310	0.322	0.012	(1.38)	98
Increase	SB	PCM	PCS	0.299	0.304	0.005	(0.68)	118
Increase	SB	PCM	MHHI delta	0.303	0.315	0.012	(1.57)	90
Increase	SB	PCM	C	0.278	0.275	- 0.003	(- 0.39)	77
Decrease	2SD	Markup	Density	1.107	1.106	- 0.001	(- 0.33)	552
Decrease	2SD	Markup	PCF	1.104	1.105	0.001	(0.26)	624
Decrease	2SD	Markup	PCS	1.118	1.118	0.000	(- 0.14)	611
Decrease	2SD	Markup	MHHI delta	1.113	1.117	0.004	(1.37)	637
Decrease	2SD	Markup	C	1.103	1.105	0.003	(0.84)	579
Decrease	2SD	PCM	Density	0.307	0.305	- 0.002	(- 0.46)	552
Decrease	2SD	PCM	PCF	0.290	0.291	0.001	(0.35)	623
Decrease	2SD	PCM	PCS	0.304	0.306	0.002	(0.55)	611
Decrease	2SD	PCM	MHHI delta	0.295	0.295	0.000	(- 0.14)	637
Decrease	2SD	PCM	C	0.284	0.290	0.006	(1.44)	579
Decrease	SB	Markup	Density	1.105	1.119	0.014	(1.62)	79
Decrease	SB	Markup	PCF	1.131	1.139	0.008	(0.86)	77
Decrease	SB	Markup	PCS	1.126	1.140	0.014	(1.53)	83
Decrease	SB	Markup	MHHI delta	1.113	1.120	0.008	(0.87)	80
Decrease	SB	Markup	C	1.107	1.102	- 0.005	(- 0.42)	69
Decrease	SB	PCM	Density	0.287	0.315	0.028	(2.56)**	79
Decrease	SB	PCM	PCF	0.297	0.295	- 0.002	(- 0.20)	77
Decrease	SB	PCM	PCS	0.279	0.289	0.010	(1.04)	83
Decrease	SB	PCM	MHHI delta	0.286	0.280	- 0.006	(- 0.81)	80
Decrease	SB	PCM	C	0.294	0.294	0.000	(- 0.02)	69

changes in industry profitability around full and partial horizontal mergers and large changes in leverage (see, e.g., Phillips, 1995; Bhattacharyya and Nain, 2011; Nain and Wang, 2018). The coefficient on Density is not significant at conventional levels in the presence of these variables. Column 5 reports results when the combined set of control variables is used, and the coefficient on Density is again not significant.

We use the specification from column 5 of Table 4 as our base specification and vary the measures of profitability (two), the measures of common ownership (five), and the sample used (six), resulting in a total of 60 regressions. The 60 common ownership coefficients, *t*-statistics, and numbers of observations from these respective regressions are reported in Table 5. Regardless of how we vary the parameters, we do not frequently observe a significant positive relation between changes in common ownership and changes in industry profitability, which is inconsistent with the COC hypothesis.[20] To investigate the possibility that our subsample characteristics are actually substitutes for common ownership, and its effects are stronger in the subsamples of unconcentrated industries, industries with

[20] We assess the robustness of our reported results to aggregating holdings across related institutions with different manager numbers in Thomson. We use the mapping provided in the replication packet for Azar et al. (2018) that covers institutions that own 88% of assets under management in our sample. As reported in Table IA 14, results using these aggregated holdings are very similar to those when we use the manager numbers, as assigned by Thomson, without any further aggregation.

Table 4
Panel regressions of industries' markups on density.
This table reports the results of multivariate OLS regressions explaining industry-level Markups with Density and controls for other aspects of institutional ownership and for differences in industry structure. All specifications include quarter fixed effects. Industry fixed effects are also included where indicated. Standard errors are robust to heteroskedasticity and are clustered at the industry level. Variables are defined in Appendix A. *t*-statistics are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)
Density	- 0.074**	0.003	- 0.004	0.003	- 0.004
	(- 2.023)	(0.327)	(- 0.391)	(0.299)	(- 0.403)
Off degree (x 1,000)			- 1.741*		- 1.691*
			(- 1.911)		(- 1.920)
ln(Assets)			0.013***		0.018**
			(2.733)		(2.268)
1 / no. firms			0.188***		0.202***
			(3.639)		(2.844)
HHI			- 0.000***		- 0.000***
			(- 3.279)		(- 2.959)
Firms with blocks			0.019*		0.018
			(1.747)		(1.474)
Capital intensity				- 0.001	- 0.001
				(- 0.322)	(- 0.434)
Sales growth				0.000**	0.000**
				(2.316)	(2.202)
R&D intensity				- 0.189	- 0.200
				(- 0.420)	(- 0.446)
R&D missing				0.011*	0.012**
				(1.819)	(2.092)
Leverage				- 0.053**	- 0.065***
				(- 2.567)	(- 3.334)
Quarter effects	Y	Y	Y	Y	Y
Industry effects	N	Y	Y	Y	Y
Observations	24,441	24,441	24,441	24,388	24,388
R^2	0.008	0.026	0.038	0.033	0.048
Industries		269	269	269	269

no history of cartelization, etc., we also report results for the complementary subsamples in the Internet Appendix. The results are largely the same (i.e., insignificant coefficients are by far the most frequent outcome).

These results are in contrast to previous literature. In terms of economic effects, in a specification most comparable to those above, Azar et al. (2018) report a 4.3% increase in airline ticket prices as common ownership increases from the 25th to the 75th percentiles. Of the 60 coefficients in Table 5, one is marginally significantly positive, one marginally significantly negative, and the rest are indistinguishable from zero. The significant positive coefficient of 0.023 (obtained using PCS and Markups) suggests a 0.4% increase in Markups as common ownership increases from the 25th to 75th percentiles, and the negative coefficient of - 0.079 (obtained using C and Markups) suggests Markups drop by 0.7% for the same increase in common ownership. Even in cases in which statistical significance is obtained, economically, the effect is close to zero.[21];[22]

While Table 4 offers an indication of how changes in specifications affect our results, we provide additional information regarding specification changes in the Internet Appendix and summarize it here. None of the common ownership variables are significant in univariate regressions explaining profitability. Adding time fixed effects produces a few negative and significant coefficients on common ownership but does not increase adjusted R^2s.[23] We note that replacing the time fixed effects with industry-specific time trend variables does not alter these results. Adding only industry fixed effects to the univariate regressions results in three of five positive and significant coefficients on common ownership and dramatically larger adjusted R^2s, and including both time and industry fixed effects reduces this to two significant coefficients. Including the control variables from Azar (2011) and Nain and Wang (2018) and excluding any fixed effects results in only one significant coefficient on common ownership. Adding time and industry fixed effects in the presence of the controls results in only one significant coefficient on common

[21] Price effects are directly comparable to effects on Markups (a 4.3% increase in price is equivalent to an increase in Markup by 4.3%) if any common-ownership-driven price increase is pure profit and costs are not affected.

[22] When repeating the same tests using SIC-defined industries, we find one significant result which implies Markups drop by 1.7% as common ownership increases from the 25th to 75th percentile. We find no significant results using H&P in the full sample, however there are several positive and significant results among concentrated industries. Here the largest economic effect we estimate is an increase in Markups of 1.8% for the same change in common ownership.

[23] For these results, we report R^2s that reflect variation in all independent variables including time and industry effects.

