A Development in Common Ownership: How Intra-Industry Diversified Shareholders Can Create Anticompetitive Incentives in the Airline Industry

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Abstract

In economics, competition between firms in an industry – i.e., competition to maximize market share – traditionally, is beneficial for the consumers. Competition causes firms to develop new products and services while undercutting their competitors’ prices to gain market share by attracting more customers. In economic theory, firms in a competitive industry produce – and have incentive to produce – the *socially optimal* output level at the minimum possible cost per unit. In today’s economy, in addition to considering their own interests, many firm’s must also consider shareholder value – i.e., the value enjoyed by each of their shareholders; and in a lot of cases, this is the ultimate measure of a company’s success. Given that, if every firm competing in

an industry had distinctly different shareholders, the optimal price competition strategies would align properly with each respective shareholders' interests.

In the recent decades, the share of stock that is partially owned by institutional investors has increased substantially – and because of this, many natural competitors are owned by a small set of large institutional investors (intra-industry diversified shareholders). This common ownership, implicitly, changes the objective function of firm managers, as they now must consider that some of their largest shareholders also have ownership rights in their competitors. In order to quantify the extent of common ownership in the airline industry, this paper constructs a measure for total market concentration denoted as the modified Herfindahl-Hirschman Index (MHHI). This index is used as a reduced form measure of the decrease in incentives to compete due to common ownership.

This paper applies previous economic theory/literature with distinct empirical evidence to show that the MHHI is strongly correlated to the markups of airline companies between 2010-2019. Additionally, given the results displayed, antitrust regulators and authorities must consider common ownership when quantifying the market concentration measures; because ultimately, stock acquisitions by shareholders that are intra-industry diversified, can create anticompetitive incentives that result in a deadweight loss for society and bear a heavy the cost on consumers.

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I. Introduction

Chairmen and CEO of Berkshire Hathaway – which is an American multinational conglomerate holding company – Warren Buffet, confirmed that, following an acquisition of major stakes in the airline industry in 2016, he (or the holding company) held between 7 and 8.5 percent in the major airlines. CNBC's Becky Quick, in an interview in February following that year, confronts Buffet in this regard and asks, "You know, Warren, it does occur to me, though, if you're building up such a significant stake in all the major players, is that anything that's, like, monopolistic behavior? Is there any concern to think that you would say something to the airlines to make them make sure that they're not competing on prices quite the same? What would keep somebody from worrying about that" (2007)? Buffet responds, expectedly, by recognizing he is a 'passive investor,' and by definition, is one that does not participate in the daily decisions to run the companies that he holds shares in.

An aim of this paper is to investigate if, regardless of their passivity, institutional investors that hold shares across an industry implicitly influence, and impact, the way the managers of these firms make pricing decisions. This paper suggests, in the airline industry, taking common ownership – or horizontal shareholding – into account, implies an increase in total market concentration (which is defined on page 18) that is much larger (10.2 times) than the legally allowed amount by antitrust authorities. Additionally, empirical evidence shows that there is a positive relationship between the extent to which shareholders hold shares across the airline industry – i.e., they are intra-industry diversified – and the markups of firms in said industry.

This paper uses a baseline specification complemented with four alternative regression analyses, to investigate how, if at all, common ownership creates anticompetitive incentives in the airline industry. Using two alternative calculations to estimate the market concentration level that is 'modified' for common ownership links – which is denoted as MHHI (modified Herfindahl-Hirschman Index) – this paper utilizes both empirical evidence and past economic literature/theory to shed light on the extent to which the stock acquisitions of 'passive' institutional investors should not only concern antitrust regulators, but additionally, has the ability to create anticompetitive incentives; which, in turn, can be costly to consumers.

A. Underlying Theory

Common ownership, in sum, is the idea that institutional investors own shares in firms that compete – and are aligned horizontally – within an industry. These investors are referred to as 'intra-industry diversified shareholders.' Previous literature in this development predicts that firms' incentive to compete is reduced when their largest shareholders also hold shares in their competitors; ultimately because, the gains from competing aggressively – for example, employing a growth strategy (to possibly gain market share) that involves price-cutting – come at the expense of firms that are part of the same investors' portfolio (Azar et al., 2018).

Without considering their shareholders, a firm managers' decision under perfect competition – i.e., when they act as 'price takers'[1] – is to maximize profits by producing at the point in which marginal cost of production equals the market price; and this is determined entirely by forces independent of the producer itself. On the contrary, in the case of a monopoly, the firm manager makes production decisions that ultimately influence the overall market price in that industry – i.e., they are 'price-makers.' Given that, in a monopolized market – or a highly concentrated one per se – an artificial reduction in output leads to a price increase, resulting in

[1] This idea is that a firm's output has no control to dictate prices. In other words, its output is so small relative to the overall market output that it cannot impact market price by altering said output. This is the opposite of a 'price maker;' which comes from a firm that acts as a monopoly.

the producers benefiting at the expense of the consumers. Because of this, it can be argued – or assumed – that there is incentive for firms in an industry to coordinate and reduce their aggregate output to a level that a single monopolist would produce. In other words, there is an underlying motivation for firms in an industry to coordinate in order to receive a higher price for their combined reduction in output. In sum, within a concentrated industry, if all firms act as if they are a single monopoly – and cease to compete – then the total industry profit level would seemingly increase. But it is more complicated than that and effective coordination is difficult to accomplish. While all firms stand to benefit from coordination, each individual firm stands to gain the most if its rivals coordinate (thereby pushing prices up) while it competes (lowering its own price to win business from the coordinating rivals). So, while a 'cheater' gains when it departs from a coordinated production or pricing strategy, the amount it gains is less than the amount its coordinating rivals collectively lose (Lambert & Skyuta, 2018, pp. 5-7). Thus, this implies that when there is departure from entire industry coordination, the firm who practices price competition enhances their 'own profit' but reduces overall industry profit. So, what does this have to do with shareholders?

In the standard case, where there are no intra-industry diversified shareholders,[2] the shareholders of a corporation would want managers to attempt to maximize their individual profit (or 'own profit'). Which, as discussed, would be through price-competition; which ultimately enhances the individual's own corporate profit, but can reduce overall industry profits – because there is no coordination (Lambert & Skyuta, 2018, p. 6). Thus, for shareholders who don't hold shares across the industry, they would assumingly prefer price competition (lack of coordination) – i.e., the maximization of 'own-firm' profits in the firm they hold shares in. But

[2] For example, each firm is owned by separate shareholders.

the scenario is quite different in the case of intra-industry diversified shareholders. These investors would prefer that managers maximize industry profits by avoiding price competition. Any decrease in price (from monopoly level to price competition level) caused by, for example, one firm ceasing to coordinate and attempting to win business from its competitors in order to increase market share (the 'cheater' in the paragraph above), will come at the expense of one of its rivals. Therefore, for a shareholder with stake in each company, this doesn't maximize their profits.[3]

In sum, for these investors, managers who purse practices that aim to increase individual corporate performance – by competing with rivals and taking away market share – decrease, overall, the profits of institutional investors across the industry by decreasing total industry profits. The basic assumption of this paper, and this theory, is that intra-industry diversified shareholders are more likely to prefer managers who maximize industry profits by avoiding competition (Elhauge, 2016, p. 1279). This contention is rather intuitive if there was one single investor in the entire industry (which is illustrated below in section *I.B*), but – and what this paper aims to examine – how does common ownership of smaller, more realistic, percentages reduce competition?

These 'smaller percentages,' which are quantified in later sections, must be considered by antitrust regulators when monitoring stock acquisitions with regard to relevant legislation. This paper references to two main antitrust legislative regulations – the Clayton Act § 7 and the DOJ/FTC 2010 Horizontal Merger Guidelines. Although the Clayton Act § 7 is noted predominately in the case of mergers, it can be extended much further and is applicable in the

[3] In the case of common ownership, when a firm undercuts its rival's price to take away a sale, the movement of the sale to the firm from the rival simply moves their owners' money from one pocket to another; the net effect of the price cut for those owners is that the prices charged by both firms are lower, thus lowering those owners' profits across both firms (Elhauge, 2016, pp. 1268-1269).

case of stock acquisitions. This act essentially relates to the assumption that institutional investors' acquisition of firms aligned horizontally in an industry can likely reduce the incentive for these firms to compete when these acquisitions produce an increase in industry wide common ownership – which is measured by MHHI. Additionally, in the same vein, the DOJ/FTC 2010 Horizontal Merger Guidelines addresses critical numerical figures – in regard to the Herfindahl-Hirschman Index (HHI) – that, later, put this paper's findings (in regard to MHHI) into perspective. For both the Clayton Act and the Merger Guidelines, the language of both legislations is below:

Clayton § 7: [4] *No person engaged in commerce or in any activity affecting commerce shall acquire, directly or indirectly, the whole or any part of the stock or other share capital and no person subject to the jurisdiction of the Federal Trade Commission shall acquire the whole or any part of the assets of another person engaged also in commerce or in any activity affecting commerce, where in any line of commerce or in any activity affecting commerce in any section of the country, the effect of such acquisition may be substantially to lessen competition, or to tend to create monopoly... This section shall not apply to persons purchasing such stock solely for investment and not using the same by voting or otherwise to bring about, in attempting to bring about, the substantial lessening of competition.*

DOJ/FTC 2010 Horizontal Merger Guidelines: [5] *Highly Concentrated Markets: Mergers resulting in highly concentrated markets (HHI>2500) that involve an increase in the HHI of between 100 points and 200 points potentially raise significant competitive concerns and often warrant scrutiny. Mergers resulting in highly concentrated markets that involve an increase in the HHI of more than 200 points will be presumed to be likely to enhance market power.*

[4] See: 15 U.S.C. § 18 – Acquisition by one corporation of stock of another. https://www.law.cornell.edu/uscode/text/15/18
[5] See: U.S. Dep't of Justice & Fed. Trade Commission Horizontal Merger Guidelines § 5.3 (2010). https://www.justice.gov/atr/horizontal-merger-guidelines-08192010

B. Basic Premise

Before delving into the specifications of MHHI, the subsequent empirical analysis, and the alternative regression models, the following basic example is provided to simplify the common ownership and anticompetition relationship. Ultimately, the premise that common ownership caused by intra-industry diversified shareholders results in anticompetitive practices follows these overarching assumptions and generalizes the rationale to the entire industry.

Imagine an industry with two equal-sized firms – firm *A* and firm *B.* Suppose *A* undercuts *B*'s price to attract customers from *B* and thus gain market share. Firm *A* may benefit from such a move – by selling many more units of a product at slightly reduced price; i.e., they have elastic demand. However, *A*'s gain in market share comes at the expense of firm *B*'s loss in market share, and average prices in the market are lower. As a result, the owner(s) of firm *B* lose more revenue that the owner(s) of firm *A* gains. Ultimately, the sum of *A*'s and *B*'s profit falls compared to their profit prior to firm *A*'s undercut. Considering an investor holding equal-sized stakes in both *A* and *B* – i.e., this shareholder is intra-industry diversified – the movement of the sale from firm *B* to firm *A* simply moves this investors' money, or profit, from one pocket to the another. The net effect of the price cut is that both firms charge a lower price; thus, lowering the owners' profits across both firms (Elhauge, 2016, p. 1269). In sum, an investor holding equal-sized stakes in both *A* and *B* would enjoy greater total profits if the two firms set prices or quantities as if they were two divisions of a monopoly instead of as two independent firms. Considering the assumption that shareholders are diversified across natural competitors and portfolio firms act in their diversified shareholders' interests – regardless of their 'passivity' – it is reasonable to expect that there will be less firm competition when there is more common ownership (Azar et al., 2018, p. 11). In the context of this paper, the hypothesis is that the markups of airline companies will be positively correlated with common ownership; and will reflect anticompetition through an increased generated by an assumed price raise (i.e., they act as a monopoly) – thus, creating a deadweight loss in the economy that benefits producers and hurts consumers.

C. Outline

The research question of this paper is, as discussed, to see if common ownership in the airline industry – that provided through intra-industry diversified shareholders' shares – displays anticompetitive effects between firms in said industry. This paper pairs previous economic theory/literature in this field with distinct empirical evidence to illustrate a reduced form relationship between a modified market concentration index – that which takes into account common ownership – and markups of firms in the airline industry. After explaining the data sources and providing insight into the way – and reason – it was compiled, the HHI and MHHI for each period was constructed. The trends and magnitude of these numbers were compared, and four regressions were specified to analyze the robustness of both concentrations (HHI and MHHI) in relation to markups.

The MHHI values in the airline industry make it evident that common ownership links were present, and in order to use these values to quantify the anticompetitive impacts, a baseline regression was specified that utilized the MHHI Δ (the change in MHHI) and treated the HHI as a control. Following that, four additional models were used to further develop the relationship between MHHI and markups more thoroughly – these provided insight into how specific companies and specific pairings were impacted by horizontal shareholding. Lastly, since the airline industry experienced significant changes over time, a test was conducted to examine whether the effects MHHI Δ and HHI had similar magnitudes over time. In sum, this paper provides empirical evidence to show that, between 2010 and 2019, the markups of airline companies were positively and significantly related to the modified market concentration; and additionally, the conclusion is made that common ownership from institutional investors – regardless of their passivity – creates anticompetitive incentives that needs to be considered by antitrust regulators.

The paper proceeds as follows. Section II discusses previous literature. Section III discusses in detail the market concentration measurements utilized. Section IV develops a hypothesis. Section V describes the data used in the subsequent empirical analysis. Section VI analyzes the MHHIs at a fundamental level and compares it with the traditional market concentration index HHI. Section VII presents the baseline empirical methodology and results. Section VIII performs four additional regression specifications to further interpret the robustness of the analysis and relationships. Section IX evaluates how the link between the market concentration measures and markups vary over time. Finally, Section X concludes by referencing the results and the implications on antitrust regulations.

II. Literature Review

Although empirical studies and economics literature, in regards to common ownership and anticompetition, have gained some popularity in recent years, the previous theoretical literature which argues that diversified shareholders seek to maximize joint portfolio profits as opposed to individual corporate profit (or 'own profit'), and as a result, soften market competition, has existed quite profoundly. This paper aims to utilize existing theories to provide justification for analysis and complement this with an empirical analysis that modifies a recent paper by authors José Azar, Martin C. Schmalz, and Isabel Tecu (2018, revised from 2014).[6] This paper differs from AST and – additionally – contributes to the economic literature in the following ways: (i) provides an additional way to calculate the MHHI index (referred to as MHHI') that provides insight into what constitutes shareholder control for firm managers and is compared directly to the traditional calculation, (ii) uses markups, rather than prices, as the dependent variable to illustrate anticompetition in the airline industry, (iii) breaks down the analysis at the company-specific, and pairing-specific level, (iv) introduces a variable 'MHHI Δ addition' to measure how each pairing contributes specifically to the industry wide MHHI Δ, and (v) utilizes a scaled approach to calculate market share that controls for limitations in data.

This paper uses authors Daniel O'Brien's and Steven Salop's (2000) version of the modified Herfindahl-Hirschman Index (MHHI) to quantify the common ownership concentration in the airline industry. These authors show that the MHHI can be derived from a Cournot model of competition in which firm managers attempt to maximize the weighted average of their shareholders' interests.[7] O'Brien and Salop established that if HHI (the traditional market concentration) accurately measure the likelihood of anticompetitive effects from completely separate ownership, economic modeling indicates how to calculate MHHIs that measure the likelihood of anticompetitive effects in a way that takes into account partial-ownership overlaps among horizontal rivals (Elhauge, 2016, pp. 1273-1274). More importantly, these authors establish an economic model for these anticompetitive effects that does not require any coordination or communication among the firms. The fundamental effects of anticompetition arise from the fact that interlocking shareholdings diminish each individual firm's incentive to cut prices or expand output by increasing the costs of taking away sales from rivals.

[6] This paper will be referred to as AST.
[7] This derivation is further explored and presented in section *IILC*.