Table 5
Panel regressions of industry profitability on institutional common ownership, summary of results.
This table reports the results of multivariate OLS regressions explaining industry-level profitability with common ownership and controls for other aspects of institutional ownership and for differences in industry structure. The specification is the same as column 5 from Table 4. All specifications include industry and quarter fixed effects. Standard errors are robust to heteroskedasticity and are clustered at the industry level. Variables are defined in Appendix A. *t*-statistics are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

			Subsample				
Profitability	C.O.	Full	Concen-trated=1	Private, family, dual=0	Cartel=1	Cover-age=1	Balanced panel=1
		Coefficient					
Markup	Density	- 0.004	- 0.012	0.013	- 0.028	- 0.007	- 0.013
	PCF	- 0.001	0.001	0.032	- 0.027	- 0.038	0.029
	PCS	0.023*	- 0.010	0.027	- 0.000	- 0.003	0.011
	MHHI delta	0.000	- 0.000	- 0.000	0.000	0.000	0.000
	C	- 0.006	- 0.038	- 0.079*	0.057	0.003	0.012
PCM	Density	- 0.003	0.018	0.014	- 0.002	0.017	- 0.004
	PCF	0.010	0.037	0.043	- 0.043	0.022	0.003
	PCS	- 0.001	0.008	0.013	0.012	0.016	0.003
	MHHI delta	- 0.000	- 0.000	- 0.000	- 0.000	0.000	0.000
	C	- 0.030	- 0.043	- 0.082	0.006	0.020	- 0.033
		t-statistic					
Markup	Density	(- 0.403)	(- 0.914)	(0.686)	(- 1.560)	(- 0.551)	(- 0.880)
	PCF	(- 0.055)	(0.019)	(0.919)	(- 1.045)	(- 1.511)	(1.234)
	PCS	(1.839)	(- 0.668)	(1.219)	(- 0.016)	(- 0.193)	(0.738)
	MHHI delta	(1.121)	(- 0.838)	(- 0.707)	(1.178)	(0.933)	(0.674)
	C	(- 0.291)	(- 1.139)	(- 1.886)	(1.408)	(0.108)	(0.325)
PCM	Density	(- 0.184)	(0.958)	(0.630)	(- 0.095)	(0.740)	(- 0.258)
	PCF	(0.505)	(1.111)	(1.206)	(- 0.865)	(0.649)	(0.131)
	PCS	(- 0.067)	(0.259)	(0.461)	(0.510)	(0.566)	(0.142)
	MHHI delta	(- 0.438)	(- 1.256)	(- 1.322)	(- 0.659)	(0.516)	(0.730)
	C	(- 1.182)	(- 0.953)	(- 1.559)	(0.156)	(0.479)	(- 1.072)
		N					
Markup	Density	24,388	6,886	5,831	5,305	7,887	13,755
	PCF	24,388	6,886	5,831	5,305	7,887	13,755
	PCS	24,388	6,886	5,831	5,305	7,887	13,755
	MHHI delta	24,388	6,886	5,831	5,305	7,887	13,755
	C	24,388	6,886	5,831	5,305	7,887	13,755
PCM	Density	24,377	6,875	5,824	5,302	7,883	13,753
	PCF	24,377	6,875	5,824	5,302	7,883	13,753
	PCS	24,377	6,875	5,824	5,302	7,883	13,753
	MHHI delta	24,377	6,875	5,824	5,302	7,883	13,753
	C	24,377	6,875	5,824	5,302	7,883	13,753

ownership, albeit for a different measure of common ownership than the one significant without the fixed effects. Adding other measures of institutional ownership, i.e., total institutional ownership of the industry and ownership by the top five institutions, does not alter reported results. In summary, there are no significant results in univariate specifications and also in specifications with exhaustive fixed effects and controls. Specifications in between these extremes at times produce significant coefficients of either sign.

We also examine the variance inflation factors (VIFs) for common ownership. In only two of 35 instances are the VIFs greater than 10; however, the coefficient on common ownership is actually significant in one of the instances. Further, the inclusion of HHI does not increase the VIFs of our measures of common ownership, including MHHI delta, which incorporates market shares, suggesting that multicollinearity is not a concern.

It is possible that we do not detect a relation between industry profitability and common ownership because the effects of common ownership are not homogeneous among the firms within industries, i.e., some firms benefit and some are harmed by changes in common ownership leaving the average unchanged, and this heterogeneity is not reflected in our previously described sample splits. Thus, we have also examined relations between common ownership and measures of the variability in intra-industry profitability (i.e., the standard deviation of firm profitability and the difference between the 10th and 90th percentiles of firm profitability). As reported in the Internet Appendix, insignificant coefficients are the most frequent outcome, with significant coefficients split between positive and negative, suggesting that the lack of a relation between average profitability and common ownership is not due to heterogeneous effects within industries. It may also be that our construction of industry profitability (as the simple equal-weighted industry average) is not correct. Thus, we have repeated the analysis in Table 5 using the market-share-weighted average industry profitability as the dependent variable. As reported in the Internet Appendix, none of the common ownership coefficients is significant.

We also investigate the possibility that any relation between common ownership and profitability is nonlinear (i.e., there are thresholds below which the impact on competitiveness is zero). We do this by replacing our continuous measures of common ownership with indicators that take a value of one if common ownership is above a stated threshold (i.e., the median, 75th percentile, or 90th percentile). The results reported in the Internet Appendix do not support a conclusion that a positive relation is more frequently observed when our common ownership variables are converted to dummy variables that take a value of one above certain levels of common ownership.

As detailed in the Internet Appendix, when our base specification is run on the samples constructed with alternative industry classifications, the tenor of the results is quite similar. Specifically, the only significant common ownership coefficients when using SIC codes to define industries are actually negative, which is again inconsistent with the COC hypothesis. While the results for the overall sample when industries are defined using H&P codes offer no support for the COC hypothesis, the results when using the subsample of concentrated industries and measuring profitability with Markups are somewhat consistent with the predictions of the COC hypotheses (i.e., three significantly positive coefficients on the five common ownership measures). However, changing the profitability measure to PCMs for this same subsample renders one of the three coefficients insignificant and drops the significance of the remaining two coefficients to only marginal significance.

Taken together, the evidence from the regressions does not support accepting the COC hypothesis. That a certain few reasonable choices of combinations of industry definitions, subsamples, profitability measures, and common ownership measures generate evidence consistent with the COC hypothesis, but the vast majority of other equally reasonable choices do not, potentially explains why several prior papers reach differing or even opposing conclusions regarding the relation between common ownership and industry profitability.

We also run regressions explaining Net CAPX and Advertising, respectively, with common ownership and the same controls as our base specification. Using two measures of nonprice competition and the same combinations of ownership measures and samples used previously, we estimate 60 regressions in total. The 60 common ownership coefficients, *t*-statistics, and numbers of observations from these respective regressions are reported in the Internet Appendix. While there are several negative and significant coefficients, we do not find consistent evidence of a negative relation between common ownership and changes in capacity or market share investment, as would be predicted by the COC hypothesis. We note that any reductions in other spending on nonprice competition (specifically Selling, general and administrative expense (SG&A), R&D, or COGS) associated with increased common ownership are also evidently not large enough in combination to result in significantly increased Markups or PCMs.

5.3. Plausibly exogenous changes in common ownership

Our event study and regression results do not rely on exogenous variation in common ownership. These tests may be misspecified if, for example, there is some variable that when omitted from empirical tests obscures the true relation between common ownership and measures of COC. Furthermore, the COC hypothesis stipulates a causal effect of common owners. Therefore, to more directly address the causal nature of the proposed relation, we follow He and Huang (2017), Azar et al. (2018), and Lewellen and Lowry (2018) and use changes in common ownership that are driven by mergers of financial institutions. Our identifying assumption is that any changes in common ownership due to the mergers were incidental in the decisions to merge. As the majority of the mergers were the result of consolidation in the commercial banking industry, it seems unlikely that the respective portfolio holdings of the institutional investment divisions of the merging banks played a role in the decisions to merge.

We use 48 mergers that occur during our sample period and satisfy the conditions described in Section 4.2 of He and Huang (2017). We compare actual measures of common ownership in the quarter prior to a given merger announcement to counterfactual measures computed under the assumption that the two institutions had already merged. Table 6 summarizes these differences between actual and counterfactual measures of common ownership, which we refer to as implied changes, for all mergers in our sample. We find that the implied changes in Density, PCF, and PCS are very small. However, roughly 25% of industries in the quarter prior to a merger have implied increases in MHHI delta and C due to the mergers. We define these industries with positive implied changes in MHHI delta or C as treated.

Interestingly, Table 6 also reports that the mergers imply a drop in MHHI delta and C in more than 5% of industries. This is counterintuitive, as one might expect a measure of common ownership to increase when owners become common.[24] This simple result alone has potential policy implications. Policymakers are currently debating whether we should limit the scale of large institutional investors. If either MHHI delta or C is the “true” measure of common ownership and we accept that common ownership has negative anticompetitive effects that outweigh any benefits, then it is still not the case that policymakers should necessarily limit the scale of large institutions. In fact, 5% of the time (according to the mergers in our sample), policymakers should encourage mergers among large institutions in order to limit the potential negative anticompetitive effects of common ownership. Of course, an

[24] Consider an example with three institutions (A, B, C) and two firms (1, 2). Assume that each institution has 10% of firm 1’s ownership and voting. Regarding firm 2, institution A has zero voting and ownership, B has zero voting and 10% ownership, and C has 10% of both voting and ownership. In this case, if institutions A and B merge, common ownership, as measured by MHHI delta and C, will drop.

Table 6
The implied effects of mergers of institutions on common ownership.
This table summarizes the implied changes in five measures of common ownership resulting from 48 mergers of institutional investors. The implied change is the actual common ownership measure in the quarter prior to the merger announcement minus the counterfactual measure computed under the assumption that the merger has already taken place. Variables are defined in Appendix A.

Implied change in:	Min.	P1	P5	P10	P25	Median	P75	P90	P95	P99	Max.
Density	0	0	0	0	0	0	0	0	0	0.0083	1
PCF	- 0.047	0	0	0	0	0	0	0	0	0.0138	0.333
PCS	0	0	0	0	0	0	0	0	0	0	0.5
MHHI delta	- 251.19	- 5.469	- 0.2859	0	0	0	0.0001	7.388	23.67	101.56	1,199.3
C	- 0.0197	- 0.00065	- 0.00002	0	0	0	<0.00001	0.00062	0.00168	0.00725	0.1785

alternate implication is that neither MHHI delta nor C is the “correct” way to measure common ownership.

If common ownership causes anticompetitive behavior, then we expect higher Markups and PCMs among treated industries after the merger. Following He and Huang (2017), we compare industry outcomes in the three years prior to the merger announcement to those in the three years after the effective date of the merger in the following difference-in-difference specification:

$$Profitability_{j,t} = \beta_1 Treat \times Post + X_{j,t}\lambda + \alpha_t + \theta_j + \varepsilon_{j,t}, \quad (4)$$

where j indexes industries and t indexes time. Profitability is either Markup or PCM. Treat is a dummy equal to one for industries with positive implied changes in MHHI delta or C, Post is a dummy equal to one for quarters after the merger, $X_{j,t}$ is a vector of controls, α_t is a quarter fixed effect, and θ_j is an industry effect.

Results for Markups are presented in Table 7. Column 1 presents results without controls and without industry effects. We add industry fixed effects in column 2 and various controls in columns 3 through 5. These first five columns use MHHI delta to define treated industries. Columns 6 through 10 repeat the same specifications but use C to identify treated industries. We observe no evidence of a causal positive relation between MHHI delta and Markup in any of the specifications. In two of the specification using C, we actually find a marginally statistically significant negative relation with Markups (see, e.g., Kennedy et al., 2017; Dennis et al., 2017).

We assess the sensitivity of the results in Table 7 to alternative definitions of the treatment variable, particularly those reflecting large implied changes in common ownership. In Table 8, we use specifications corresponding to columns 1, 5, 6, and 10 of Table 7 but use two alternative definitions of treated industries. In columns 1–4, we define treated industries as those with implied changes in common ownership greater than the 90th percentile, and columns 5–8 use the 95th percentile. As reported in columns 1–4, there is one case of a positive and marginally significant coefficient when using a treatment variable that reflects implied changes in common ownership greater than the 90th percentile. However, as reported in columns 5–8, we find no significant results using a treatment variable that reflects implied changes in common ownership greater than the 95th percentile. As reported in the Internet Appendix in Table IA 8, results for these same alternative treatment variables when PCMs are the profitably measure contain no instances of positive and significant relations between implied changes in common ownership and profitability. Thus, the conclusion from Table 7 that the results do not support the COC hypothesis appears generally robust to alternative treatment definitions.

As reported in the Internet Appendix, we have also conducted the difference-in-difference profitability analyses with alternative treatments on samples formed using alternative industry definitions. Results using SIC codes and Markups (Table IA 21), SIC codes and PCMs (Table IA 22), H&P definitions and Markups (Table IA 30), and H&P definitions and PCMs (Table IA 31) are included in the Internet Appendix. Our findings are largely consistent with the results reported above. Of the 32 estimates across these tables, 2 are negative and significant and 3 are positive and significant.

We further explore the results reported in Table 7 by examining the effects within a variety of subsamples. In Table 9, we report the coefficients of interest (β_1 from Eq. 4), the t-statistics, and the numbers of observations. Other coefficients are estimated but are not reported. The specifications used correspond to columns 5 or 10 of Table 7, depending on whether MHHI delta or C is used to identify treated industries. Results indicate weak evidence of a negative causal effect of common ownership on markups or margins. This is not a robust finding, however. Of the 24 reported coefficients, 15 are indistinguishable from zero. This is, again, in contrast to findings in prior literature. Azar et al. (2018), using the Blackrock-BGI merger, estimates ticket prices increase 0.5% for a 91 point increase in MHHI delta. For comparison purposes, the - 0.003 coefficient obtained using MHHI delta and Markup, while statistically insignificant, suggests Markup drops 1.6% for a 91 point increase in MHHI delta.

As reported in the Internet Appendix, we have also conducted the difference-in-difference analysis when industries are defined using SIC and H&P codes. Results using SIC codes are similar in that, if anything, there tends to be a negative estimated effect. There are some positive and significant coefficients when using H&P codes. However, the relations are, as mentioned above, not robust to alternative treatment definitions and measures of profitability nor is the relation more pronounced in concentrated industries, as predicted. Further, as detailed in Section 7 below, the overall economic magnitudes are quite small. In summary, we do not find a robust, economically signifi-

Table 7
Difference-in-difference regressions of industries' markups on institutional common ownership.
This table presents results of difference-in-difference regressions. The sample includes 12 quarters prior to each of the 48 institutional merger announcements and 12 quarters after each merger is completed. The periods between announcement and completion are not included. Treat is a dummy set to one if the implied change in common ownership (either MHHI delta or C) is positive for that industry, zero otherwise. Post is a dummy set to one for the post merger period. Variables are defined in Appendix A. Standard errors are clustered at the industry level. *t*-statistics are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$Treat_{MHHI\ delta}$*Post	0.002	- 0.003	- 0.003	- 0.002	- 0.003					
	(0.426)	(- 1.192)	(- 1.613)	(- 0.938)	(- 1.451)					
$Treat_{MHHI\ delta}$	0.020									
	(1.328)									
$Treat_C$*Post						0.000	- 0.003	- 0.003*	- 0.003	- 0.003*
						(0.078)	(- 1.393)	(- 1.792)	(- 1.178)	(- 1.729)
$Treat_C$						0.018				
						(1.213)				
Off degree (x 1,000)			- 1.752**		- 1.812**			- 1.751**		- 1.810**
			(- 2.120)		(- 2.277)			(- 2.119)		(- 2.275)
ln(Assets)			0.013***		0.020***			0.013***		0.020***
			(2.658)		(2.769)			(2.660)		(2.771)
1 / no. firms			0.220***		0.248***			0.220***		0.248***
			(4.077)		(3.704)			(4.078)		(3.704)
HHI			- 0.076***		- 0.077***			- 0.076***		- 0.077***
			(- 3.127)		(- 2.927)			(- 3.125)		(- 2.924)
Firms with blocks			0.020*		0.017			0.020*		0.017
			(1.801)		(1.403)			(1.798)		(1.400)
Capital intensity				- 0.002	- 0.003				- 0.002	- 0.003
				(- 0.938)	(- 1.102)				(- 0.938)	(- 1.102)
Sales growth				0.000**	0.000**				0.000**	0.000**
				(2.349)	(2.096)				(2.349)	(2.096)
R&D intensity				0.013	0.001				0.014	0.001
				(0.033)	(0.003)				(0.033)	(0.003)
R&D missing				0.012**	0.012**				0.012**	0.012**
				(2.138)	(2.169)				(2.137)	(2.169)
Leverage				- 0.049**	- 0.064***				- 0.049**	- 0.064***
				(- 2.419)	(- 3.337)				(- 2.419)	(- 3.339)
Quarter effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Industry effects		Y	Y	Y	Y		Y	Y	Y	Y
Observations	184,298	184,298	184,298	183,952	183,952	184,298	184,298	184,298	183,952	183,952
R^2	0.006	0.021	0.035	0.035	0.053	0.006	0.021	0.035	0.035	0.053
Industries	269	269	269	269	269	269	269	269	269	269

cant, and causal positive relation between common ownership and industry profitability.