Additionally, horizontal shareholding could produce communications that aid in coordination among firm managers, that which would make these effects even worse; but no such communication is necessary for the basic anticompetitive effects and the structural incentives created by interlocking holdings suffice (Elhauge, 2016, pp. 1273-1274). Author Einer Elhauge (2016) notes that typically, firms tend to have a collective interest in having inflated market prices – i.e., they receive more money per output – but, when there are no horizontal shareholders, firms have a strong incentive to use price competition to undercut inflated prices to gain market share and increase 'own profit' (p. 1274, footnote 30). Ultimately, intra-industry diversified shareholders reduce the incentive for individual firms to undercut their rival's prices, regardless if accessible communication is probable or not.

Referring back to AST (2018), these authors offer an empirical study of common ownership in the airline industry. Unlike this paper, they consider each route as a different market, and calculate an HHI (which ignores horizontal shareholdings), a MHHI (which takes into account horizontal shareholdings) and a MHHI Δ (which is the difference between HHI and MHHI).[8] Ultimately, the MHHI Δ thus provides a good measure of the degree to which market concentration is increased by the stock acquisitions that create horizontal shareholdings (Elhauge, 2016, p. 1275). AST (2018) first find that their calculations are more than 10 times larger than what the U.S. Dep't of Justice & Fed. Trade Commission, Horizontal Merger Guidelines § 5.3 (2010) presume "to be likely to enhance market power" (p. 4). Using a fixed effect panel regression, they regress ticket prices on MHHI Δ, HHI, additional controls, and time/market fixed effects. They find that ticket prices are approximately 3% to 7% higher in the average U.S. airline route than would be the case under separate ownership.

[8] This paper treats the airline industry, as a whole, as one market and doesn't specify different values of market concentration at the route-level.

AST (2018) do mention that when interpreting the coefficient on MHHI Δ, "one should keep in mind that market shares (which enter into both MHHI delta and HHI) are potentially endogenous in ways that are likely to negatively bias this coefficient" (p. 21). These authors complement this panel regression methodology with a series of placebo and robustness tests to examine "the empirical validity of concerns regarding functional form, market definition, cofounding mergers and bankruptcies, reverse causality, the assumption that control is proportional to the fraction of votes held, and the model of competition" (p. 5). Notably, AST (2018) uses an instrumental variable (IV) design to exploit BlackRock's acquisition of Barclays Global Investors; in doing so, they aim to address endogeneity concerns with the variation of ownership and market shares. Their IV results indicate that product prices may be 10% to 12% higher due to common ownership, and this IV specification uses much less variation than the panel regression – which estimated price increases of 3% to 7%.[9] Although this paper doesn't replicate this specification, the endogeneity concerns AST (2018) refutes is worth keeping in mind. In sum, AST (2018) provided a fundamental understanding in how to adequately combine past economic theory in this field with proper empirical and regression analysis.

Authors Jose Azar, Sahil Raine, and Martin Schmalz (2019, revised from 2016) use substantial time-series and cross-sectional variation in branch-level deposit account interest rates, maintenance fees, and fee thresholds, to examine whether variation in bank concentration help explain the variation in these prices.[10] The importance of this study, in regards to this paper, is

[9] This strategy used only the variation in common ownership across routes that was implied by the hypothetical combination of the two parties' portfolios as of the quarter before the announcement of the acquisition. The intuition behind using this acquisition is that "since airline stocks constituted only a small fraction of the merging parties' portfolios, it is unlikely that this variation is driven by expected changes in U.S. airline ticket prices" (Azar et al., 2018, p. 6). In sum, they show that the BlackRock-Barclays combination of institutional investors increased airline prices on routes affected by the combination, compared to unaffected routes, using a regression that controlled not only for local economic conditions but also for differences across each route and carrier (Elhauge, 2016, p. 1276).

[10] This paper will be referred to as ARS.

their critique in using HHI alone as an explanatory variable in prices. ARS (2019) make note of the previous use – in past economic literature – of the traditional HHI in its correlation to prices, but indicate that these findings, and results, have been mixed. They write "one way in which the HHI model is inconsistent with factual reality is that it assumes that each bank is controlled by undiversified investors who do not own stakes in competitors" (p. 14). They utilize a 'generalized HHI' denoted as GHHI that can be derived, like the MHHI, from a Cournot game between competitors.[11] The GHHI differs from the MHHI this paper utilizes in the sense that it allows for simultaneous common ownership and cross-ownership; "when ultimate ownership is the same as direct ownership (as in the case in the study of airline competition) the MHHI and the GHHI are the same" (p. 17).[12] The authors examine the question of whether the HHI or the GHHI better captures variation in banking deposit products using a panel regression at the county level; this paper models this analysis with equations (1.a), (1.b), (2.a), and (2.b) in section *VI.C.2*. Lastly, they find that the relationship between concentration and fee amounts is much stronger and more robust when concentration is measured using the GHHI (p. 20).

Lastly, author Azar (2012) develops a model of oligopoly with shareholder voting to study the implication of portfolio diversification for equilibrium outcomes in oligopolistic industries. The relevance of this paper comes in Azar's empirical analysis between markups and networks of common ownership. He finds that, in sum, industries with a higher density of common ownership networks within the industry have higher markups (p. 3). Azar (2012) provided this paper with justification in using markups at the outcome variable – which is discussed in section *V.C* AST (2018) used ticket prices as the dependent variable to reflect anticompetitive practices; but, this paper aims to build on that analysis to see if common

11 Which is discussed in section *III.C*.
12 Cross-ownership refers to the extent to which banks own shares in each other.

ownership – as measured by MHHI – reflects changes in firm markups. Which, ultimately is the outcome variable that Azar (2012) used to formulate an empirical analysis of the relationship between common ownership and market power.[13]

Throughout this section, and the paper in general, author Einer Elhauge (2016, revised from 2015) is referenced. Elhauge's work is primarily theoretical, as he uses no empirical evidence, but provides great insight in the anticompetitive theory, the previous literature of the field, and the application that horizontal shareholding – and stock acquisitions – has on current legislation. His most substantive contribution, in regard to this paper, is about the 'passive investor.' As discussed in section *I.A*, the Clayton Act § 7 denounces that no person engaged in commerce should acquire a stock to the effect that such acquisition substantially lessens competition, or tends to create a monopoly. Additionally, it includes – in regard to the 'passive investor' – "this does not apply to persons purchasing such stock solely for investment and not using the same by voting or otherwise to bring about, or in attempting to bring about, the substantial lessening of competition." Author Elhauge (2016) categorizes the latter part of this act as the so-called passive investor "exception." He writes, this "does not immunize anticompetitive horizontal shareholdings of institutional investors." Agency guidelines make clear that antitrust regulators do consider partial stock acquisitions as anticompetitive if it "gives the acquirer an ability to influence the target that might produce anticompetitive effects" (p. 1306). Additionally, it is critical to distinguish between 'passive investing' and 'passive ownership.' Although a lot of institutional funds follow a 'passive investment strategy – as with an index fund that makes no active decisions in stock acquisitions, but purchases based on some index – practitioners point out that "having a passive investment strategy has nothing to do with

[13] Instead of using only one industry, Azar (2012) compiles a sample of 7,277 U.S. and Canadian firms (p. 32).

your behavior as an owner (Azar et al., 2018, p.10).[14] Elhauge (2016) argues that a purely passive investment could lessen competition if it "simply lessens the incentives of the firms to compete with each other, even though the investors never use their stock to affirmatively influence business conduct" (p. 1308). Ultimately, he concludes that, the passive investor "exception," in reality, is not an exception at all; but rather, it means that a different standard of proof applies to purely passive investments. With this in mind, this paper aims to prove, through an analysis of firm markups, that even if investors who hold horizontal stock were purely passive, the passive investor "exception" is still negated; and in sum, leaves horizontal shareholders subject to challenge under § 7 of the Clayton Act.

III. Concentration Measures

In order to use empirical data (which is discussed in section *V*) to investigate if common ownership of firms competing in an industry has anticompetitive effects – which in this paper, would be reflected through markups – a measurement needs to be constructed that quantifies the extent to which firms are connected in regard to their intra-industry diversified shareholders. This measure, as briefly mentioned, is denoted as the 'modified Herfindahl-Hirschman Index' MHHI. This paper uses O'Brien and Salop's (2000) derivation of this index to capture the degree in which shareholders' interests are linked through their ownership and control in competing firms. Given that the MHHI is derived implicitly through the development of the traditional HHI, and the fact this paper will analyze their comparison and incorporates both simultaneously in regression analysis, it is important to first explain this conventional measurement (HHI).

[14] See: Scott, M. (2016). Passive investment, active ownership. *Financial Times*. https://www.ft.com/content/7c5f8d60-ba91-11e3-b391-00144feabdc0

A. HHI Derivation

The Herfindahl-Hirschman Index (HHI) is the standard measurement of market concentration used by regulators and those conducting research in the competitive landscape of different markets/industries. The equation for the HHI is shown below – it is the sum of the market shares squared for all firms in a given industry

$$HHI = \sum_j S_j^2,$$

where s_j is the market share of firm *j*. In relation to outcomes for firms – price, markups, or profit margin – this measure of market concentration is only meaningful if each firm seeks to maximize its own profit; i.e., each firm acts in the financial interest of an investor who has no wealth invested in other firms in the industry (ARS, 2019, p. 13).[15] Additionally, and as shown in the derivation below, the HHI arises as a natural consequence of assuming that a given market's structure is described by Cournot competition.[16]

Consider a Cournot model of competition between *n* firms with different marginal costs and a homogenous product. The profit function of the i_{th} firm is

$$\pi_i = P(Q)q_i - c_i q_i,$$

$$Q = \sum_{i=1}^{n} q_i,$$

where q_i is the quantity produced, c_i is the marginal cost of production for each firm, and *P(Q)* is the price of the product. Taking the derivative of the firm's profit function with respect to output in order to maximize profit gives the equation:

$$\frac{\partial \pi_i}{\partial q_i} = P'(Q)q_i + P(Q) - c_i \rightarrow -\frac{dP}{dQ} q_i = P - c_i.$$

[15] These 'investors' are thus not intra-industry diversified shareholders.
[16] Cournot competition is an economic model used to describe an industry structure where all the firms, or players, compete in regard to their choice of output production; and in making these production decisions, they decide independently of one another and at the same time.

Each firm's profit margin is given by dividing by P, where s_i (the market share) is $\frac{q_i}{Q}$ and η is the elasticity of demand:

$$\frac{P-c_i}{P} = -\frac{dP}{dQ}\frac{q_i}{p} = -\frac{\frac{dP}{P}}{\frac{dQ}{Q}}\frac{q_i}{Q} = \frac{s_i}{\eta}.$$

Multiplying each firm's profit margin by its market share, where H is the Herfindahl-Hirschman Index (HHI), you get:

$$s_1\frac{p-c_1}{p} + \cdots + s_n\frac{p-c_n}{p} = \frac{H}{\eta}.$$

In sum, under these assumptions, if firms compete à la Cournot, markups $\frac{P-C\prime_j(X_j)}{P}$ in a given market will be proportional to the markets HHI, where $C'_j(X_j)$ is the total cost of firm *j's* output and $P - C'_j(X_j)$ is firm *j's* net profit:[17]

$$\eta \sum_j s_j \frac{P-C\prime_j(X_j)}{P} = HHI = \sum_j S_j^2.$$

As mentioned by authors ARS (2019), "existing work finds mixed results on the correlation between the HHI and prices, especially for regressions in changes" (p. 14). They argue that the relationship displayed above, between markups and HHI, is inconsistent with 'factual reality (p. 14);' it implicitly assumes that each firm is controlled by shareholders who don't also own shares horizontally in an industry – i.e., they don't have stake in competitors. Ultimately, the HHI doesn't capture the extent in which firm competitors are connected through common ownership, and this is where MHHI is useful.

[17] Markups are defined as the percentage difference between gross profit and cost $\frac{P-C\prime_j(X_j)}{C\prime_j(X_j}$ and margins refer to the percentage difference between gross profit and selling price $\frac{P-C\prime_j(X_j)}{P}$. Breaking down the markup equation you get: $\frac{P}{C\prime_j(X_j)} - \frac{C\prime_j(X_j)}{C\prime_j(X_j)} \to \frac{P}{C\prime_j(X_j)} - 1 \to P - C'_j(X_j)$. Breaking down the margin equation you get: $\frac{P}{P} - \frac{C\prime_j(X_j)}{P} \to 1 - \frac{C\prime_j(X_j)}{P} \to P - C'_j(X_j)$. In sum, $\frac{P-C\prime_j(X_j)}{P}$ refers to markups.

B. MHHI Derivation

The MHHI index, as mentioned, captures the extent in which firm's owners also own shares in their competitors within in an industry. Before delving into its derivation – using a Cournot model of competition developed by O'Brien and Salop (2000) – it is important to define this index and the parameters it includes. The equation for MHHI is

$$MHHI = \sum_j \sum_k s_j s_k \frac{\sum_i \gamma_{i,j}\beta_{i,k}}{\sum_i \gamma_{i,j}\beta_{i,j}},$$

where $\beta_{i,j}$ is the ownership share (or cash-flow rights) of firm *j* accruing to shareholder *i*, $\gamma_{i,j}$ is control share of firm *j* exercised by shareholder *i* based on a shareholder's voting or sole voting shares and $S_{i,j}$ is the market share of firm *j*.

The MHHI, in this analysis – and should be in all economic research – represents the total market concentration. A useful property of this index is its ability to decompose market concentration into two parts: industry concentration as measured by HHI ($\sum_j S_j^2$), and common ownership concentration, which is referred to as MHHI Δ. In terms of market competition, HHI – given that it only includes parameters for market size – captures the relative size and number of firm competitors, while MHHI Δ captures the extent in which these competitors are connected through common ownership (Azar et al., 2018, p. 13). Formally, MHHI is equal to

$$\underbrace{\sum_j \sum_k s_j s_k \frac{\sum_i \gamma_{i,j}\beta_{i,k}}{\sum_i \gamma_{i,j}\beta_{i,j}}}_{MHHI} = \underbrace{\sum_j S_j^2}_{HHI} + \underbrace{\sum_j \sum_{k \neq j} s_j s_k \frac{\sum_i \gamma_{i,j}\beta_{i,k}}{\sum_i \gamma_{i,j}\beta_{i,j}}}_{MHHI\Delta} \rightarrow\ MHHI = HHI + MHHI\Delta.$$

As shown, the MHHI Δ represent the difference between the MHHI and the HHI. Since the HHI calculation ignores horizontal shareholding while the MHHI takes this into account – and since the MHHI Δ is the difference between these two measurements – the MHHI Δ thus provides a good measure of the degree to which market concentration is increased by stock acquisitions that create horizontal shareholdings within an industry. The equation for MHHI Δ is

$$MHHI\Delta = \sum_j \sum_{k \neq j} s_j s_k \frac{\sum_i \gamma_{i,j}\beta_{i,k}}{\sum_i \gamma_{i,j}\beta_{i,j}}.$$

To illustrate the relationship between MHHI and HHI more clearly, consider the following example. If two firms each have 50% market share, the HHI would equal 5,000 ($50^2 + 50^2 = 5{,}000$).[18] If the firms are separately owned, the MHHI Δ is 0; and the MHHI equals the HHI at 5,000. If, perhaps, the two owners swap 50% of their shares with each other, they now both receive 50% of the profits from each firm. Given this, it is in their (the shareholders) best interest if the two firms act as if they were two divisions of a monopoly (recall the arguments made in section *I.A*). Regardless, the HHI doesn't not reflect this interest and because the two firms are still formally independent, it remains at 5,000. But the effective, or total, market concentration, reflected by a MHHI of 10,000, is identical to that of a monopoly (AST Internet Appendix, 2018, pp. 3-4).