We have also conducted difference-in-difference analyses of capacity and market share investment, respectively. The results, reported in the Internet Appendix, provide some suggestive evidence of reduced investment in additional capacity (i.e., eight of ten coefficients are negative, with four of the eight significant). However, the results are not consistent across measures of common ownership or the various subsamples. Further, the results for advertising expenditures vary in both sign and significance in ways that do not support the COC hypothesis.

6. Common ownership, prices, and profitability in the manufacturing sector

One may be concerned that the COC hypothesis would be evidenced in prices rather than in profitability. As discussed above, we view this as unlikely given the contention in Azar et al. (2018) that there is nothing for participants to conceal. Portfolio firms would not have incentives to understate their true profitability through real or accrual-based earnings management or through reporting fraudulent transaction price data to the U.S. Bureau of Labor Statistics (BLS). Nevertheless, in this section we analyze the relation between common ownership and output prices using a subsample of manufacturing industries defined by the availability of data from several sources.

We measure quarterly industry price levels by the monthly producer price index published by the BLS. Each month, the BLS collects over 100,000 actual transactions prices for selected products from roughly 25,000 manufacturing establishments. The resulting industry (NAICS) indices measure the average change over time in the selling prices received by domestic producers for their output. We adjust this series for inflation using the consumer price index (CPI) to obtain a real producer price index (RPPI) and aggregate to the quarterly level by taking the average over the three months in each quarter. Some industry price series are not available for the entire sample period.

We use the Annual Survey of Manufactures (ASM) published by the U.S. Census Bureau to collect information on labor and materials costs. ASM data are available with annual frequency by NAICS code for the period beginning with 1997. Data on the quantity produced by an industry is obtained from the Federal Reserve, and these data sum-

Table 8
Difference-in-difference regressions of industries' markups on institutional common ownership, alternative treatment definitions.
This table presents results of difference-in-difference regressions. The sample includes 12 quarters prior to each of the 48 institutional merger announcements and 12 quarters after each merger is completed. The periods between announcement and completion are not included. In the first four columns, Treat is a dummy set to one if the implied change in common ownership (either MHHI delta or C) is above the 90th percentile, and zero otherwise. Columns 5 through 8 identify treated industries as those with implied changes above the 95th percentile. Post is a dummy set to one for the post-merger period. Variables are defined in Appendix A. Standard errors are clustered at the industry level. *t*-statistics are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	90th				95th			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\text{Treat}_{\text{MHHI delta}}$*Post	0.002	0.006*			0.003	0.009		
	(0.453)	(1.864)			(0.514)	(1.594)		
$\text{Treat}_{\text{MHHI delta}}$	0.005				- 0.001			
	(0.556)				(- 0.113)			
Treat_{C}*Post			0.001	0.005			0.003	0.009
			(0.198)	(1.370)			(0.489)	(1.612)
Treat_{C}			0.004				0.009	
			(0.476)				(0.844)	
Off degree (x 1,000)		- 1.823**		- 1.818**		- 1.828**		- 1.824**
		(- 2.288)		(- 2.284)		(- 2.289)		(- 2.287)
ln(Assets)		0.020***		0.020***		0.020***		0.020***
		(2.760)		(2.758)		(2.760)		(2.756)
1 / no. firms		0.248***		0.248***		0.248***		0.248***
		(3.704)		(3.695)		(3.705)		(3.701)
HHI		- 0.077***		- 0.077***		- 0.077***		- 0.077***
		(- 2.913)		(- 2.916)		(- 2.910)		(- 2.912)
Firms with blocks		0.017		0.017		0.017		0.017
		(1.412)		(1.406)		(1.412)		(1.411)
Capital intensity		- 0.003		- 0.003		- 0.003		- 0.003
		(- 1.104)		(- 1.102)		(- 1.105)		(- 1.104)
Sales growth		0.000**		0.000**		0.000**		0.000**
		(2.099)		(2.099)		(2.100)		(2.099)
R&D intensity		0.001		0.000		-0.000		0.001
		(0.002)		(0.001)		(-0.000)		(0.003)
R&D missing		0.012**		0.012**		0.012**		0.012**
		(2.165)		(2.169)		(2.164)		(2.164)
Leverage		- 0.064***		- 0.064***		- 0.064***		- 0.064***
		(- 3.341)		(- 3.334)		(- 3.347)		(- 3.341)
Quarter effects	Y	Y	Y	Y	Y	Y	Y	Y
Industry effects		Y		Y		Y		Y
Observations	184,298	183,952	184,298	183,952	184,298	183,952	184,298	183,952
R^2	0.005	0.053	0.005	0.053	0.005	0.053	0.005	0.053
Industries	269	269	269	269	269	269	269	269

marize the real output for all U.S. manufacturing facilities. These indices are available monthly, and we average over the three months in each calendar quarter. If a four-digit NAICS industry does not have specific quantity data, then we use the production data for the three-digit industry to which the four-digit industry belongs. In all, 78 four-digit NAICS industries have sufficient data.

Augmented Dickey-Fuller tests developed by Choi (2001) indicate the presence of a unit root in the output price series. These tests also confirm that a unit root is not present in the first differences of these series. Thus, our reduced-form price regression specification is as follows:

$$\begin{aligned}\Delta \ln RPPI_{j,t} = {} & \beta_1 \Delta CommonOwnership_{j,t} + \beta_2 \Delta HHI_{j,t} \\ & + \beta_3 \Delta \ln Materials_{j,t} + \beta_4 \Delta \ln Wages_{j,t} \\ & + \beta_5 \Delta \ln Quantity_{j,t} + \alpha_t + \theta_j + \varepsilon_{j,t}, \end{aligned} \quad (5)$$

where the Δ represents the quarterly first difference, j indexes industries, t indexes time, α_t is a quarter fixed effect, and θ_j is an industry effect. Wages, the real average wage from the ASM, is calculated as the total pay to production workers divided by the number of hours worked by production workers. Materials is the real total cost of materials from the ASM. Given Wages and Materials data are only available with annual frequency, we use the annual changes in costs for each quarter within the year.[25] Quantity reflects shocks to the demand for an industry's output. Standard errors are clustered at the industry level.

As reported in Table 10, the five respective coefficients on the common ownership measures are insignificant. Thus, after controlling for cost and demand shocks, price changes in the manufacturing sector are not robustly positively related to changes in common ownership, as is predicted by the COC hypothesis. In contrast, Nain and Wang (2018), using similar price data and con-

[25] While this results in the changes for quarters 1–3 being based on future information, reported results are robust to using lagged annual changes in Wages and Materials, confirming that our choice to use information for quarters 1–3 that is not actually available until quarter 4 does not affect the reported results.

Table 9
Difference-in-difference regressions of industry profitability on institutional common ownership, summary of results.
This table summarizes the coefficient of interest from difference-in-difference regressions for the full sample and various subsamples. The specifications correspond to those in columns 5 and 10 from Table 7. The sample includes 12 quarters prior to each of the 48 merger announcements and 12 quarters after each merger is completed. The periods between announcement and completion are not included. Treat is a dummy set to one if the implied change in common ownership (either MHHI delta or C) is positive for that industry, and zero otherwise. Post is a dummy set to one for the post-merger period. Variables are defined in Appendix A. Standard errors are clustered at the industry level. *t*-statistics are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

			Subsample				
Profitability	C.O.	Full	Concen-trated=1	Private, family, dual=0	Cartel=1	Cover-age=1	Balanced panel=1
		Coefficient					
Markup	MHHI delta	- 0.003	- 0.006	- 0.004	- 0.003**	- 0.003	- 0.002
	C	- 0.003*	- 0.007	0.000	- 0.004*	- 0.003	- 0.002
PCM	MHHI delta	- 0.003*	- 0.014*	- 0.005	- 0.003*	- 0.002	- 0.002
	C	- 0.004**	- 0.014*	- 0.002	- 0.004***	- 0.003	- 0.002
		t-statistic					
Markup	MHHI delta	(- 1.451)	(- 0.937)	(- 0.522)	(- 2.016)	(- 1.111)	(- 1.036)
	C	(- 1.729)	(- 1.120)	(0.023)	(- 2.002)	(- 0.939)	(- 0.801)
PCM	MHHI delta	(- 1.754)	(- 1.805)	(- 0.690)	(- 1.689)	(- 0.618)	(- 0.933)
	C	(- 2.202)	(- 1.802)	(- 0.356)	(- 2.702)	(- 1.107)	(- 1.068)
		N					
Markup	MHHI delta	183,952	53,026	45,506	39,184	56,713	102,727
	C	183,952	53,026	45,506	39,184	56,713	102,727
PCM	MHHI delta	183,846	52,920	45,440	39,159	56,672	102,717
	C	183,846	52,920	45,440	39,159	56,672	102,717