Similar to the HHI, the MHHI measurement can also be derived from a Cournot model of competition in which firms maximize a weighted average of their shareholders' interests. In this case, common ownership concentration, as measured by MHHI Δ, is a measurement of the anticompetitive incentives of common ownership if the commonly owned firms compete à la Cournot. Per the HHI model shown above, in section *III.A*, when firms are assumed to maximize nothing but their own profits, the traditional HHI is an adequate measurement of market concentration. This paper – and throughout the analysis – does not interpret the Cournot model literally; instead, MHHI Δ is interpreted as a reduced-form measure of common ownership concentration (similar to the way previous models have used HHI as a reduced-form measure of market concentration). The MHHI derivation from a Cournot model of competition established

18 The HHI can range from 100 (perfect competition with all 100 firms having an equal 1% market share) to 10,000 (1 firm with 100% market share).

by O'Brien and Salop (2000) helps inform this paper's interpretation of empirical results and clarifies potential sources of endogeneity.

C. Cournot Competitor Model of Common Ownership

As shown, the HHI measure of market concentration is meaningful if each firm maximizes its own profits; i.e., each firm acts in the financial interest of an investor who has no wealth invested in other firms in the industry. Under that assumption, if firms compete à la Cournot, markups in a given market will be proportional to the market's HHI:

$$\eta \sum_j s_j \frac{P - C\prime_j(X_j)}{P} = HHI = \sum_j S_j^2.$$

The MHHI derivation, like the HHI, assumes that firms are Cournot competitors. Recall the notation introduced above: shareholder *i's* ownership share (or cash-flow rights) in firm *k* is $\beta_{i,k}$ (shares denoted as 'sole voting shares,' 'shared voting shares,' and 'no voting shares' were combined in this paper's calculation of this variable) and shareholder *i's* control share (based on their sole and shared voting shares) in firm *j* is $\gamma_{i,j}$. The total portfolio profits of shareholder *i* is $\pi^i = \sum_k \beta_{i,k} \pi_k$ – where π_k are the profits of portfolio firm *k* and $\beta_{i,k}$ represents the ultimate financial interest of shareholder *i* in firm *k*. The main assumption in the idea that common ownership has anticompetitive effect relies on the fact that when powerful shareholders hold stakes in other firms, the managers of firms must pay attention to the interests of these shareholders.[19] On the other hand, when firms are owned by undiversified and concentrated shareholders, aggressively pursuing a growth strategy at the expense of their rivals – even if it reduces industry-wide profits – is a viable option (AST Internet Appendix, 2018, p. 2). Ultimately, each firm manager maximizes the weighted average of its shareholders economic

[19] In other worlds, when these shareholders are intra-industry diversified – and hold stakes in competitors – the goal for these firm managers may be to refrain from output increases and price undercuts.

interests (Azar et al., 2019), This intuition is captured by the following objective function in an industry with N competitors, which are owned by M shareholders, where x_j is the strategy of firm j:[20]

$$Max_{x_j}\Pi_j = Max_{x_j}\sum_i^M \gamma_{i,j}\pi^i = Max_{x_j}\sum_{i=1}^M \gamma_{i,j}\sum_{k=1}^N \beta_{i,k}\pi_k.$$

To better interpret this formula, the order of sums was changed, π_k was taken out of the second sum, and the equation was divided by $\sum_i \gamma_{i,j}\beta_{i,k}$. The objective function can be rewritten as:

$$Max_{x_j}\Pi_j = \pi_j + \sum_{k\neq j}\frac{\sum_i \gamma_{i,j}\beta_{i,k}}{\sum_i \gamma_{i,j}\beta_{i,j}}\pi_k.$$

In words, this formula shows that firm *j* maximizes its own profits plus a linear combination of the profits of other firms in which its shareholders hold stakes in. Firm *j* will not compete quite so hard with more commonly owned competitors as it does with competitors that are not part of firm *j's* largest shareholder's portfolios (Azar et al., 2019). The weight that firm *j* puts on the profits of firm *k* in its objective function relative to its own profits is given by $\frac{\sum_i \gamma_{i,j}\beta_{i,k}}{\sum_i \gamma_{i,j}\beta_{i,j}}$.[21] This ratio provides for a meaningful measure of how connected two firms are in regards to their common shareholders. In sum, the manager of a firm contemplates two things when considering their strategic actions: one, the benefits to their firm ('own profit') and two, the portfolio gains or losses for diversified shareholders. Ultimately, the objective function renders the idea that firm managers act in the interest of their shareholders, and given that, it is reasonable to use this assumption to investigate, and predict, firm behavior. Applying this model to the Cournot setting, the objective function of firm *j* is

$$Max_{x_j}\sum_{i=1}^M \gamma_{i,j}\sum_{k=1}^N \beta_{i,k}[P(X)x_k - C_k(x_k)],$$

20 Firm *j* implements these incentives of his shareholders by maximizing a weighted average of its shareholders' portfolio profits, where the weights are given by the control weights $\gamma_{i,j}$.

21 Note, the weights are asymmetric; the weight firm *j* gives firm *k* in its objective function will in general be different from the weight firm *k* gives firm *j*.

where $\pi_k = P(X)x_k - C_k(x_k)$ are profits in a Cournot model, $P(X)$ is the inverse demand function for the homogenous good, x_k is the quantity produced by firm k and $C_k(x_k)$ are the associated costs. The first order condition is taken below; this represents a weighted average of the first-order conditions for the maximization of the profits of each shareholder:

$$\sum_{i=1}^{M} \gamma_{i,j}\{ \beta_{i,j}\left[P(X) - C_j'(x_j)\right] + \sum_{k=1}^{N} \beta_{i,k} P'(X)x_k\} = 0.$$

Lastly, with some algebraic manipulation of the first-order condition, the following equation shows that in equilibrium, the market-share weighted average markup in an industry is given by:

$$\sum_j s_j \frac{P - C_j'(X_j)}{P} = \frac{1}{\eta}\left[\sum_k \sum_j s_j s_k \frac{\sum_i \gamma_{i,j}\beta_{i,k}}{\sum_i \gamma_{i,j}\beta_{i,j}}\right].$$

In regard to this condition, in the standard Cournot model with no partial ownership – i.e., all separately owned firms – the market-share weighted average markup in an industry is proportional HHI. In other words, the bracketed terms would equal $\sum_j S_j^2$, and this provides for a theoretical justification in the use of HHI as a measurement of market power in the case of no common ownership. Using the same rules to develop the case of intra-industry diversified shareholder, O'Brien and Salop (2000) propose using the MHHI defined as the following:

$$MHHI = \sum_j \sum_k s_j s_k \frac{\sum_i \gamma_{i,j}\beta_{i,k}}{\sum_i \gamma_{i,j}\beta_{i,j}}.$$

Lastly, by separating out the terms for which $k=j$, this expression can be rewritten as:

$$MHHI = HHI + \sum_j \sum_{k \neq j} s_j s_k \left(\frac{\sum_i \gamma_{i,j}\beta_{i,k}}{\sum_i \gamma_{i,j}\beta_{i,j}}\right).$$

Thus, the MMHI is equal to the HHI plus a set of terms reflecting the competitive effects of common ownership within the industry. And when starting from a position of zero partial ownership interests, the MHHI Δ for a particular new ownership structure can be measured by the summation terms in the equation above (O'Brien & Salop, 2000) In sum, applying the generalized objective function to a Cournot setting renders:

$$\eta \sum_j s_j \frac{P - C_j'(X_j)}{P} = \underbrace{\sum_j \sum_k s_j s_k \frac{\sum_i \gamma_{i,j} \beta_{i,k}}{\sum_i \gamma_{i,j} \beta_{i,j}}}_{MHHI} = \underbrace{\sum_j S_j^2}_{HHI} + \underbrace{\sum_j \sum_{k \neq j} s_j s_k \left(\frac{\sum_i \gamma_{i,j} \beta_{i,k}}{\sum_i \gamma_{i,j} \beta_{i,j}}\right)}_{MHHI\Delta}.$$

In terms of variables that effect MHHI Δ, there are four main determinants worth noting (Lambert & Skyuta, 2018, pp. 10-11). First is the degree of control intra-industry diversified investors exercise over the managers of their portfolio firms. The greater the control these shareholders have the higher the MHHI Δ. Second is the size of the financial stakes – or shares – that the intra-industry diversified investors hold in the firms within the industry; and additionally, the degree to which, for each investor, those stakes are equal across firms. The larger the stakes of intra-industry diversified shareholders and the more equal those stakes across firms, the higher the MHHI Δ. Intuitively, investors have a greater interest in industry-wide profits, rather than own-firm profits. Third is the degree to which the firms within the industry have non-diversified shareholders with control over firm management. The greater the stakes and control of investors who don't hold horizontal shares in an industry, the lower the MHHI Δ. Fourth is the market shares of firms that share common ownership by investors. The greater the market shares, the greater the market effect of management's decisions concerning competitive behavior, and the higher the MHHI Δ.

IV. Hypothesis

The main research question of this paper is to examine if anticompetitive effects, and practices, arise when intra-industry diversified shareholders hold shares in competing firms in an industry. The above literature, as discussed, provides the fundamental intuition for this theory. In sum, the common ownership theory predicts that shareholders who have ownership stakes across an industry are able to implicitly, and inherently, influence the decision-making process of firm managers to reflect said shareholder's interests. And ultimately, in doing so, soften market competition as a result. Before delving into the empirical methods and specifications used to analyze this hypothesis, the theoretical argument for this claim must be considered and revisited. Referencing authors Lambert and Sykuta (2018, p. 19) the argument in regard to the above claim proceeds as follows:

Premise 1: Because institutional investors are intra-industry diversified, they rather the firm managers of their portfolios in concentrated industries seek to maximize industry, rather than own-firm, profits.

Premise 2: Corporate managers seek to maximize the returns of their corporations' largest shareholders – which are proven to be intra-industry diversified institutional investors – and will thus pursue maximization of industry profits.[22]

Premise 3: Industry profits, unlike own-firm profits, are maximized when producers avoid undercutting their competitors' prices in order to increase market share and win business; i.e., industry profits are maximized using anticompetitive practices.

The conclusion from this theory, given these premises, is in industries where institutional investors, or shareholders, diversify their shares within the industry – and across competitors – price competition will be reduced.

Ultimately, the empirical question this paper aims to address is whether common ownership concentration, as measured by the modified market concentration index – MHHI – has explanatory power for markups (which is discussed in section *V.C*) of firms after controlling for the traditional market concentration index – HHI. If MHHI does not capture an important part of shareholder incentives – as reflected through a firm's markup – or if frictions are seemingly

22 Table 1 illustrates the ownership statistics in the airline industry and proves that the biggest shareholders are indeed intra-industry diversified.

present that prevent the implementation of shareholders' anticompetitive incentives, empirical tests should support the null hypothesis.

H_0: Common ownership concentration, as measured by MHHI Δ, has no effect on markups of firms.

If, on the other hand, economic incentives, as captured by MHHI, explain economic outcomes – reflected by markups – in some form, the alternative hypothesis should find support.

H_1: Common ownership by diversified investors, as measured by MHHI Δ, has a positive effect on the markups of firms.

A. Proportional Control Assumption

This paper tests these hypotheses using two main methods to calculate MHHI and MHHI Δ. The distinctions between these calculations has to do with the *proportional control assumption*; which in short, means that for all shareholders, ownership – as measured by $\beta_{i,j}$ – is considered to be the only parameter that influences the decisions that firm managers make when considering their shareholders.

The first MHHI is based on the originally designed calculation by O'Brien/Salop (2000) and is represented by the notation illustrated earlier: $MHHI = \sum_j \sum_k s_j s_k \frac{\sum_i \gamma_{i,j}\beta_{i,k}}{\sum_i \gamma_{i,j}\beta_{i,j}} + \sum_j S_j^2$. In this case, the proportional control assumption, between shareholders, is not assumed.[23] Additionally, influence over management is based on both the ownership shares and the control share of firm *j* exercised by shareholder *i*. – which is denoted as $\gamma_{i,j}$ and takes into consideration the voting rights of the shareholder *i*. It is quite natural to assume that $\gamma_{i,j}$ is a non-decreasing function of $\beta_{i,j}$. In other words, as *i's* ownership of firm *j* increases, the manager of firm *j* would

[23] I.e., both ownership – $\beta_{i,j}$ – and control – $\gamma_{i,j}$ – are included in the calculation.

place more weight on shareholder *i's* objective function and grant them more control. It is also quite likely that $\gamma_{i,j}$ doesn't only depend on $\beta_{i,j}$ but also the entire ownership structure of the firm. For example, if ownership share $\beta_{i,j} = .49$ or 49%, this might result in almost full control if all other shareholders are small; or, on the other hand, if the other 51% is held by one shareholder, this could result in almost no control (Gramlich & Grundl, 2017, p. 8). This disparity is the reason for considering the distinction between $\beta_{i,j}$ and $\gamma_{i,j}$; i.e., regardless of ownership stake, the type of shares held – reflected by $\gamma_{i,j}$ in terms of voting shares – must be considered when properly analyzing the influence that these shareholders have over firm management.

The second method of calculation assumes proportional control; meaning, the shareholder's influence depends strictly on their ownership. This method treats the variables $\beta_{i,j}$ and $\gamma_{i,j}$ to be equal; in other words, it puts no specification on the difference between the ownership that the shareholder has and the control, from voting shares, they have over the manager of a firm. – e.g., $\beta_{i,k} = \gamma_{i,j}$. This assumption is followed in the previous literature and assumes that the ownership that the shareholder has is equivalent to the control they have over the manager of a firm (Gramlich & Grundl, 2017, p. 8). Moving forward, this calculation – that of proportional control – of MHHI will be denoted as MHHI' and the equation is: $MHHI' = \sum_j \sum_k s_j s_k \frac{\sum_i \beta_{i,j}\beta_{i,k}}{\sum_i \beta_{i,j}^2} + \sum_j S_j^2$. The benefit of using this alternative calculation is to properly examine how the effect of common ownership on firm managers differs when ownership, alone, entirely represents influence. In other words, the question that arises, given these two calculations is: do firm managers consider the type of shares their shareholders have, or merely just the amount of these shares?

Lastly, one final remark in regard to these distinctions: since it is the case that if owner *i* increases their ownership of firm j, two terms in manager *j's* objective function will increase – $\beta_{i,j}$ and $\gamma_{i,j}$ – implicitly, the objective function of the manager depends on the interaction between these two variables ($\beta_{i,j}\ \gamma_{i,j}$). So, when estimating the competitive effects of common ownership, the proportional control assumption ($\beta_{i,k} = \gamma_{i,j}$), may result in large shareholders having a disproportionate impact. Moving forward, these different calculations provide for a useful way in interpreting the impact common ownership has on anticompetition. Consider the scenarios below:

1. *MHHI is a better predictor of the common ownership theory than MHHI'.*
2. *MHHI' is a better predictor of the common ownership theory than MHHI.*

If case 1 becomes evident, then the assumption is that in the case of intra-industry diversified shareholders, firm managers consider the type of shares these shareholders have when contemplating to soften market competition. If case 2 becomes evident – that of assuming proportional control – then the assumption is that firm managers merely just consider how much ownership their shareholders have when making these same decisions. The rationale prediction would be case 1; i.e., the proportional control assumption is a less realistic calculation when considering the influence that shareholders have over management. Regardless, both case 1 and case 2 should provide for an analytical interpretation. Although these calculations represent the total MHHI measurement, they can be extended to MHHI Δ – because, recall in section *III.B*, the MHHI is the sum of the MHHI Δ and the HHI index. In this case:

$$MHHI'\Delta = \sum_j \sum_{k\neq j} s_j s_k \frac{\sum_i \beta_{i,j}\beta_{i,k}}{\sum_i \beta_{i,j}^2}.$$

V. Data

A. Market Share

In order to calculate the MHHI, industry-specific market share data needed to be compiled. Although market share is used directly in calculating the MHHI index,[24] these figures were also used to determine which U.S. publicly traded companies would be analyzed in an industry.[25] In other words, the selection of firms – in this case airline companies – was based on their market size.

Market share data for the airline industry was taken from Euromonitor International (also known as Passport).[26] Specifications were placed on the *travel* industry under category *Airline*. Geography was filtered to the U.S. and market share statistics were denoted as *Company Shares*. Data was taken annually from 2010 to 2019q1; but given the availability of quarterly ownership data, these percentages were aggregated across the four quarters of the year.[27]

The Euromonitor market share dataset includes companies that are privately held. Since ownership data is unavailable for these companies, in order to control for the shares that these companies hold, the market share for the U.S. publicly traded companies was scaled based on the airlines used in a given quarter. For example, if there were only three U.S. publicly traded airlines used in 2010q1, the sum was taken between these three firms, and the individual market share was divided by the industry total to get the scaled – or relative – market share for each

24 Recall: $MHHI = \sum_j \sum_k s_j s_k \frac{\sum_i \gamma_{i,j}\beta_{i,k}}{\sum_i \gamma_{i,j}\beta_{i,j}} + \sum_j S_j^2$, where s_j is the market share of firm *j* and s_k is the market share of firm *k*.

25 In a previous analysis, industries – in this case the beer industry – were considered to be the main scope of the paper. But, given that two major players – Anheuser Busch InBev and Heineken International – were based internationally, ownership shares weren't adequately available. Instead, American Depositary Receipts (ADRs) – which is a negotiable certificate of title to a number of shares in a non-US company which are deposited in an overseas bank – were used; and this was problematic. Ultimately, an industry with all the major players being U.S. publicly traded companies was necessary.

26 Passport is Euromonitor's global market research database.

27 For example, 2018 annual data was aggregated to 2018q1, 2018q2, 2018q3, 2018q4. Problems with this assumption are mentioned later on.

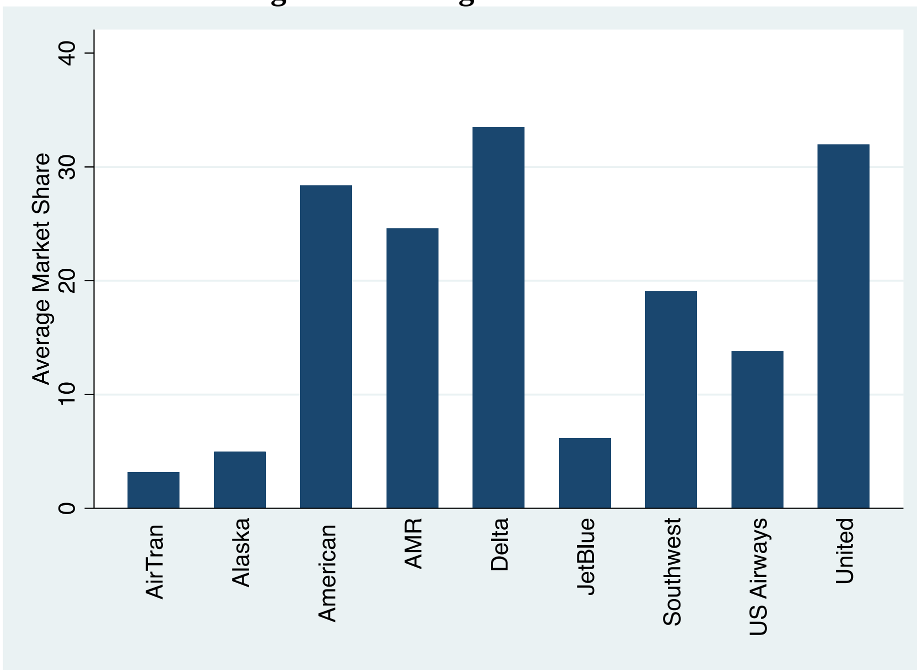
company. Also, this technique helps reduce the bias in using annual data as quarters. For example, if there was a merger mid-year, this would likely affect the rest of the industries' quarterly market share data; which wouldn't necessarily be illustrated in annual market share data. To control for this, now, when a merger happened, the newly formed company's market share is included in the total for that mid-year quarter; and the relative market share for each other company – since it is divided by the industry total – changes in a similar fashion to how it would realistically. This technique helps control for quarters when the number of total companies included in the data set differs.

Figure 1 shows the average market share for all airline companies included in this analysis. There were nine total companies included between 2010-2019q1 (37 quarters); but given the availability of the ownership data, which is discussed below in section *V.B*, and the three major merger events, not all nine companies were included in each quarter.[28] In total, across the airline industry, there were 198 market share observations from 2010 to 2019q1.[29]

[28] From 2010 to 2019q1 there were three notable mergers that needed to be identified when compiling the appropriate data. The United-Continental merger was announced in May 2010 and became effective in October 2010; the Southwest-AirTran merger was announced in September 2010 and became effective in March 2012; and the AMR (American was formally known as AMR)-US Airways merger was announced in February 2013 and became effective in November 2013.

[29] Delta, Southwest, Jet Blue, and Alaska Airlines had ownership data available for all 37 quarters (37 quarters * 4 companies = 148 observations). AMR and US Airways just had 2010 (4 quarters * 2 companies = 8 observations). United Airlines data became available after 2010q4 (34 quarters = 34 observations). AirTran stopped reporting ownership after 2011q1 (5 quarters). American Airlines data was available from 2018q3-2019q1 (3 quarters = 3 observations). Adding all the observations together – based on the ownership data available – there is 198 total quarters of data available.

Figure 1: Average Market Share



Notes: Figure 1 shows the average market share for all 9 airline companies over the analyzed time period – 2010q1-2019q1 (37 total quarters). The y-axis represents the market share that was scaled based on the number of companies included in the given quarter.
Source: Euromonitor International.

B. Ownership

To construct the common ownership network necessary for the calculation of MHHI, institutional holdings were compiled from the Thomson Reuters (TR) spectrum data set that comes from 13F filings. This data includes all U.S. holdings of publicly traded firms by institutional investors. The TR data set includes information on the number of shares that are sole voting shares, shared voting shares, and no voting shares.

In total, across all 37 quarters and nine companies, there was 91,644 shareholder observations. Dates were compiled based on 'report dates.' Because the 13f filings occasionally reports some holdings separately from the parent company or fund family, ownership and control rights were aggregated to the unit at which the control is exercised. Keeping these shares independent would have been problematic; because ultimately, parent companies or fund families generally vote their voting shares together and the relative size of investors determines their relative power to control or influence a firm. For example, the holdings of Blackrock Advisors, Blackrock Asset Ireland, Blackrock Inc, Blackrock Investment Management, Blackrock UL and Blackrock Japan were aggregated. After this collection for all shareholders, there were 84,448 shareholder observations. To shed light on the extent of common ownership in the U.S. airline industry, the top-10 shareholders and their ownership percentage as of 2011q1 is displayed in table 1; going from smallest to largest as you move down the row.[30]

Table 1: Within-Industry Common Shareholder Links

AirTran	***%***	***Alaska***	***%***	***Delta***	***%***
D.E. Shaw & Co	2.461623	Mellon Bank	2.489105	TCW	2.050156
Fidelity	2.621397	T. Rowe Price	2.503278	Vanguard	2.379918
State Street	3.426998	Dimensional Fund	2.566358	Capital Group	3.578137
Havens Advisors	3.858529	AXA Financial	2.70437	Watzata	3.638286
Vanguard	4.366948	Wells Fargo	2.857442	Capital World	3.644259
Pentwater Capital	4.779412	State Street	3.949069	Fidelity	5.002188
Westchester	5.734927	Renaissance	4.439722	Wellington Mgmt	5.418122
Arbitrage & Trade	6.344559	Vanguard	5.09015	AXA Financial	6.05539
Donald Smith Co	8.942442	PrimeCap	7.35375	Janus Henderson	6.908639
Blackrock	10.30015	Blackrock	9.357519	Blackrock	10.13588
JetBlue	***%***	***Southwest***	***%***	***United***	***%***
State Street	2.79225	Wellington	2.222204	Capital Growth	2.568389
Dimensional Fund	3.503535	Fidelity	2.288063	Evercore Trust	2.736587
Federate Equity	3.64283	Manning &Napier	3.31125	Legg Mason	2.90887
Vanguard	3.754104	State Street	3.392654	Par Capital	3.537049
MSDW & CO	5.750879	Vanguard	3.769422	Vanguard	3.905064
Goldman Sachs	5.944755	Par Capital	3.960388	Capital World	5.45666
Blackrock	6.131554	T. Rowe Price	5.535782	Blackrock	5.917209
PrimeCap	6.330527	Blackrock	8.196965	Wellington Mgmt	8.035963
Donald Smith	9.91624	PrimeCap	10.61603	Janus Henderson	8.978364
Fidelity	14.92683	Capital Group	11.70352	Fidelity	9.878772

Notes: Table 1 shows the top-10 shareholders for all the airline companies included in 2011q1. Refer to footnote 29 for information on the availability of airline data. The right column for each airline represents the ownership shares – which is equal to $\beta_{i,j}$ shown in section *III.B* – of each shareholder. This was calculated by taking the total shares (regardless of if they were denoted as 'shared voting,' 'sole voting,' or 'no voting shares') and dividing by the total shares outstanding of the airline in that period.
Source: Thomson Reuters 13f Filings.

[30] Note, in this quarter, there were only six companies included in the TR dataset. The details of this is explained further in section *VI.C*.

C. *Markup*

Compustat fundamentals quarterly North America was used for accounting data. Variables included cost of goods sold (cogsq) and revenue (revtq). To remain consistent with the Thomson Reuters data set, dates were compiled based on ‘data dates;’ which is the same as the ‘report date’ used for ownership. Data was dropped to match the observations numbers from Thomson Reuters – refer to footnote 29 for availability of data. Given this, there was the same 198 total observations for cost and revenue as there was for market share.

The outcome variable used in this analysis is markups. In previous literature – (Azar et al., 2018) – price was used as the dependent variable to reflect anticompetitive practices; but, this paper aims to build on that analysis to see if common ownership – measured by MHHI – reflects changes in firm markups that ultimately render anticompetitive practices through an assumed price increase; that being, one that benefits producers but hurts consumers.

Markups were calculated by dividing gross profit by cost. $Cost_{r,t}$ is the total quarterly cost for company *r* in quarter *t* and $Revenue_{r,t}$ is the total quarterly revenue for company *r* in quarter *t*. Each company has one markup number for each quarter they were included in. Refer to the equation below:

$$Markup_{r,t} = \frac{Gross\ Profit_{r,t} = (Revenue_{r,t} - Cost_{r,t})}{Cost_{r,t}}.$$

Referring back to the Cournot model of competition established by O’Brien and Salop (2000), they produced an economic model that equates market concentration to a company’s markup. As discussed, the measure of market concentration is meaningful if each firm maximizes its own profits. Under that assumption, if firms compete á la Cournot, markups $\frac{P - C_j'(x_j)}{P}$ in a given market will be proportional to the market’s HHI:

$$\sum_j s_j \frac{P - C_j'(X_j)}{P} = HHI = \sum_j S_j^2.$$

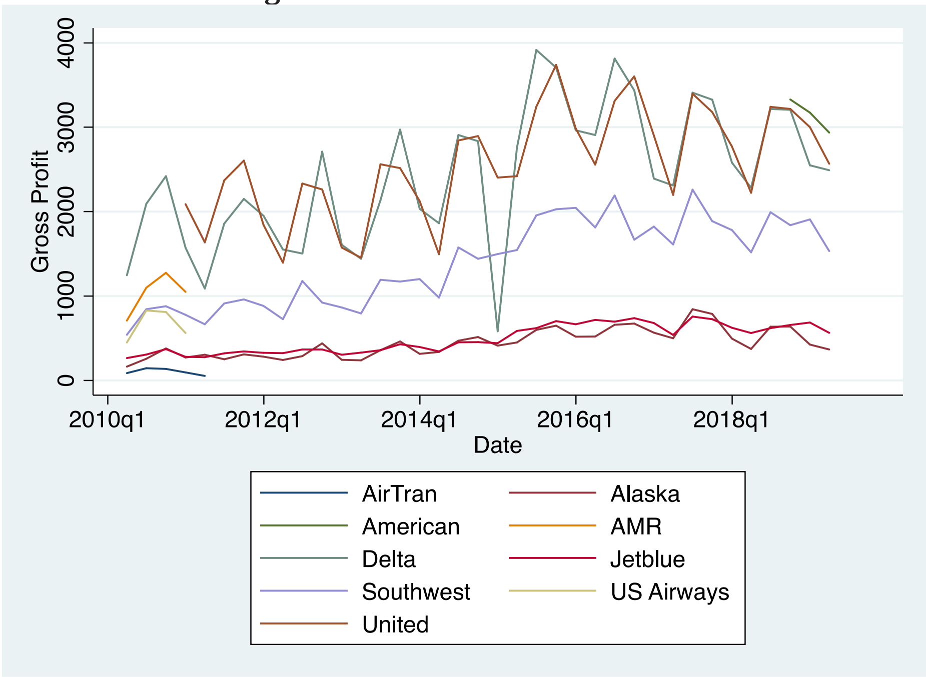
If firms represent the interest of their intra-industry diversified investors' economic interest, and again compete á la Cournot, markups are proportional to the MHHI index:

$$\eta \sum_j s_j \frac{P - C_j'(X_j)}{P} = MHHI = \sum_j \sum_k s_j s_k \frac{\sum_i \gamma_{i,j} \beta_{i,k}}{\sum_i \gamma_{i,j} \beta_{i,j}}.$$

Given the availability of airline pricing data, this paper followed Azar's (2012) approach in applying the structure offered by O'Brien and Salop (2000) to perform an empirical analysis with markups. Lastly, this paper modifies the O'Brien and Salop (2000) model slightly and uses average markup rather than markup on the margin – which is what the theory refers to. In other words, this calculation uses average cost rather than marginal cost – and thus, it is a measure of the average markup, rather than the markup at the margin (assumed by $\frac{P - C_j'(X_j)}{P}$). The main advantage of using average markup is that it is possible to calculate using standard account data. It is important to understand this distinction, but for the entirety of the paper, the variable will be simply denoted as markups. In some regression analysis, the average markups are displayed; this refers to the mean value across the industry; and not the type of average – that dealing with average cost – just discussed; the details of this specification are explained when utilized.

In reality, for any company, markups are influenced by variables other than market concentration; whether that be, for example, stock turnover or possibly the availability of goods. With that in mind, the combined data set, between ownership and markups is in *Panel Data* form – which intuitively, is a data set in which the behavior of entities (in this case companies) are observed across time. Figure 2 explores the panel data in regard to gross profit for each company over time. As shown, the nine airline companies have varying levels of gross profit across the years.

Figure 2: Gross Profit Over Time



Notes: Figure 2 is a line graph showing the gross profit of each airline per quarter over time (between 2010q1 and 2019q1). The y-axis represents the *gross profit* – which is: $Gross\ Profit_{r,t} = (Revenue_{r,t} - Cost_{r,t})$. Notice, some airlines don't have data for all 37 quarters; this is shown in the reduced length of their line.
Source: Compustat fundamentals quarterly – North America.