Table 10
Panel regressions of industry output prices on institutional common ownership.
This table reports the results of reduced-form regressions of changes in output prices on changes in common ownership, changes in the costs of materials and labor used in production, and changes in demand for industry output. The sample is all four-digit NAICS manufacturing industries that have sufficient data. Variables are defined in Appendix A. All specifications include industry and quarter fixed effects. Standard errors are robust to heteroskedasticity and are clustered at the industry level. *t*-statistics are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)
ΔDensity	- 0.001				
	(- 0.206)				
ΔPCF		- 0.005			
		(- 0.701)			
ΔPCS			0.000		
			(0.122)		
Δ MHHI delta				0.000	
				(0.082)	
ΔC					0.001
					(0.058)
ΔHHI	- 0.000	- 0.000	- 0.000	- 0.000	- 0.000
	(- 0.649)	(- 0.711)	(- 0.667)	(- 0.653)	(- 0.646)
Δln(Materials)	0.042***	0.042***	0.042***	0.042***	0.042***
	(3.722)	(3.731)	(3.726)	(3.724)	(3.735)
Δln(Wages)	0.037*	0.037*	0.037*	0.037*	0.037*
	(1.908)	(1.912)	(1.908)	(1.910)	(1.897)
Δln(Quantity)	0.038	0.038	0.038	0.038	0.038
	(1.647)	(1.646)	(1.642)	(1.639)	(1.645)
Quarter effects	Y	Y	Y	Y	Y
Industry effects	Y	Y	Y	Y	Y
Observations	3,255	3,255	3,255	3,255	3,255
R^2	0.081	0.081	0.081	0.081	0.081
Industries	78	78	78	78	78

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trols, find that more direct cross-ownership by rival firms does lead to significantly higher industry prices. Also, Bhattacharyya and Nain (2011) find that horizontal mergers are associated with lower supplier-industry prices, especially when the suppliers are particularly dependent on firms in the merging industries for sales.[26] Thus, our evidence suggests that the effects of increased industry concentration due to full and partial mergers are distinct from those due to common ownership by institutional investors. Coefficients on the control variables are mostly as expected (i.e., increases in respective input costs are associated with higher prices as are positive shocks to demand).

We have also used changes in common ownership implied by mergers of financial institutions to examine a potential causal relation between common ownership and output prices. In contrast to the profitability analysis above that includes all industries and all mergers of institutions, we are forced to limit the sample to manufacturing industries and also to a subset of institutional mergers for the prices analysis. Thus, these results are reported in the Internet Appendix.

As an additional robustness check on the profitability results reported earlier, we calculate PCM_{ASM} based on separate information collected by the U.S. Census Bureau. In particular, following Allayannis and Ihrig (2001), Ali et al. (2008), and Nain and Wang (2018), for each four-digit NAICS industry i for each period t, $PCM_{ASM,i,t}$ is defined as

$$PCM_{ASM,i,t} = \frac{Value\ of\ shipments_{i,t} + \Delta Inventories_{i,t} - Payroll_{i,t} - Cost\ of\ materials_{i,t}}{Value\ of\ shipments_{i,t} + \Delta Inventories_{i,t}}, \tag{6}$$

where value of shipments is the received or receivable net selling values of all products shipped. The data used by the Bureau to calculate PCMs are from the ASM and are at the individual establishment level, including the establishments of many private firms. In all, 78 four-digit NAICS industries have sufficient data to calculate $\mathrm{PCM}_{\mathrm{ASM}}$.

As reported in the Internet Appendix, we regress $\mathrm{PCM}_{\mathrm{ASM}}$ on controls for industry structure and characteristics. In short, there are no cases in which the coefficients on common ownership are significant. Again, this is in contrast to Nain and Wang (2018) who find significantly higher PCMs following increased cross-ownership of rivals within an industry. Also, these results, which are estimated using a sample that includes many private firms, suggest our PCM results above that use samples of firms with public securities are not likely attributable to selection bias (see, e.g., Ali et al., 2008).

7. Interpretation

Our results are broadly consistent with the conclusion that common ownership does not reliably affect industry profitability. However, one might view our results as the outcome of tests that lack power. Relatedly, it may be that the lack of an observed relation across all industries obscures strong relations in a small subsample of industries. In this section, we analyze the collected estimates reported throughout our paper and summarize the effects' sizes across the various tests to resolve potential uncertainty in interpretations associated with occasionally conflicting results (see, e.g., Harvey, 2017). We also take a permutation-based approach and conduct a "specification curve" analysis, as advocated by Simonsohn et al. (2015).

Our paper includes 534 estimates of the common ownership-profitability relation arising from various combinations of five measures of common ownership, three industry definitions, two measures of profitability, different samples, and different econometric specifications. To facilitate comparison across estimates, we first translate each estimate into an economic magnitude measured as the change in profitability in units of standard deviation per a one standard deviation increase in common ownership. The average economic effect is an increase in profitability of 0.0012 standard deviations for a one standard deviation increase in common ownership. If we assume that our tests have sufficient power and our estimates are therefore very precise, then we would conclude a positive relation but one that is economically very close to zero. This small economic effect suggests low power is not a concern. Further, we can consider the fact that some of our estimates are more precise than others. If we weight each estimate by its inverse variance, our average estimated economic effect is 0.0040 standard deviations for a one standard deviation increase in common ownership. Thus, when we do estimate sizable effects at times throughout the paper, these tend to be imprecise, and our most precise estimates are close to zero. This again supports a conclusion that low power is not driving our results.

We find consistently small effects across the three industry definitions. The unweighted and weighted average economic effects (standard deviations of profitability for one standard deviation increase in common ownership) using NAICS codes are - 0.0003 and 0.0025, respectively. The same statistics are 0.0006 and - 0.0172 for SIC-defined industries and 0.0069 and 0.0207 for H&P defined industries.

It is difficult to correctly gauge the confidence bounds around the average of the point estimates because the individual estimates are not independent. If we were to assume independence, then the 95% confidence bounds are $(-0.0030, 0.0019)$ around the unweighted average point estimate (using all 534 estimates) and (0.0012, 0.0067) around the weighted average. It is unlikely that we can correctly treat the dependence using clustering, for example, without modeling the sources of dependence. Therefore, we take an alternative, permutation-based approach (Simonsohn et al., 2015). We estimate the profitability-common ownership relation under various permutations of assumptions regarding samples and measures. Specifically, we randomly select one of the three industry definitions, one of the five measures of common ownership, and one

[26] Phillips (1995) finds that large changes in individual firm leverage are associated with significant changes in prices.