Panel data allows you to control for variables than cannot be observed and may change over time but not across entities. More generally, it accounts for, and recognizes, the individual heterogeneity at the company level.[31] *Fixed Effects* and *Random Effects* are techniques used to analyze panel data; and moving forward, these approaches are crucial to the analysis. Since this paper is only interested in analyzing the impact of variables (in this case MHHI and market concentration) over time, it is important to recognize that each company has individual characteristics that may influence or bias gross profit, and with that – markups. Fixed effects is a technique that assumes that there may be omitted variables that cause variation across entities and these variables are potentially correlated with the variables in the model – i.e., the error term is assumed to vary non-stochastically over companies through time. In contrast, random effects is a technique that assumes the variation across entities is random and uncorrelated with the

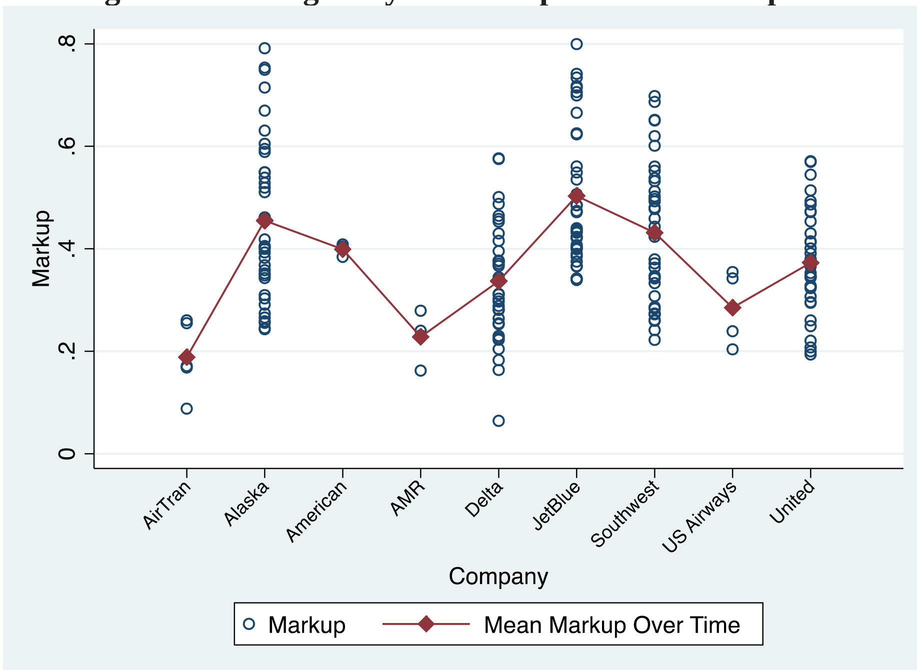
[31] I.e., it accounts for variables that change over time but not across entities.

variables in the model – i.e., the error term is assumed to not be correlated with the predictors. In sum, the crucial distinction between fixed and random effects is whether the unobserved individual effects exhibit elements that are correlated with the model's regressors.

Figure 3 displays the heterogeneity of markups across companies, with the mean markup for each company overtime connected between these companies. As shown, the mean markup for each company deviates a bit from the industry wide mean (which is shown in the connected red line below); and with that, fixed or random effects must be used. Two common assumptions, which will be explored prior to the regression analysis, can be made about individual specific effects. In the context of this paper, these assumptions are:

- *Random Effect Assumption*: individual unobserved heterogeneity of markups between companies is uncorrelated with the independent variables of market concentration.
- *Fixed Effect Assumption*: the individual specific effect is correlated with the independent variables of market concentration; and with that time-invariant characteristics are removed.

Figure 3: Heterogeneity of Markups Between Companies



Notes: Figure 3 shows how the markups for each company differs from their mean markup over time (between 2010q1 and 2019q1) and compares this with the entire industry. The blue circles represent the markup for each company in each specific quarter; the red diamonds represent the mean markup for a company over all quarters that the respective airline was represented in. These markers are connected to illustrate the heterogeneity – or difference – between the mean markups (across all quarters) of each company. The y-axis is markups; which as shown in section *V.C* represents the average markup but is denoted as markups throughout the paper. The graph was plotted for the periods between 2010q1 and 2019q1.
Source: Compustat fundamentals quarterly – North America.

D. MHHI Matrix Definition

Table 1 gives a sense of the degree to which the airline industry is commonly owned; but it does not quantify the extent to which these companies are connected – i.e., the MHHI must be calculated. The Thomson Reuters data set does not include share percentage as a variable; instead it includes total shares outstanding. Control share of shareholder *i* in firm *j* – $\gamma_{i,j}$ – is calculated as the percentage of sole voting shares and shared voting shares of firm *j* held by shareholder *i* in relation to overall shares outstanding.[32] The ownership share of shareholder *i* in

[32] The US Securities and Exchange Commission defines the difference between voting types as the following: "If you vote on non-routine matters (*e.g.*, contested election of directors, merger, sale of substantial assets, change in articles of incorporation effecting shareholders, change in fundamental investment policy), you have either sole or shared voting authority, depending on the voting rights of your accountholders; if you only vote on routine matters (*e.g.*, selection of accountant, uncontested election of directors, approval of annual report), you report none." Since the control variable $\gamma_{i,j}$ is calculated as the percentage of sole

firm j – β_{ij} – is calculated as the percentage of all shares (sole voting, shared voting, and no voting) of firm j held by shareholder i in relation to overall shares outstanding.

Figuring out the right way to calculate MHHI Δ was a difficult process. Before delving into the findings, and the implications of these findings, it is important to note the process undertaken to compute this matrix. Referenced below is an example and derivation from authors Patrick Dennis, Kristopher Geradi, and Crola Schenone (2018),[33] who like AST (2018) utilize the MHHI to analyze ticket prices in the airline industry.[34]

In the specifications of MHHI, firms are denoted by j and k, and the number of owners and shareholders can be represented as m and n respectively. Let γ_j be a $m \times 1$ vector of control rights and β_j be a $m \times 1$ vector of ownership – or cash-flow – rights for firm j. Each element in γ_j and β_j corresponds to one of the m owners. As shown in section *III.C* prior, firms compete in a Cournot setting with the manager of firm j choosing an output quantity to maximize a weighted average of the profits of all m owners of the firm.[35] Setting the first-order condition equal to zero yields the modified Herfindahl-Hirschman index (MHHI), which is a measure of market concentration accounting for common ownership. The market shares for each of the n firms are given by the $n \times 1$ vector S, hence the ordinary Herfindahl-Hirschman index (HHI) without considering the anticompetitive effects of common ownership is $S'S$. The "concentration matrix" $n \times n$ can be defined as C; which provides a set of weights defining the additional concentration due to common ownership (Dennis et al., 2018, p. 25):

voting shares and share voting shares, a distinction between 'sole' and 'shared' isn't necessary. See: https://www.sec.gov/divisions/investment/13ffaq.htm, question 50a.

33 This paper will be referred to as DGS.

34 The DGS (2018) paper comes in the form of a critique to AST (2018); but is refuted by a later response by the same authors – AST – in 2018.

35 Firm j implements these incentives by maximizing a weighted average of its shareholders' portfolio profits, where the weights are given by the control weights $\gamma_{i,j}$: $Max_{x_j}\pi_j = \sum_{i=1}^{m} \gamma_{i,j} \sum \beta_{i,k}\pi_k$

$$C = \begin{bmatrix} 0 & \frac{\gamma'_1\beta_2}{\gamma'_1\beta_1} & \cdots & \frac{\gamma'_1\beta_n}{\gamma'_1\beta_1} \\ \frac{\gamma'_2\beta_1}{\gamma'_2\beta_2} & 0 & \cdots & \frac{\gamma'_2\beta_n}{\gamma'_2\beta_2} \\ \vdots & \vdots & \ddots & \vdots \\ \frac{\gamma'_n\beta_2}{\gamma'_n\beta_n} & \frac{\gamma'_n\beta_2}{\gamma'_n\beta_n} & \cdots & 0 \end{bmatrix}.$$

The MHHI that results from each manager in the market maximizing the weighted-average profits of all owners in their firm is:

$$MHHI = S'S + S'CS = HHI + MHHI\Delta.$$

In understanding how this measure captures the additional concentration due to common ownership, authors DGS (2018) utilize a hypothetical example with two firms – firm 5 and firm 7. The additional market concentration due to common ownership will be the product of the market share between firm 5 and firm 7 – $S_5 \times S_7$ – weighted by the term $\frac{\gamma'_5\beta_7}{\gamma'_5\beta_5} + \frac{\gamma'_7\beta_5}{\gamma'_7\beta_7}$. The numerator in the first term captures the *across-firm concentration*: if an owner has control rights to firm 5 and cash-flow (ownership) rights to firm 7, then they will use their control rights to influence firm 5 to compete less with firm 7. The denominator in the first term captures the *within-firm concentration*: if an owner has both control rights and cash-flow (ownership) rights to firm 5, then to maximize the owner's profit, the manager of firm 5 competes more with firm 7, maximizing profits accruing to firm 5 at the expense of the joint profit accruing to both firms 5 and 7 (Dennis et al., 2018, p. 26). The interpretation of the $\frac{\gamma'_5\beta_7}{\gamma'_5\beta_5}$ is the same as $\frac{\gamma'_7\beta_5}{\gamma'_7\beta_7}$. Hence, the weight applied to $S_5 \times S_7$ when computing the MHHI Δ is the ratio of the numerators – which capture across-firm concentration – to the denominators – which capture within-firm concentration.

VI. MHHI

A. Construction

Calculating this index was quite a lengthy and difficult process. As mentioned, there were two main ways in which the MHHI Δ was calculated. First, ownership and control were treated separately – $\beta_{i,j} \neq \gamma_{i,j}$; in other words, a distinction was made in regard to the type of shares the shareholder held. Control ($\gamma_{i,j}$) represents the percentage of the total sole and shared voting shares; while ownership ($\beta_{i,k}$)– or cash-flow rights – represents the percentage of total shares, regardless of voting rights. The second calculation of MHHI Δ – MHHI' Δ – assumed proportional control; i.e., the ownership that the shareholder has in a given firm is equivalent to the control they have over the manager of the firm – $\beta_{i,j} = \gamma_{i,j}$.

Because the 13F filings includes a wide range of ownership stake among shareholders – i.e., the difference between the top shareholder and the lowest is quite extreme – investors were ranked based on their overall ownership in each firm.[36] All shareholders whose cash-flow rights – or $\beta_{i,j}$ – were ranked amongst the top-10 largest percentages, in regard to all other shareholders in that quarter, for each company, were kept in the analysis. All shareholders who were outside the top-10 were dropped. This procedure resulted in 1,980 total shareholder observations for the airline industry. This corresponds correctly to the number of market share observations, given the available data, mentioned prior; that being, 198.[37] It would be interesting to see how the construction of MHHI Δ, and resulting effect on markups, would differ if a different rank were used – e.g., top-5 or bottom-10.

[36] For example, within all 84,448 shareholder observations, the minimum share percent was 1.18e-07% and the maximum was 15.9%.

[37] Considering each airline company corresponds to 10 respective shareholders, the total observation number of 1,980 makes intuitive sense.

Although the process for calculating MHHI Δ was quite different for the proportional control assumption – the case in which control equated to ownership – it is important to address the steps taken, more generally, in the calculation of this index. In doing so, it is beneficial – in regard to understanding the common ownership development – to further breakdown this index by *across firm concentration* (numerator) and *within-firm concentration* (denominator).

B. Across-Firm Concentration & Within-Firm Concentration

The basis of the computing this matrix comes from utilizing the couplings, or pairings, within the industry and totaling the common ownership across all pairings for the entire industry. Ultimately, in regard to its calculation, MHHI Δ can be broken down into two distinct quantifiable segments – across-firm concentration (HHIAF), and within-firm concentration (HHIWF). The equation below displays the MHHI Δ with this classification noted – authors O'Brien and Salop (2000) introduce this distinction:

$$MHHI\Delta = \sum_j \sum_{k \neq j} s_j s_k \frac{HHIAF_{j,k}}{HHIWF_j}.$$

$HHIAF_{j,k} = \sum_i \gamma_{i,j} \beta_{i,k}$ measures the market concentration that arises from shareholders that have ownership interests in firm *j* and control rights over the manager of firm *k*. $HHIWF_j = \sum_i \gamma_{i,j} \beta_{i,j}$ measures the market concentration that arises from the joint ownership and control of firm *j*. As O'Brien and Salop (2000) mention, "all else equal, the greater the across-firms concentration from joint ownership of firm *k* and control of firm *j*, the greater is the weight placed on the cross-product of the shares of firms *j* and *k* in the MHHI calculation" (p. 612). Intuitively, if there was an increase in the amount of across-firm concentration, managers of the firms would consider, and put more of an emphasis on, the adverse effects that could occur from output or pricing decisions of the cross-owned firms. Additionally, as you can see based on the above equation, the larger the within-firm concentration of ownership and control of firm *j* is, the smaller the effect of an increase concentration arising through the across-firm term. In other words, if the ownership and control within firm *j* is already quite high, then additional control exercised over firm *j* by owners of firm *k* has little additional influence over firm *j's* management.

As mentioned, the pairings of firms within the industry are used to compile a total numeric value for the MHHI Δ for each quarter. If ownership data on all nine airline companies were available in a given quarter, there would have been 72 different arrangements of pairings: *n(n-1)* where *n* is the number of firms.[38] Since this is not the case for the majority, if any, of the quarters, the number of pairings differs across quarters. Using the data compiled from the airline industry, below is an example that clarifies the intuitive arguments concerning the role of across-firms and within-firm concentrations in determining the MHHI Δ; and additionally, helps render the steps and processes taken in calculating this index.

One pairing in the airline industry is the Delta-JetBlue pair. Table 2 shows the respective ownership and control shareholders Fidelity, Vanguard Wellington Management and Donald Smith & Co had in 2010q2. The market share for Delta was 32% and 5% for JetBlue.

[38] This number of 72 pairings includes 2 different pairings for each 2 firms. For example, for Delta and JetBlue, there would be pairings *Delta-JetBlue* and *JetBlue-Delta*. This is significant because owner *i's* (for example) control and ownership changes based on this distinction. In the *Delta-JetBlue* pairing, owner *i* 's control and ownership interaction would be control in Delta times ownership in JetBlue. Alternatively, for *JetBlue-Delta* pairing, owner *i's* control and ownership interaction would be control in JetBlue times ownership in Delta.

Table 2: Ownership and Control of Delta-JetBlue

Firms	*Fidelity*	*Vanguard*	*Wellington Management*	*Donald Smith & Co*
Delta – Control	$\gamma_{F,D} = .3567027$	$\gamma_{V,D} = 3.779634$	$\gamma_{W,D} = 5.686709$	$\gamma_{DS,D} = 0$
Delta – Ownership	$\beta_{F,D} = 13.27588$	$\beta_{V,D} = 3.779634$	$\beta_{W,D} = 9.316542$	$\beta_{DS,D} = 0$
JetBlue – Control	$\gamma_{F,JB} = .0064164$	$\gamma_{V,JB} = 3.548742$	$\gamma_{W,JB} = 2.317259$	$\gamma_{DS,JB} = 4.818604$
JetBlue – Ownership	$\beta_{F,JB} = 14.68322$	$\beta_{V,JB} = 3.548742$	$\beta_{W,JB} = 4.340647$	$\beta_{DS,JB} = 7.639908$

Notes: $\beta_{i,j}$ – as shown in section III.B – is the ownership of firm *j* accruing to shareholder *i*; it was calculated by taking the total shares (regardless of if they were denoted as 'shared voting, sole voting, or no voting shares') and dividing by the total shares outstanding of the airline in that period. $\gamma_{i,j}$ is control share of firm *j* exercised by shareholder *i* based on a shareholder's voting or sole voting shares; it was calculated by taking the total shares that were sole voting or share voting shares and divided by the total shares outstanding of the airline in that period.

The MHHI Δ calculation for this pairing is shown below using *HHIAF* and *HHIWF* and assuming that – for the purpose of this illustration – the only shareholders available are Fidelity, Vanguard, Wellington Management, and Donald Smith & Co.

Across-Firm Concentration:

$$HHIAF_{D,JB} = \gamma_{F,D}\beta_{F,JB} + \gamma_{V,D}\beta_{V,JB} + \gamma_{W,D}\beta_{W,JB} + \gamma_{DS,D}\beta_{DS,JB}$$

$$= (.357 * 14.68) + (3.78 * 3.55) + (5.69 * 4.34) + (0 * 7.64) = 43.35$$

$$HHIAF_{JB,D} = \gamma_{F,JB}\beta_{F,D} + \gamma_{V,JB}\beta_{V,D} + \gamma_{W,JB}\beta_{W,D} + \gamma_{DS,JB}\beta_{DS,D}$$

$$= (.006 * 13.276) + (3.55 * 3.78) + (2.32 * 9.32) + (4.81 * 0) = 35.12$$

Within-Firm Concentration:

$$HHIWF_{D} = \gamma_{F,D}\beta_{F,D} + \gamma_{V,D}\beta_{V,D} + \gamma_{W,D}\beta_{W,D} + \gamma_{DS,D}\beta_{DS,D}$$

$$= (.357 * 13.276) + (3.78 * 3.78) + (5.69 * 9.32) + (0 * 0) = 72.06$$

$$HHIWF_{JB} = \gamma_{F,JB}\beta_{F,JB} + \gamma_{V,JB}\beta_{V,JB} + \gamma_{W,JB}\beta_{W,JB} + \gamma_{DS,JB}\beta_{DS,JB}$$

$$= (.006 * 14.68) + (3.55 * 3.55) + (2.32 * 4.34) + (4.81 * 7.64) = 59.5$$

Total Weight Applied to the Cross-Products ($S_D S_{JB}$):

$$\frac{HHIAF_{D,JB}}{HHIWF_D} + \frac{HHIAF_{JB,D}}{HHIWF_{JB}} = \frac{43.35}{72.06} + \frac{35.12}{59.5} = 1.191$$

Thus, the change in MHHI Δ is equal to market shares *($S_D S_{JB}$)* × 1.191; which is 190.69. If this example considered all of the shareholders in 2010q2, the *Within-Firm Concentration* would continue to change, but the *Across-Firm Concentration* may not change.[39] As you can see from above, the *HHIAF* is dependent on whether or not the shareholder has control or ownership in both firms in the pairing. To illustrate this, look at Donald Smith & Co. They only have ownership and control in JetBlue so their addition to $HHIAF_{D,JB}$ and $HHIAF_{JB,D}$ is zero. On the other hand, they have a contribution to the $HHIWF_{JB}$ but not $HHIWF_D$.

Now consider a different example with some additional hypothetical parameters: Fidelity has the same ownership in Delta and JetBlue, but zero control in Delta; Vanguard has the same ownership in Delta and JetBlue, but zero control in JetBlue; Wellington Management has the same ownership in Delta and JetBlue, but zero control in either; Donald Smith & Co remains the same. Table 3 reports this framework given the parameters specified and the data provided above.

Table 3

Firms	*Fidelity*	*Vanguard*	*Wellington Management*	*Donald Smith & Co*
Delta – Control	$\gamma_{F,D} = 0$	$\gamma_{V,D} = 3.779634$	$\gamma_{W,D} = 0$	$\gamma_{DS,D} = 0$
Delta – Ownership	$\beta_{F,D} = 13.27588$	$\beta_{V,D} = 3.779634$	$\beta_{W,D} = 9.316542$	$\beta_{DS,D} = 0$
JetBlue – Control	$\gamma_{F,JB} = .0064164$	$\gamma_{V,JB} = 0$	$\gamma_{W,JB} = 0$	$\gamma_{DS,JB} = 4.818604$
JetBlue – Ownership	$\beta_{F,JB} = 14.68322$	$\beta_{V,JB} = 3.548742$	$\beta_{W,JB} = 4.340647$	$\beta_{DS,JB} = 7.639908$

39 In other words, the within-firm concentration considers the ownership and control shares of each shareholder separately. In terms of the *Delta-JetBlue* pairing, if a shareholder had ownership or control shares in just Delta, this would be considered in the $HHIWF_D$ calculation. On the other hand, if the same shareholder had no stake in JetBlue, the calculation of $HHIAF_{D,JB}$ would be unaffected.

The MHHI Δ calculation for this pairing is shown below using *HHIAF* and *HHIWF* and assuming that the only shareholders available are Fidelity, Vanguard, Wellington Management, and Donald Smith & Co.

Across-Firm Concentration:

$$HHIAF_{D,JB} = \gamma_{F,D}\beta_{F,JB} + \gamma_{V,D}\beta_{V,JB} + \gamma_{W,D}\beta_{W,JB} + \gamma_{DS,D}\beta_{DS,JB}$$

$$= (0 * 14.68) + (3.78 * 3.55) + (0 * 4.34) + (0 * 7.64) = 13.42$$

$$HHIAF_{JB,D} = \gamma_{F,JB}\beta_{F,D} + \gamma_{V,JB}\beta_{V,D} + \gamma_{W,JB}\beta_{W,D} + \gamma_{DS,JB}\beta_{DS,D}$$

$$= (.006 * 13.276) + (0 * 3.78) + (0 * 9.32) + (4.81 * 0).08$$

Within-Firm Concentration:

$$HHIWF_{D} = \gamma_{F,D}\beta_{F,D} + \gamma_{V,D}\beta_{V,D} + \gamma_{W,D}\beta_{W,D} + \gamma_{DS,D}\beta_{DS,D}$$

$$= (0 * 13.276) + (3.78 * 3.78) + (0 * 9.32) + (0 * 0) = 14.29$$

$$HHIWF_{JB} = \gamma_{F,JB}\beta_{F,JB} + \gamma_{V,JB}\beta_{V,JB} + \gamma_{W,JB}\beta_{W,JB} + \gamma_{DS,JB}\beta_{DS,JB}$$

$$= (.006 * 14.68) + (0 * 3.55) + (0 * 4.34) + (4.81 * 7.64) = 36.84$$

Total Weight Applied to the Cross-Products ($S_D\,S_{JB}$):

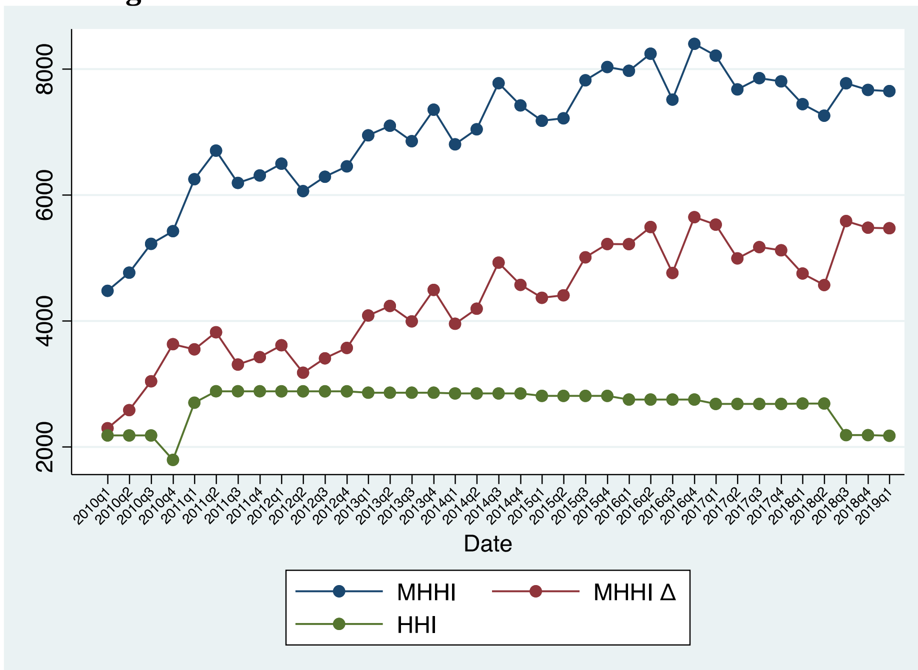
$$\frac{HHIAF_{D,JB}}{HHIWF_{D}} + \frac{HHIAF_{JB,D}}{HHIWF_{JB}} = \frac{13.42}{14.29} + \frac{.08}{36.84} = .94$$

Thus, the change in the MHHI – or MHHI Δ – in this case is equal to the market shares *($S_D\,S_{JB}$)* × .94; which is 150.6. In comparison to the prior example, where actual control rights were used, the concentration added through common ownership is 40 points lower. Previously, Fidelity had control and ownership in both Delta and JetBlue. In that example, they could influence – as this paper argues – the managers of both airlines, as opposed to only one, to compete less aggressively. The same idea is true for Vanguard in the initial example. Intuitively, with the decrease in the amount of *Across-Firm Concentration* – due to the specifications made in this example, in terms of control – managers of the firms are less likely to consider the adverse effects that could occur through anti-competitive practices of the cross-owned firms. In sum, this simplified application was extended to all the firm pairings in a given quarter; and additionally, considered all shareholders ranked between the couplings.

C. *MHHI vs HHI*

The MHHI Δ – or in other words, the index that represents the common links in the ownership network – was calculated between 2010q1 and 2019q1 for a total of 37 quarters. Additionally, the traditional HHI was constructed for comparison. Figure 4 displays the MHHI, MHHI Δ and HHI values across the analyzed periods. Note that, for a specific industry, the MHHI and MHHI Δ, like HHI, is one numeric value per quarter. The MHHI Δ is the difference between the MHHI and HHI; and is the part of the total market concentration that is due to common ownership.

Figure 4: Market Concentration Measures Over Time



Notes: Figure 4 displays the HHI, MHHI, and MHHI Δ over time. The HHI is the Herfindahl-Hirschman Index described in section *III.A*. This index is calculated as the sum of the market shares squared in a given quarter. The MHHI is the modified Herfindahl-Hirschman Index established by O'Brien and Salop (2000) and described in section *III.B*; this represents the total market concentration. The MHHI Δ, which is a measure of common ownership among airlines in a quarter, is the difference between MHHI and HHI. Recall in section *IV.A* an alternative calculation of MHHI that treated control and ownership the same was developed – this is not illustrated in figure 4. The y-axis represents the value of the concentration measure.
Source: Thomson Reuters 13f Filings.

The HHI value is quite stable between 2010q1 and 2019q1; with an average value of 2,567.5. Previous mergers in the airline industry help explain the three distinct changes in the HHI points – i.e., after 2010q3, 2010q4 and 2018q2. The United-Continental merger was announced in May 2010 and became effective in October 2010; the TR data set begins to include data for United in 2010q4. Given that, from 2010q3 to 2010q4 the market share data went from including seven companies to eight companies; hence the reason for the drop in HHI. Additionally, the AMR-US Airways (American was formally known as AMR) merger was announced in February 2013 and became effective in November 2013 – the resulting company was American Airlines. The TR data set only includes ownership for AMR and US Airways in 2010 and introduces American Airlines in 2018q3. Given that, from 2010q4 to 2011q1 the market share data went from including eight companies to six companies (AMR and US Airways was dropped); hence the reason for the spike. The Southwest-AirTran merger was announced in September 2010 and became effective in March 2012. AirTran dropped out of the data after 2011q1; given that, the total amount of companies fell to five in 2011q2 and remained there until 2018q3. From 2011q2-2018q2 the data remained consistent with five total companies. In 2018q3, data on American Airlines became available, making the total company number six; hence the reason for the drop. In sum, the addition of a company caused a decrease in the overall HHI, while a subtraction of a company did the opposite. This makes intuitive sense, considering the market would be more concentrated (higher HHI) with less competitors.

Recall that since the Euromonitor doesn't have quarterly market share data, market share was aggregated to the quarters based on the annual data. So, given this, when companies were added and subtracted in the market share data, the effect on HHI seem to be enhanced. For example, after United was added in 2010q4, the yearly market share data for the seven other companies in 2010 was used.[40] Realistically, the addition of this company would have impacted the 2010q4 market share of the other companies; i.e., their market share would have likely decreased. If data was available at the quarterly level, the HHI would likely still change in similar patterns to what figure 4 reports, but the change would be less dramatic.

In contrast, the MHHI values are much less consistent over the time period. Although it increased throughout the 37 quarters, it changes more frequently. Similarly, and beneficial to the empirical study that follows, the MHHI is also impacted by the various mergers in the industry.

[40] It is likely that after the United-Continental merger, when United joined the market in 2010q4, the market share of the other companies form 2010q3 to 2010q4 would change. But, since quarterly data was not available, this change was only reflected through the scaling of the market share technique discussed in section *V.A*. In other words, in 2010q3, company-specific market share was scaled based on the total for the industry, which didn't include United. In 2010q4, company-specific market share was scaled based on the total for the industry which now included United. So, although the company-specific market share remained the same in both 2010q3 and 2010q4 – which is unlikely given the inclusion of United in the market share – it was rescaled based on the new total; and this helps mitigate some of the issues with aggregating annual data given this merger.

In terms of the following analysis, it is beneficial to consider how the MHHI Δ changes. At the beginning of the period, the MHHI Δ was 2,297 and increased to 3,632 by the end of 2010. It reached its peak in 2016q4 at 5,649 and remained above 4,500 until the end of the period. The average level of MHHI Δ, across all quarters, was 4,344. Note, the traditional MHHI calculation was used and proportional control wasn't assumed (MHHI').

According to the U.S. Dep't of Justice & Fed. Trade Commission, Horizontal Merger Guidelines § 5.3 (2010), in highly concentrated markets – markets with an HHI greater than 2,500 – a merger raises significant competitive concerns if it produced a change in HHI between 100-200. Additionally, "mergers resulting in highly concentrated markets that involve an increase in the HHI of more than 200 points will be presumed likely to enhance market power" (Azar et al., 2018, p.18). On average, the HHI was above the 2,500 highly concentrated market threshold. So, to put these numbers in perspective, if we modify these specifications to the context of the MHHI Δ, rather than just the HHI, a change in MHHI Δ of 2,297 in 2010q1 to 4,344 – the average level – implies increases in concentration that are over 10 times higher than the threshold that raises antitrust concerns.[41] Although the procedure in which this paper scales the market share, and doesn't include privately held companies into the equation, may modify the realistic interpretation MHHI Δ and its application to the merger guidelines, these numbers – in regard to anti-trust laws – are concerning. Also, given that the HHI calculation followed this same scaling operation, the MHHI Δ, in comparison to the HHI, should be considered.

With regard to the 200 point threshold change that is presumed likely to enhance market power, this mark also notes the point beyond which, if two companies intended to merge, the burden of proof that the merger does not lead to enhanced market power shifts to the merging

41 $\frac{Mean\ MHHI\Delta - Minimum\ MHHI\Delta}{200(threshold\ amount)} = \frac{4{,}344-2{,}297}{200} = 10.2$

parties, rather than the regulator (Azar et al., 2018, p.18). In other words, in order to prove that that a merger doesn't soften market competition, it is the job of the merging parities to prove this contention doesn't exist. Continuing to shift these guidelines in the context of asset management and stock acquisition – which relates implicitly to common ownership and MHHI Δ – if this logic is applied to the changes in market concentration that are due to common ownership, these shareholders would have to prove that the common ownership links that their holdings create do not affect market prices; and for the purpose of this paper, increases in their markups. In sum, the incentives for anticompetitive behavior implied by MHHI are much larger than the conventional measures of market power – that which only consider HHI – recognized by antitrust authorities.

C.1 Empirical Hypothesis

Referring back to ARS (2019), one of the key questions they examined was whether the HHI or the GHHI were more robustly linked to various prices of banking deposit products (p. 18). In the following analysis, this paper aims to modify this approach in the context of the MHHI. Ultimately, the only difference between the HHI and MHHI is taking ownership structures into account; in other words, the following analysis aims to determine whether or not the ownership of airlines, held by shareholders, is empirically important.

Before delving into the regression specifications, moving forward, both calculations of MHHI discussed in section *IV.A* will be used to analyze the robustness of MHHI and HHI – i.e., the MHHI that treats ownership and control differently and the MHHI that assumes proportional control. The equations below reference both types of calculations:

$$MHHI = \sum_j \sum_k s_j s_k \frac{\sum_i \gamma_{i,j}\beta_{i,k}}{\sum_i \gamma_{i,j}\beta_{i,j}} + \sum_j S_j^2,$$

$$MHHI' = \sum_j \sum_k s_j s_k \frac{\sum_i \beta_{i,j}\beta_{i,k}}{\sum_i \beta_{i,j}^2} + \sum_j S_j^2.$$

Given the MHHI and MHHI Δ values displayed above, in figure 4, it is evident that in the airline industry, common ownership links are present. But, despite this, there are still reasons why anticompetitive incentives – those arising from common ownership – might not be implemented. Examples that could reduce these practices may include: agency conflicts between shareholders and management, informational frictions, or even fear of antitrust backlash (Azar el al., 2019, p. 18), With that being said, the null hypothesis is that these conflicts could overwhelm any anticompetitive motivations from overlapping ownership. More specifically, partial ownership links are irrelevant for economic outcomes and MHHI and HHI are equal indices of market concentration in terms of capturing variation in the outcome variable markups. The null hypothesis in this case would be:

H_0: The HHI and the MHHI are equally effective at capturing variation in a company's markup.