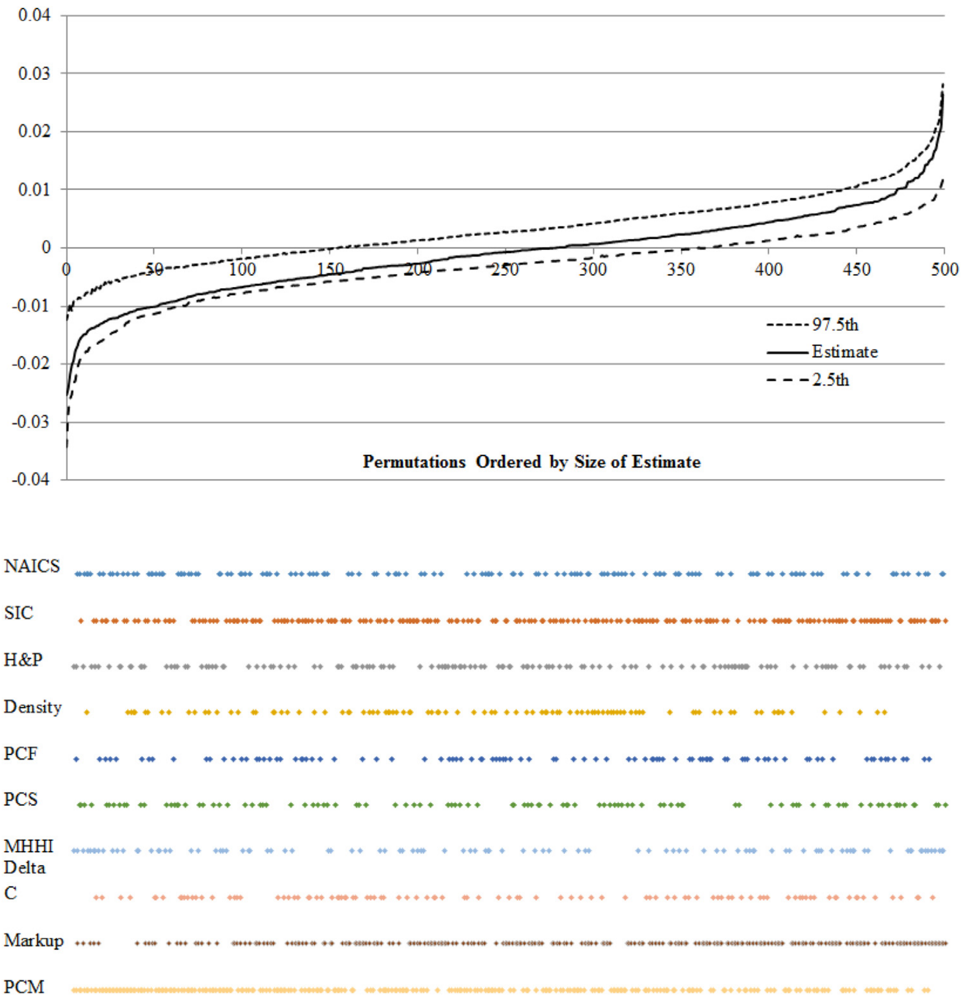

Fig. 2. Specification curve.
The figure above plots point estimates and 95% confidence intervals for 500 permutations of industry definition, common ownership measure, and profitability measure. Each permutation is estimated over a random sample of 50 industries and includes the same control variables as in column 5 of Table 4. The resulting 500 estimates are plotted in the solid line in order from the smallest sized effect to the largest. At the bottom, we plot the characteristics of each specification.

of the two measures of profitability. We then randomly sample 50 industries and run a regression following the specification in column 5 of Table 4. We repeat this 500 times and plot the resulting estimates in Fig. 2. Again, to facilitate comparison, the variables in each permutation are standardized such that each estimate can be interpreted in terms of standard deviations. The solid curve in the top portion of Fig. 2 plots these estimates ranked from smallest to largest.

More estimates are negative (277) than positive (223), and the median point estimate is - 0.00073. To compare this with what is expected under the null, we repeat the permutation approach described above but first randomly assign institutional ownership. We assign the entire structure of ownership of an industry to another randomly selected industry. We repeat the permutation procedure 200 times, each time reshuffling ownership across industries. Randomly assigning common ownership constructs the distribution under the null and requires no assumptions regarding dependence. Instead, we only assume that ownership is exchangeable (i.e., any industry could have the ownership structure of any other industry). At the median, the 95% confidence interval is (- 0.00298, 0.00285). Therefore, the median relation between industry profitability and common ownership is slightly negative but is not statistically different from zero. However, the bounds around the estimate are very tight such that we can statistically reject any meaningful economic effects. Other point estimates are also not significant, and as shown in Fig. 2, the entire specification curve lies within the 95% confidence interval.

In addition to examining the median relation, Simonsohn et al. (2015) also suggest other joint significance tests. For example, we can compare the fraction of estimates that are of the dominant sign, which in this case is negative. As mentioned, 277 of the 500 permutations produce a negative estimate. Among the 200 randomized samples, 73 produce at least 277 negative

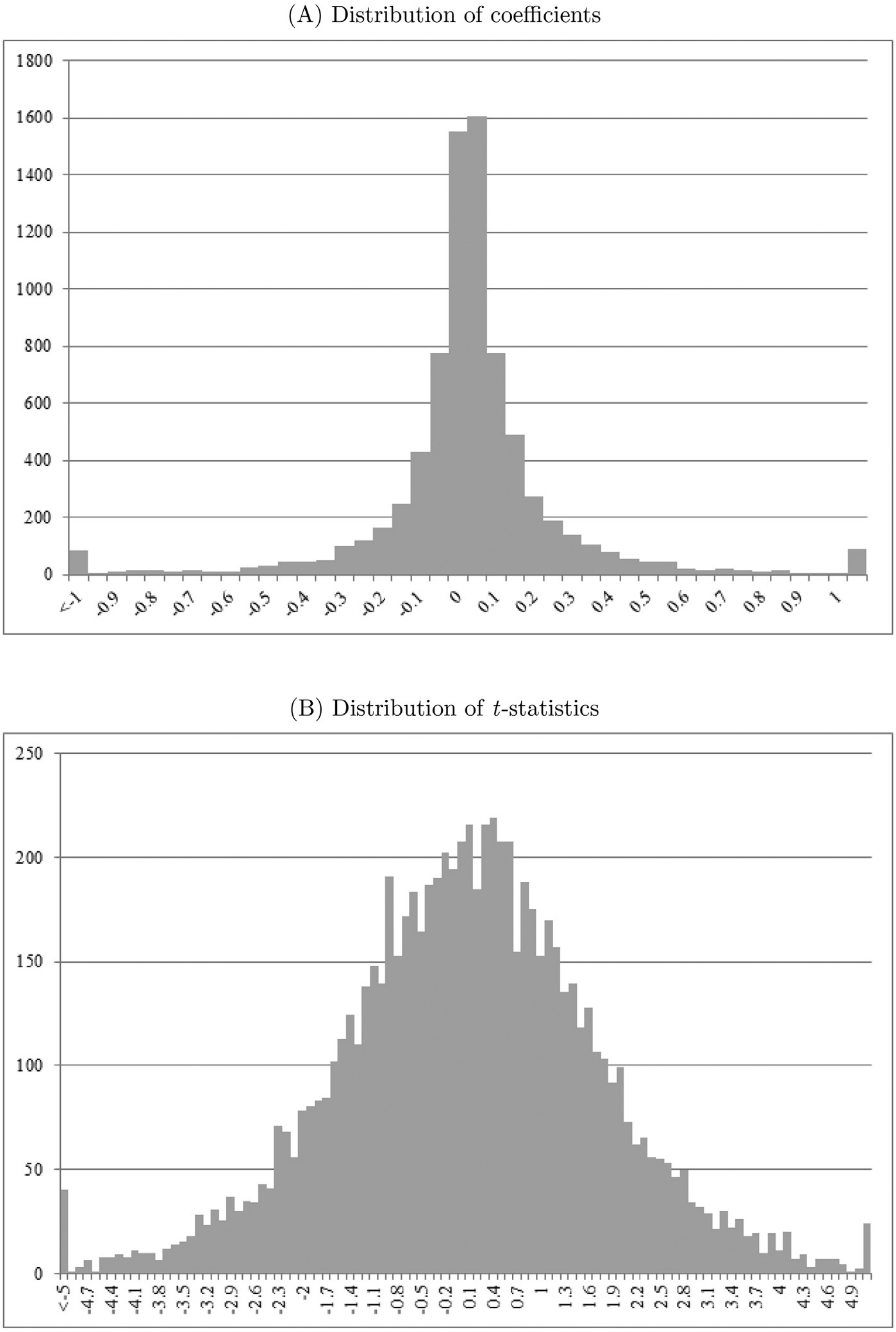

Fig. 3. Distributions of coefficients and t-statistics from industry-by-industry regressions.
The figures above summarize results from 7,738 regressions of profitability on common ownership. Specifically, we run the specification from column 5 of Table 4, but rather than pooled OLS, we run one time-series regression for each industry using all of the different combinations of measures of industry, ownership, and profitability. Panel (A) below presents the resulting distribution of standardized coefficients representing the effect of common ownership on profitability. Panel (B) presents the distribution of corresponding t-statistics.

estimates, generating a p-value of 0.365 for this joint significance test. Therefore, we have no statistical evidence of a relation between profitability and common ownership. At the bottom of Fig. 2, we plot the characteristics of each specification. There are few perceptible patterns. Estimates in the left (right) tail tend to use PCM (Markup) as the measure of profitability. Density tends to produce estimates in the center of the distribution rather than the tails, and MHHI delta tends to produce estimates in the tails rather than in the center. Again, this suggests that choices of profitability and common ownership measures can affect the likelihood of observing significant relations. Importantly, there are also no obvious differences across industry classification schemes. None of the three industry

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definitions seems to produce more positive and significant results than the others, suggesting that our overall conclusion of no relation is not attributable to measurement error in identifying rivals.