On the other hand, if firms do consider, and act, in the economic interests of their shareholders, the alternative hypothesis would find support for the MHHI capturing more variation in the outcome variable than the variation captured by HHI. The alternative hypothesis in this case would be:

H_1: The MHHI is a better predictor of a company's markup than the HHI.

C.2 Regression Specifications

As discussed in the section *V.C*, because there is heterogeneity in company-specific markups across years, in order to analyze the impact of either concentration index on this variable – and average level across the entire industry – a fixed effect or random effect panel regression is necessary. To determine which technique better fits the data, a 'Hausman test' was run, where the null hypothesis is that the preferred model uses random effects and the alternative hypothesis is that the preferred model uses random effects. In other words, this is a test to see whether or not the unique errors are correlated with the regressors; this was done for both the MHHI and HHI measurements separately.[42] The results from this test using MHHI presented a probability chi-squared value of .2, which is greater than .05 (i.e. not significant) and the null hypothesis is not rejected. The results from this test using HHI presented a probability chi-squared value of .004, which is smaller than .05 (i.e., significant) and the null hypothesis is rejected. Given that, in order to analyze markups at the company-specific level, a random effects regression is used for MHHI– this is equation (1.a); and a fixed effects regression is used for HHI – this is equation (1.b). The distinction between these approaches will be explored in detail later, but to put simply, using fixed effects for HHI simply means that the company-specific variation of markups is correlated to HHI and is assumed to be non-random. Additionally, another important distinction between these techniques is random effects are estimated using 'partial pooling' – which means, if only a few data points are available for a company – which is the case (refer to footnote 29 in section *V.A)* – the company's effect estimate will be based partially on the more abundant data from other groups. This serves as a beneficial compromise between estimating an effect by completely pooling all companies – which may mask company-level variations – and estimating an effect for all companies specifically; i.e., the goal of equations (1.a) and (1.b).

Complementing that analysis, an additional regression is run with the outcome variable as the average markup – or mean markup – by quarter for all the companies combined. This analysis doesn't require random or fixed effects because the mean is taken across entities (companies) and the unobserved individual specific effect, or heterogeneity, doesn't impact the

[42] The 'Hausman test' used compared a fixed effect vs random effect regression. A regression of log average markup on the concentration index (MHHI and HHI separately) was used for this test. The traditional calculation of MHHI was used for both the fixed effect and random effect regression that were run.

overall mean – this is equation (2.a). In the last regression, the total industry wide markup, or the sum of markups per quarter, is taken – this analysis also doesn't require random or fixed effects and is equation (2.b).[43]

In this analysis, equations (1.a) and (1.b) take the logarithm of markup for each airline company *c* at quarter *t* – this outcome variable is denoted as $Markup_{ct}$. Equation (1.a) regresses this variable on MHHI; equation (1.b) regresses this variable on HHI. Additionally, equation (2.a) takes the logarithm of average markup across all airlines at quarter *t* and regresses it on the MHHI and the HHI separately – this outcome variable is denoted as $Average\ Markup_t$.[44] Lastly, equation (2.b) takes the logarithm of industry total markup, which is the sum of markups across all companies at quarter *t*, and regresses it on the MHHI and the HHI separately – this outcome variable is denoted as $Industry\ Total\ Markup_t$. For equations (2.a) and (2.b), the variable $Concentration\ Index_t$ represents MHHI or HHI; i.e., each concentration is included alone – as in equations (1.a) and (1.b). Following this analysis, panel regressions with random effects and fixed effects will be used to better understand the reduced-form relationship between MHHI Δ and markups. To test the empirical hypothesis, and which concentration measure better captures the variation in markups, the regressions are specified below:

$$\boldsymbol{Log(Markup)_{ct} = \alpha + \beta \mathrm{MHHI}_t + \upsilon_{ct} + \epsilon_{ct}} \qquad \textbf{(1.a),}$$

Description: α is the constant term. υ_{ct} is the company-specific random effect: it measures the difference between the average markup at company *c* and the average markup in the entire industry; it can also be considered the 'between-entity' error. ϵ_t is the error term: it measures the error within the company; it can also be considered the 'within-entity' error.

$$\boldsymbol{Log(Markup)_{ct} = \beta_1 \mathrm{HHI}_t + \alpha_c + \upsilon_{ct}} \qquad \textbf{(1.b),}$$

Description: α_c is the company-specific fixed effect: it measures the unobserved time-invariant company effect. It is considered the unknown intercept for each company. υ_{ct} is the error term.

[43] Generally, the main reason equations (2.a) and (2.b) don't required random or fixed effects is because they are not run at the entity-specific level. They take into consideration the mean markup across the industry – equation (2.a) – and the industry sum markup – equation (2.b).

[44] This use of average markups differs from the one specified in the outcome variable of equation (2.a). Recall that in section *V.C* the variable of interest considered average markups and not markup on the margin; but is denoted and referred to markups throughout the paper. The outcome variable average markups is simply referring to the average of the markups for each company – but, realistically, given that markups reflect average markups, this can also be considered as the average of the average markups.

$$\boldsymbol{Log(Average\ Markup)_t = \beta_0 + \beta_1 \textbf{Concentration Index}_t + \partial_t} \quad \textbf{(2.a),}$$

Description: $\beta_0$is the constant term. ∂_t is the error term: it captures all other factors which influence markups other than the market concentration index.

$$\boldsymbol{Log(Industry\ Total\ Markup)_t = \beta_0 + \beta_1 \textbf{Concentration Index}_t + \partial_t} \quad \textbf{(2.b).}$$

Description: $\beta_0$is the constant term. ∂_t is the error term: it captures all other factors which influence markups other than the market concentration index.

Equations (1.a), (2.a) and (2.b) use both calculations of MHHI as the concentration index. Recall, there is only one value for MHHI, MHHI', and HHI in each period (as shown in figure 4). Table 4 displays the regression results. Specification (1) displays the original MHHI calculation; specification (2) displays the results using HHI; specification (3) displays the proportional control assumption of MHHI (MHHI').

Table 4: Concentration Index Comparison[a]

Equation	*1.a*	*1.b*	*1.a*	*2.a*	*2.a*	*2.a*	*2.b*	*2.b*	*2.b*
Outcome Variables	*Markup*	*Markup*	*Markup*	*Average Markup*	*Average Markup*	*Average Markup*	*Industry Total Markup*	*Industry Total Markup*	*Industry Total Markup*
Specification	*1*	*2*	*3*	*1*	*2*	*3*	*1*	*2*	*3*
MHHI	0.000172***			0.000202***			0.00012**		
	(2.3e-05)			(3.8e-05)			(4.4e-05)		
HHI		-0.000024			0.000127			-0.00028*	
		(8.8e-05)			(0.00017)			(0.00016)	
MHHI'			0.000179***			0.000199***			0.000140***
			(2.2e-05)			(3.7e-05)			(4.1e-05)
Constant	-2.26***	-0.903***	-2.347***	-2.341***	-1.264***	-2.399***	-0.0945	1.493***	-0.289
	(0.165)	(0.233)	(0.170)	(0.268)	(0.461)	(0.275)	(0.312)	(0.423)	(0.307)
Obs	198	198	198	37	37	37	37	37	37
R-squared	0.214	0.000	0.230	0.447	0.015	0.454	0.174	0.083	0.247
Corr	.5095	.1403	.5102	.6688	.1239	.6739	.4168	-.288	.4970
Effect	Random	Fixed	Random	N/A	N/A	N/A	N/A	N/A	N/A

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Table 4 shows the regression results from the four equations above. Equation (1.a) is a company-specific random effect regression that utilizes both calculations of MHHI (refer to section *IV.A*) and is shown in the first and third column displaying specification (1) and (3) respectively. The outcome variable is markups at the company level; there are 198 observations because that is how many times company data was available across the 37 quarters. Equation (1.b) is a company-specific fixed effect regression that uses the HHI index (refer to section *III.A*) and is shown in the second column displaying specification (3). The outcome variable is markups at the company level; there are 198 observations because that is how many times company data was available across the 37 quarters. Equation (2.a) utilizes both calculations of MHHI and is shown in the fourth, fifth, and sixth column displaying specification (1), (2) and (3) respectively. The outcome variable is average markup and considers the average of the entire industries' markups in a given quarter; there are 37 observations because there are 37 quarters analyzed. Equation (2.b) utilizes both calculations of MHHI and is shown in the seventh, eighth, and ninth column displaying specification (1), (2) and (3) respectively. The outcome variable is industry total markup and considers the sum of the entire industries' markups in a given quarter; there are 37 observations because there are 37 quarters analyzed.
The asterisks (*,**,***) indicate statistically significant at the 1%, 5%, and 10% levels.

[a] In all regression analysis notes, the column references skip over the initial columns that denotes what each row is referring to. For example, the 'first column' in table 4 starts with equation (1.a) and specification (1). The column that has 'equation' in the first row is neglected when making reference to the column order.

Overall, these findings show that the relationship between concentration and markups is much stronger and more robust when concentration is measured using MHHI, regardless if proportional control is assumed (MHHI'). Looking at the correlation values alone, MHHI is above .4 in all equations used in specification (1). Contrastingly, as shown in specification (2) the HHI correlation does not exceed .13 in any of the equations – and actually, is negative in equations (1.b) and (2.b). Additionally, the r-squared value – which represents the proportion of the variance for the dependent variable (markups) that's explained by the independent variable (specific market concentration measure) – is near zero for all regressions including HHI. In terms of statistical significance both the MHHI and MHHI' have statistically significant correlations with all three outcome variables. There is only one case where the modified market concentration index is not significant at the .01 level, while the traditional index HHI is never significant in the positive direction.[45] In other words, it is safe to reject the null hypothesis that the HHI and the MHHI are equally effective at capturing variation in markups.

When interpreting the coefficients on the concentration indices, it is better, and provides for a more causal interpretation, when you regress the outcome variable on both the HHI and MHHI simultaneously. Although the above results don't display much of a relationship, the HHI has been shown in previous economic literature to be directly related to profit margins, but the robustness of this correlation has often been critiqued. Nonetheless, when considering the effect that common ownership alone has on markups, the traditional market concentration index (HHI) shouldn't be ignored. In this case, the HHI will act as a control variable and enter into the baseline regression in the same way as the new independent variable MHHI Δ. Including this measurement as a control will remove its interpretive effect from the equation and improve the analysis of how intra-industry diversified shareholders impact the markups of competing firms. Lastly, now that the MHHI proved to be a more robust estimator for markups, the MHHI Δ – which reflects how much the HHI would change when considering common ownership – will be used as the main explanatory variable.

45 Refer to equation (2.b), specification (1).

VII. Empirical Methodology and Results

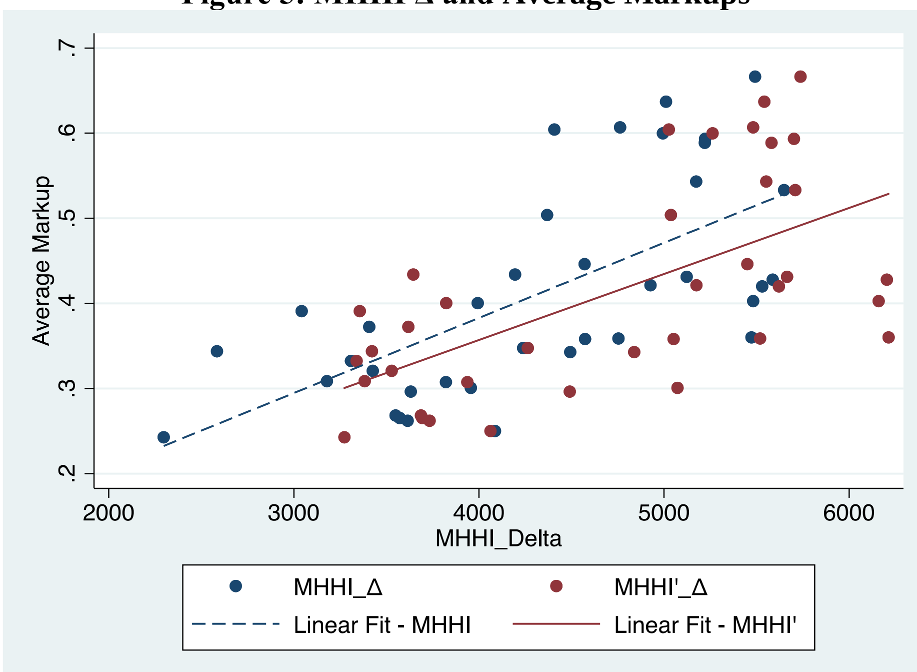
The above analysis notes the different ways that market concentrations are related to the markups of the airline industry, and their respective robustness. More specifically, it is shown that when analyzing which measurement better captures the variation in airline markups, the modified HHI index – MHHI – is a better predictor. Additionally, given that it reflects how linked the industry is through common shareholders – which can result in anticompetition – not only does its mere numeric level raise concern, the magnitude and impact it may have on markups should stimulate its need to be considered in regard to antitrust laws and regulations. In section *VI.C* the levels of these indices are documented; and additionally, the MHHI Δ – which is the difference between the HHI and MHHI – are very large. It has been made apparent, based on these levels and the economic theory that has been noted and developed, that common ownership links in the airline industry creates the potential for firm managers to soften market competition through anticompetitive incentives. In the following analysis, this paper aims to quantity these effects. AST (2018) as discussed, has used a similar analysis to investigate whether or not the pricing decisions of airline firms are consistent with these incentives. Using a different and additional approach to calculate MHHI (MHHI') and specifying alternative regression analysis, the next section will determine if these decisions are reflected in airline markups.

Figure 5 plots the average markup across all companies by quarter against the MHHI Δ in each quarter.[46] The alternative calculation of MHHI – MHHI' – was also used and displays MHHI' Δ. Instead of aggregating markup by the average across the industry, figure 5.a also plots

[46] Average markups are the mean markups in each quarter of the industry. There is one value of average markup for each quarter. This was the outcome variable measured in equation (2.a).

the markup per company against the MHHI the Δ in each quarter.[47] The linear fit line indicates a positive raw correlation between markups and MHHI Δ across all quarters. Similarly, the linear fit line for markup per company also renders a positive correlation. Given this, it is not necessarily inferred that there is a causal effect between markups and MHHI Δ based merely on the raw correlation; the following analysis attempts to provide evidence into the relationship illustrated. More specifically, MHHI Δ is used as a reduced-form measure of the decrease in incentives to compete due to common ownership reflected by firm markups.

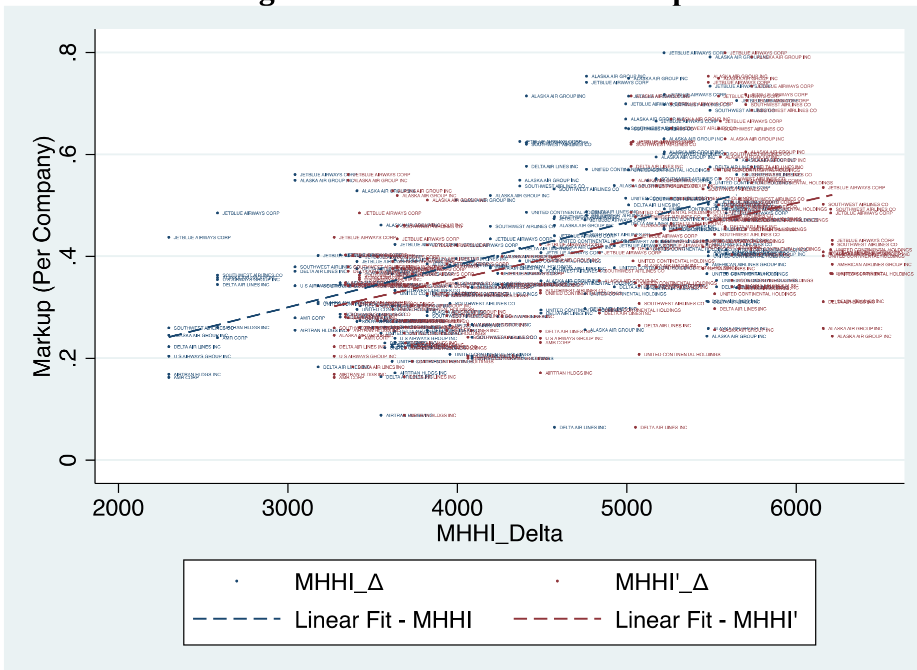
Figure 5: MHHI Δ and Average Markups



Notes: Figure 5 displays the relationship between MHHI Δ and the average markup across all companies (the entire industry) in each quarter (between 2010q1 and 2019q1). Both calculations of MHHI were used in calculating MHHI Δ – refer to section *IV.A* – and the blue dots represent the MHHI Δ coming from the traditional MHHI calculation; while the red dots represent the MHHI' Δ coming from the alternative MHHI' calculation. The linear fit line represents the line of best fit and refers to a line through the scatter plot of data points that best expresses the relationship between those points. The dotted blue line represents the positive raw correlation between average markup and MHHI Δ; the dotted red line represents the positive raw correlation between average markup and MHHI' Δ; both sets of relationships were taken independently of one another. Unlike the regression presented in section *VI.C.2* – equation (2.a) – the logarithm of average markup was not taken.