Finally, we also estimate the profitability-common ownership relation individually for each industry. These tests no longer use cross-sectional variation but rather estimate a contemporaneous association in the time series. We do this for each industry definition and for each unique combination of common ownership and profitability measures. We use the same control variables as in column 5 of Table 4 (other than the industry fixed effect), and we standardize the variables. This generates 7738 coefficients of interest and corresponding t-statistics. The coefficients and t-statistics are summarized in the distributions presented in Fig. 3. These are, not surprisingly, centered close to zero. The average economic effect across all industries is an increase in profitability of 0.0156 standard deviations for a one standard deviation increase in common ownership. The median effect is 0.003. The distribution of t-statistics indicates that there are more significant results than what would be expected due to chance; however, this is true in both the right and left tails. Approximately 11% (11%) of the estimates are positive (negative) and significant at the 5% level.

In Table IA 34, we list the industries that tend to most frequently produce t-statistics in the tails of the distribution. On the right (left) side of the table we report the industries that most frequently appear in the right (left) tail (i.e., $t > 1.96$ ($t < 1.96$)). There are no obvious patterns evident from a comparison of the industries in the respective columns.[27] For instance, pipeline transportation of natural gas frequently exhibits a positive relation, while pipeline transportation of crude oil frequently exhibits a negative relation. Interestingly, the commercial airline industry is among the industries exhibiting frequent positive relations between common ownership and profitability (see, e.g., Azar et al., 2018).

In sum, our conclusion of no relation between common ownership and profitability does not seem to be due to low-power tests. If we had perfectly precise estimates, we would conclude that the economic effect of common ownership on profitability is close to negligible. Further, no specific combination of industry definition, profitability measure, or common ownership measure seems to dominate others. At the median, we estimate an effect that is indistinguishable from zero; however, the bounds around the estimate are tight. We can therefore statistically reject even modestly sized economic effects.

8. Single-industry studies, relevant product markets, and industry definitions

In initially describing results from our panel regressions and differences-in-differences regressions, we noted that the estimated coefficients indicate much smaller average effects of common ownership on profitability than those for common ownership on ticket prices in the airline industry as reported in Azar et al. (2018). The direct challenges to Azar et al. (2018) by Kennedy et al. (2017) and Dennis et al. (2017) notwithstanding, one possibility is that the results reported in Azar et al. (2018) for the airline industry simply do not generalize more broadly to other industries. Another possibility is that the differing results across our paper and Azar et al. (2018) are due to methodological differences between the papers. Thus, in this section, we provide more details on the results we obtain specific to the airline industry and investigate more generally the potential effects of methodological differences, in particular differences in how relevant product markets are defined, in reconciling the respective conclusions reached.

As mentioned above, the airline industry, as defined by NAICS codes, is among the individual industries that most frequently exhibit positive and significant relations between common ownership and profitability. However, further comparisons and contrasts are possible. For instance, given three industry definitions, two profitability measures, and five measures of common ownership, we actually estimate a total of 30 airline industry time series regressions of common ownership on profitability. Of these 30 coefficients, 11 are positive, with $t > 1.96$. When looking at potential differences across our industry definitions, we find the most significant results using the NAICS-defined airline industry (5 of 10), followed by SIC (4 of 10) and H&P (2 of 10). The median among all 30 estimates is 0.010: a one standard deviation increase in common ownership corresponds to an increase in industry profitability of one one-hundredth of a standard deviation. To facilitate comparisons of economic significance with prior papers, we can again focus on Markups. The median among our 15 estimates that use Markups is 0.010. In other words, our median estimate implies Markups will increase by 0.14% as common ownership increases from the 25th to the 75th percentile. This is considerably smaller than the 4.3% effect reported in Azar et al. (2018).

While the differences in the conclusions reached in the respective airline industry papers are primarily due to choices regarding common ownership measures, the airline industry papers all define relevant product markets at the domestic route level and thus do not differ on this important dimension.[28] To include as many industries as possible in our study, we have had to necessarily compromise on the fineness of our product market definitions. By using NAICS (SIC or H&P) industry codes to define markets, we implicitly assume that firms within the same industry code compete with each other in product markets. Thus, it is possible that our conclusions differ from those in Azar et al. (2018) because we may not always measure common ownership or profitability at the relevant product

[27] In unreported results, we also find no patterns in profitability measures, industry definitions, or common ownership measures across the distribution.

[28] Gramlich and Grundl (2018) conclude no economically significant effect of common ownership on bank profits but differ from Azar et al. (2016) in how relevant product markets are defined. Given that our industry level results do not reveal indications of a frequent positive and significant (7 out of 30) relation between common ownership and profitability, and that Azar et al. (2016) investigate the effects of common ownership on deposit rates, customer account fees, and fee thresholds, in this section we focus on comparison of our results with those from the airline studies.

Table 11
Difference-in-difference regressions of industry markups on institutional common ownership, correspondence between industry definitions and product markets.
This table summarizes the results from difference-in-difference regressions for various subsamples. The specifications correspond to those in columns 5 and 10 from Table 7. The sample includes 12 quarters prior to each of the 48 merger announcements and 12 quarters after each merger is completed. The periods between announcement and completion are not included. Treat is a dummy, set to one if the implied change in common ownership (either MHHI delta or C) is positive for that industry, and zero otherwise. Post is a dummy set to one for the post-merger period. Variables are defined in Appendix A. Standard errors are clustered at the industry level. *t*-statistics are in parentheses. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% level, respectively.

Panel A	Geographic overlap not missing	Geographic overlap decile subsamples Low	2	3	4	5	6	7	8	9	High
$Treat_{MHHI\,delta}$*Post	- 0.003*	- 0.005**	0.002	- 0.003	0.001	0.001	0.001	-0.000	-0.002	-0.003	-0.015*
t-statistic	(- 1.760)	(- 2.218)	(1.013)	(- 1.237)	(0.708)	(0.866)	(0.659)	(- 0.060)	(- 0.786)	(- 0.766)	(- 1.883)
Standard error	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.004	0.008
R^2	0.099	0.262	0.192	0.246	0.144	0.197	0.171	0.170	0.159	0.155	0.326
$Treat_C$*Post	- 0.003**	- 0.003**	0.002	- 0.003*	- 0.000	0.001	-0.000	-0.001	-0.002	-0.005	-0.018*
t-statistic	(- 2.165)	(- 2.241)	(0.639)	(- 1.785)	(- 0.194)	(0.788)	(- 0.061)	(- 0.876)	(- 0.702)	(- 1.466)	(- 1.966)
Standard error	0.001	0.002	0.003	0.002	0.002	0.001	0.002	0.002	0.002	0.003	0.009
R^2	0.099	0.261	0.192	0.246	0.144	0.197	0.171	0.170	0.159	0.155	0.326
Observations	123,712	12,361	12,440	12,312	12,379	12,171	12,637	12,286	11,375	13,879	11,872
Industries	268	49	74	95	129	135	124	147	121	151	104

Panel B	Shipping distance not missing	Shipping distance quartile subsamples Low	2	3	High
$Treat_{MHHI\,delta}$*Post	- 0.004**	0.001	- 0.001	- 0.000	- 0.002
t-statistic	(- 2.350)	(0.441)	(- 0.417)	(- 0.178)	(- 0.763)
Standard error	0.002	0.003	0.002	0.002	0.003
R^2	0.117	0.185	0.214	0.188	0.213
$Treat_C$*Post	- 0.004**	0.003	- 0.000	- 0.001	- 0.004
t-statistic	(- 2.540)	(1.132)	(- 0.080)	(- 0.400)	(- 1.448)
Standard error	0.002	0.003	0.002	0.002	0.003
R^2	0.118	0.185	0.214	0.188	0.214
Observations	75,605	18,395	19,698	17,503	20,009
Industries	106	33	38	34	27

market level. We investigate this possibility by examining results for subsamples where our industry definitions most accurately represent relevant product markets and by assessing whether the results vary systematically with the extent of how accurately our industry definitions correspond to relevant product markets.

We use two approaches to determine the degree to which industry definitions correspond to relevant product markets. The first approach exploits disclosures in firms' 10-K filings regarding the geographic distributions of their respective operations. For each industry-year, we calculate the ratio of the average number of states mentioned by the firms in the industry to the unique number of states mentioned by the firms in the industry.[29] If the firms in an industry operate in many of the same states, then the geographic overlap measure for the industry will be high and our measures of common ownership and profitability should reflect the relevant product markets reasonably well. Examples of industries with high-measured overlap are inland water transportation and fast food restaurants. Given inland water transportation firms are concentrated primarily in the Mississippi River drainage and the Great Lakes region, and fast food is dominated by national chains present in most states, the geographic overlap measure generates reasonable outcomes.

Our second approach exploits data from the 2007 Commodity Flow Survey (CFS) conducted by the U.S. Census Bureau. The CFS contains data on domestic shipments originating from mining, manufacturing, wholesale, and catalog and mail order retail establishments. The data are available for industries defined by NAICS codes and include distances shipped and the dollar values and weights of the shipments. Industries facing high shipping costs for their output are generally organized into more local product markets, e.g., ready-mixed concrete as described in Syverson (2008), whereas industries with low shipping costs are generally characterized by national competition (e.g., pharmaceuticals). Thus, we characterize industries with higher average reported shipping distances as national markets.[30]

In the first column of Table 11, we repeat the main differences-in-differences analysis for the samples of all industries with the data to calculate geographic overlap (Panel A) and shipping distances (Panel B). The results are very similar to those reported in Table 9, indicating that selecting on the availability of overlap or shipping data does not materially affect the results. Results for the subsamples with the highest geographic overlap or the highest shipping distance suggest a small negative causal relation between common ownership and Markups. Also, the coefficients and associated standard errors across the deciles (quartiles) of overlap (shipping distance) do not vary in a manner suggesting that a significant positive relation is being obscured by combining industries for which NAICS codes are not good representations of product markets with industries for which NAICS codes are good representations. In the Internet Appendix, we report results using PCMs as the profitability measure, and these results are very similar. Further, we also report in the Internet Appendix results when industries are defined using SIC or H&P codes. While the results for PCMs and Markups using SIC codes are very similar to those for NAICS, there is a small positive and significant relation between common ownership and profitability using H&P codes. However, the relation is only apparent in the decile where geographic overlap is the lowest (i.e., in the subsample where our observed values of common ownership and profitability arguably correspond most poorly with the relevant product markets and measurement error is thus presumably highest).

In sum, to the extent that geographic overlap and shipping costs variables proxy for the degree of correspondence between industry codes and product markets, our overall conclusions are not due to a lack of precision in how well industry codes represent relevant product markets. To be sure, precise definitions of local markets and associated market-level measures of common ownership and profitability are an attractive feature of the airline industry studies. However, it is worth noting that our results across many industries are ultimately similar in nature to those reported in Kennedy et al. (2017) and Dennis et al. (2017) using detailed local market data (i.e., an economically very small and statistically weak relation between common ownership and industry profitability).

9. Conclusion

We find that greater common institutional ownership within an industry is not reliably associated with significantly higher industry profitability, the presumed end result of reduced competition among industry participants. While we find isolated instances in which reasonable a priori choices of industry classifications, profitability measures, common ownership measures, and empirical specifications generate results consistent with common ownership significantly increasing profitability, the vast majority of other reasonable a priori choices on these dimensions do not yield results consistent with reduced competition. Further, this conclusion holds in subsamples of industries where reduced competition via common ownership is expected to be facilitated, in subsamples of industries for which potential selection bias due to requiring firms to have public equity are smaller, and in subsamples of industries for which there have not been substantive changes to industry codes. This conclusion continues to hold when we use the plausibly exogenous variation in common ownership that results from mergers of institutional investors. We also find that common ownership does not reliably decrease competition among rival firms on nonprice dimensions or on prices themselves. Our failure to reject the null of no relation between common ownership and industry profitability does not appear to be due

[29] State-mention data are described in detail in Garcia and Norli (2012). We thank Diego Garcia and Øyvind Norli for generously sharing their data with us. We exclude mentions of Delaware in this calculation given it is a relatively small product market but is mentioned frequently in 10-Ks, as a disproportionately large number of firms are headquartered there. We backfill for years prior to availability of electronic filings (1994) and frontfill for years after Garcia and Norli (2012) sample ends (2008).

[30] Untabulated results using the ratio of shipment weight to value are very similar to those reported for shipping distances (see, e.g., Barrot et al., 2019).

to low-power tests. The effects we estimate are close to zero with tight bounds, and our estimates are sufficiently precise such that anticompetitive effects of common ownership would be identifiable if they existed.

Our results are inconsistent with increased common ownership decreasing product market competition. Our evidence indicates that the results of single-industry studies concluding increased common ownership decreased competition in the airline and banking industries (see, e.g., Azar et al., 2016; Azar et al., 2018) do not broadly generalize to other industries. Increased common ownership has not ushered in a new era of widespread anticompetitive behavior similar to that observed in the U.S. during the late 19th century. With the obvious caveat that our results are conditional on the extent of common ownership observed over our sample period and thus may not extrapolate to substantially higher levels of common ownership, we conclude that antitrust restrictions seeking to limit intra-industry common ownership are not currently warranted.

Appendix A. Variable definitions

Variable	Definition
Density	The ratio of the number of firm-pairs that are connected in an industry over the maximum possible number of firm-pairs in that industry. Two firms are connected when there is a blockholder that owns at least 5% of each of the two companies.
PCF	The number of blockholders that own two or more companies in the industry over the total number of blockholders in that industry.
PCS	The maximum number of stocks in an industry with at least one common blockholder divided by the total number of stocks in the industry.
MHHI delta	The marginal increase in HHI attributable to common institutional ownership, common institutional voting control, and the market shares of the firms in the industry.
C	Common ownership incentive term reflecting the extent to which firms in an industry are connected by common ownership and voting control among institutional owners but does not depend on the respective market shares of firms in the industry.
Markup	The average of an industry's firms' ratios of revenues over costs.
PCM	The sum of sales minus cost of goods sold and the change in inventories divided by the sum of sales and the change in inventories.
Net CAPX	Total capital expenditures net of depreciation scaled by industry total assets.
Advertising	Total advertising expenditures scaled by industry total sales.
Off degree	The number of pair connections between firms that do not belong to the same four-digit NAICS industries owned by the common blockholders.
Firms with blocks	The fraction of firms in the industry that have at least one institution that owns more than 5% of the firm.
1/no. firms	The reciprocal of the number of firms in the industry.

(*continued on next page*)

Variable	Definition
HHI	The sum of squared market shares of the firms in the industry.
ln(Assets)	The natural logarithm of the total assets for the industry.
Sales growth	The percent change in total industry sales in quarter t from the total industry sales in quarter t-1.
Capital intensity	Total industry assets divided by total industry sales.
R&D intensity	Total industry R&D expenditures divided by total industry assets.
R&D missing	Dummy variable set to one if total industry R&D expenditures are missing.
Leverage	Industry total debt divided by the sum of total debt and total market equity.
Concentrated	Industry-level indicator variable set to one if the industry's time-series average HHI is in the top tercile.
Private, family, dual	Industry-level indicator variable set to one if there is a large private firm, a family-owned firm, or a dual class firm in the industry.
Cartel	Industry-level indicator variable set to one if a cartel was prosecuted in the industry during our sample period.
Coverage	Industry-level indicator variable set to one if at least 95% of Compustat firms in the industry are in the CRSP/Compustat merged database.
Balanced panel	Industry-level indicator variable set to one if the industry has at least 110 consecutive quarters and no significant changes in NAICS industry definition.
RPPI	RPPI is the real producer price index obtained from the Bureau of Labor Statistics. These respective industry indices are available monthly and we average over the three months in each calendar quarter.
Wages	The real average wage from the ASM is calculated as the total pay to production workers divided by the number of hours worked by production workers.
Materials	The real total cost of materials from the ASM.
Quantity	The Federal Reserve's Index of Industrial Production. These respective industry indices are available monthly and we average over the three months in each calendar quarter.
Geographic overlap	The ratio of the average number of states mentioned in 10-Ks by the firms in the industry to the unique number of states mentioned by the firms in the industry.
Shipping distance	The average distance, in miles, that an industry's output is shipped.

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