[47] Markups in this plot are the markups per company in each quarter. There is one value of markups for each company in each quarter. This was the outcome variable measured in equations (1.a) and (1.b).

Figure 5.a: MHHI Δ and Markups



Notes: Figure 5.a displays the relationship between MHHI Δ and the markups per company in each quarter (between 2010q1 and 2019q1). Both calculations of MHHI were used in calculating MHHI Δ – refer to section *IV.A* – and the blue dots represent the MHHI Δ coming from the traditional MHHI calculation; while the red dots represent the MHHI' Δ coming from the alternative MHHI' calculation. The linear fit line represents the line of best fit and refers to a line through the scatter plot of data points that best expresses the relationship between those points. The dotted blue line represents the positive raw correlation between company markups and MHHI Δ; the dotted red line represents the positive raw correlation between company markups and MHHI' Δ; both sets of relationships were taken independently of one another. Figure 5 displayed less observations because markups were averaged across the industry; while figure 5.a looks at the company-specific markups. Unlike the regression presented in section *VI.C.2*, – equation (1.a) and (1.b) – the logarithm of markups was not taken.

A. *Baseline Regression*

In the main baseline specification, the logarithm of average markup across all airlines at quarter *t* is regressed on the MHHI Δ and the HHI – this outcome variable is denoted as *Average* $Markup_t$. Additionally, the logarithm of industry total markup, which is the sum of the markups per company at quarter *t*, is also regressed on the MHHI Δ and the HHI – this outcome variable is denoted as *Industry Total* $Markup_t$.[48] The main difference between the subsequent analysis and that conducted in section *VI.C.2* is that these regression utilize both the MHHI Δ and HHI

48 *Average* $Markup_t$ is the same outcome variable measured in equation (2.a) but this specification includes both the MHHI Δ and HHI together. Similarly, *Industry Total* $Markup_t$ is the same outcome variable measured in equation (2.b) but again, this specification includes both the MHHI Δ and HHI together.

simultaneously in order to estimate the reduced form relationship; the prior analysis aimed to compare the robustness between MHHI and HHI. Following this analysis, panel regressions with fixed and random effects will be used to better understand the relationship between MHHI Δ and markups at the company-specific and pairing-specific level.[49] The baseline regressions are specified below in equations (3.a) and (3.b):

$$\boldsymbol{Log\ (Average\ Markup)_t = \beta_0 + \beta_1 \mathrm{MHHI}\ \Delta_t + \gamma_1 HHI_t + \partial_t} \qquad \textbf{(3.a),}$$

Description: $\beta_0$is the constant term. ∂_t is the error term: it captures all other factors which influence markups other than the market concentration index.

$$\boldsymbol{Log\ (Industry\ Total\ Markup)_t = \beta_0 + \beta_1 \mathrm{MHHI}\ \Delta_t + \gamma_1 HHI_t + \partial_t} \qquad \textbf{(3.b).}$$

Description: $\beta_0$is the constant term. ∂_t is the error term: it captures all other factors which influence markups other than the market concentration index.

As mentioned equations (3.a) and (3.b) are similar to those in section *VI.C.2*, but that analysis regressed the market concentration measurements separately. Both calculations of MHHI Δ are used; specification (1) displays the original MHHI Δ calculation while specification (2) displays the proportional control assumption of MHHI' Δ. In both specifications, the HHI levels are the same. Before attempting to interpret the results, it is important to refer back to theoretical argument of the common ownership theory in regard to industry performance. When considering institutional investors that are invested across the industry – i.e., intra-industry diversified shareholders – in terms of their interest, it is assumed that they would prefer industry wide profit to increase, rather than company-specific profit. When firm managers decide to increase individual corporate performance by competing with rivals and taking away their market share, institutional investors' profits – given that they are intra-industry diversified – across the industry will decrease. Ultimately, these shareholders are more likely to prefer managers who maximize industry profits; and with that, avoid competition (Elhuage, 2016, p.

49 Equations (3.a) and (3.b) don't require these effects because, like equations (2.a) and (2.b), they are not run across entities (companies) so the unobserved individual effects – or heterogeneity – does not need to be controlled for.

1279). With that being said, the results of MHHI Δ in both regressions should yield positive results on both average markup and industry total markup. In both cases, a positive relationship between MHHI Δ and these outcome variables would indicate signs that the overall industry performance would be improving.[50] Table 5 displays the results from equations (3.a) and (3.b).

Table 5: Baseline Results

	Equation (3.a)		*Equation (3.b)*	
Outcome Variables	*Average Markup*	*Average Markup*	*Industry Total Markup*	*Industry Total Markup*
Specification	*1*	*2*	*1*	*2*
MHHI Δ	0.000216***		0.000171***	
	(4.06e-05)		(4.10e-05)	
HHI	8.00e-05	0.000215	-0.000317**	-0.000211
	(0.000129)	(0.000131)	(0.000130)	(0.000132)
MHHI' Δ		0.000198***		0.000157***
		(3.79e-05)		(3.82e-05)
Constant	-2.078***	-2.436***	0.849**	0.567
	(0.378)	(0.414)	(0.382)	(0.418)
Observations	37	37	37	37
R-squared	0.463	0.454	0.393	0.386
Corr	0.6758	0.6411	0.5362	0.5830

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Table 5 shows the regression results from the two equations above. Equation (3.a) utilizes both calculations of MHHI Δ (refer to section *IV.A*) and is shown in the first and second column displaying specifications (1) and (2) respectively. The outcome variable is average markup and considers the average of the markups across the entire industry in a given quarter. The correlation's presented (corr) represent the relationship between MHHI Δ and average markup – the correlation between HHI and average markup is not displayed. There are 37 observations because there are 37 quarters analyzed. Equation (3.b) utilizes both calculations of MHHI Δ (refer to section *IV.A*) and is shown in the third and fourth column displaying specifications (1) and (2) respectively. The outcome variable is industry total markup and considers the sum of markups across the entire industry in a given quarter. The correlation's presented (corr) represent the relationship between MHHI Δ and industry total markup – the correlation between HHI and industry total markup is not displayed. There are 37 observations because there are 37 quarters analyzed.
The asterisks (*,**,***) indicate statistically significant at the 1%, 5%, and 10% levels.

For both calculations of MHHI Δ – specifications (1) and (2) – there is a positive and statistically significant effect on average markup and industry total markup. The coefficient of

50 I.e., if the average markup across all companies is increasing, that the entire industry is doing better. If the total industry markup is increasing, then, obviously, the entire industry is doing better.

.000216 on MHHI Δ implies that an increase in MHHI Δ from 2,296.9 (the minimum level of MHHI Δ across all 37 quarters) to 4,343.8 (the average level of MHHI Δ across all 37 quarters) is associated with an increase in the average markup of the airline industry of 44.21%.[51] Additionally, using the proportional control assumption to calculate MHHI' Δ in specification (2), the coefficient of .000198 on MHHI' Δ implies that an increase from 3,273.3 (the minimum level of MHHI' Δ) to 4,725.9 (the average level of MHHI' Δ) is associated with an increase in the mean average markup of the airline industry of 28.76%.[52] To put that in perspective, the mean average markup was .4132 across all quarters. The 44.21% change in this value would equate to an average markup of .6.[53] Lastly, treating HHI constant, average markup in a highly concentrated market (when MHHI =2500) [54] are 54%[55] higher because of common ownership, compared to a counterfactual world in which firms are separately owned (MHHI Δ equals 0), or in which firms entirely ignore the anticompetitive incentives caused by common ownership.

In terms of industry total markup, the coefficients for both calculations of MHHI Δ are positive and statistically significant. The mean industry total markup across all 37 quarters was 2.18. Using the same hypothetical increase in MHHI Δ – from its minimum to average value – this would result in an increase in industry total markup of approximately 35%.[56] Given this, and the results displayed for average markup, it is evident that the reduced-form measurements of MHHI Δ estimate that an increase in common ownership is related positively to the average airline markup across all firms and the total markup of the entire industry. Assuming that the

51 (4,343.8-2,296.9) * .0216 = 44.21%.
52 (4,725.9-3,273.3) * .0198 = 28.76%.
53 A markup of 1, or 100% means that a firm is experiencing a profit margin of 50%; i.e., their revenue is double their cost.
54 According to U.S. Dep't of Justice & Fed. Trade Commission, Horizontal Merger Guidelines § 5.3 (2010) a highly concentrated market has an HHI of 2,500 or greater. Since MHHI equals MHHI Δ + HHI, treating HHI constant, if MHHI is 2,500 then MHHI Δ would also equal 2,500.
55 (2,500-0) * .0216 = 54%.
56 (4,343.8-2,296.9) * .0171 = 35%.

change in markups doesn't come from a cost reduction, rather a price increase, these findings are consistent with the hypothesis that firm managers consider the interests of their shareholders – that is, increasing industry performance and ultimately avoiding price competition – when these shareholders are intra-industry diversified.

In terms of the coefficients on the HHI, they render a positive, but insignificant relationship to average markup; and they depict a negative, yet statistically significant, relationship to industry total markup. Given that this index was included as a control, based on the results from the regressions in section *VI.C.2*, its interpretation isn't meaningful. Although previous literature has found a relationship between HHI and profit margins, its robustness has been questioned. When considering it in terms of a regression with common ownership, the MHHI is much more effective in estimating the variation in markups. Recall that the difference in specifications (1) and (2) has to do only with the calculation of MHHI Δ; and the HHI is the same across the time period in both specifications.

It makes intuitive sense that the coefficient on HHI, in the baseline regression, is insignificant for the average markup and negative for industry total markup. Ultimately, under the assumption of firms competing á la Cournot, O'Brien and Salop (2000) modeled that markups on the margin are proportional to the markets' HHI; and a greater HHI means that the market concentration is higher. With that, a corresponding empirical prediction is that markets with high HHI should have higher prices, assuming marginal cost is constant. Since this analysis used average markups, using HHI to estimate industry performance can potentially disproportionately consider the markups of the smaller, less powerful, airlines. For example, a high HHI may allow the firms with more market share to increase prices and experience a higher markup, but the firms with low market share will experience the opposite. In other words, the firms with more market share will benefit at the expense of the firms with less – and since this regression consider the average markups across the industry, the effect of the increase in markups of the more powerful firms would be negated by the decrease in margins of the smaller firms. Similarly, industry total markup may decline given how these smaller firms are impacted when the larger one's act as monopolies. Since the MHHI Δ doesn't just simply consider market share in its relation to markups, but also weights the ownership stakes with cross-products of market shares, this modifies the HHI index in a way that allows it to consider the interaction between the market share of firms and their respective links; and in doing, can better estimate the average markup of an industry. Overall, the HHI as a measure of market concentration shows inconsistent significance and signs on the regression coefficients; partly because, it doesn't consider diversified investors who hold stakes in competitors.

The last point of importance for the baseline regression is the magnitude and difference between the coefficients on MHHI Δ and MHHI' Δ. As mentioned in section *IV.A*, the distinction between these two calculations provides an insight on how common ownership links influence managers. The coefficients on MHHI Δ, for each outcome variable, are slightly higher, but both calculations are statistically significant at the .01 level. Since the coefficients in both specifications are quite similar, at this point, it is hard to discern the relevance of considering the contrast between assuming proportional control or not. Moving forward, it is important to keep this in mind.

VIII. Regression Analysis

Recall the regression in equation (1.a); where company-specific markups were regressed on MHHI. This regression used company-specific random effects based on a 'Hausman test,' and given the underlying assumption that individual differences across companies have some influence on markups and this variation across these companies is uncorrelated to market concentration. As mentioned in section *V.C*, random effects is an approach used in empirical research, like fixed effects, to study panel data. Previously, in the baseline regression, this approach was not relevant because the average markup and total industry markup were aggregations across companies in each quarter – i.e., the dependent variable did not change across entities. Given that, the dataset was not arranged in a format where the companies – or entities – behaved different across time. In other words, data was aggregated to the industry level and entity-specific indices were not used. In comparison, equation (1.a) required this specification because the outcome variable was markup per company; and given that these markups differed across entities based on individual characteristics – those unrelated to common ownership – this was necessary.

In this analysis, in order to provide insight into how common ownership relates to markups, it is beneficial to look at how company-specific markups change in this regard. Unlike the specification made above in section *VII.A* the outcome variable in this case would have to be specific to each entity or company. This will provide for an additional test in the robustness of the reduced form relationship between MHHI Δ and markups. In order to analyze the impact that common ownership has at the company-specific level – i.e., the relationship between each company's markup and the overall MHHI Δ – a random effect regression must be used. Refer back to figure 3 for a reminder on the individual specific effect that is presented in regard to average markups across companies. The key assumption in this model is that there are unique attributes of each company that impact their markups and are uncorrelated with MHHI Δ and HHI; and with that, random effects can explore the relationship between the predictor variable

(MHHI Δ) and the outcome variable (markup) at the company-specific level. Additionally, it is assumed that these characteristics need not be time-invariant, and the company-specific error term is not correlated with the predictors. Recall, equation (1.a) utilized this technique when comparing the robustness between market concentration measures MHHI and HHI. In sum, there are two main reasons to use this company-specific analysis:

i) Firstly, because of the relevant data that is accessible in the TR data set, and some of the mergers within the industry, the amount of companies included in the data differs across periods – refer to section *VI.C* for more detail on this. With that being said, the average markup and industry total markup will implicitly change based on the number of companies included in each quarter; which, for example is eight in 2010q4 but five in 2016q1. If it is the case, hypothetically, that the three companies not included in 2016q1 had high markups (which was based on their individual characteristics) then both the average markup and industry total markup would be lower in 2016q1 just simply based on their inclusion. In other words, this decrease in markups is not necessarily related to MHHI Δ, but regardless, the model could predict a relationship. Lastly, and most importantly, random effects uses partial pooling – which means the company's estimate of markups will be based partially on the more abundant data from other companies. Given that the number of companies isn't consistent throughout the quarters, random effects is a necessary technique in analyzing the panel data.

ii) Secondly, in the baseline regression results, the average markup and industry total markup included data on all the companies available in that period. As shown in figure 2, the airline companies have displayed markups that are quite different. It is plausible to assume that these variations in markups have to do with underlying specific characteristics at the company level. To illustrate this more clearly, consider the following – likely – example: if markup for JetBlue in one year were inherently higher (which figure 3 shows) because of, per se, their use increased use of automation rather than human labor – i.e., their gross profit increased through a cost reduction – then this would be reflected in their markup numbers and have no relation, or correlation, to common ownership. This would be, as assumed, an entity specific characteristic that is reflected, essentially, in the average markup and industry total markup (the variables in the baseline regression). Since this paper isn't able to adequately control for the effects of omitted variables, like cost reductions, company-specific random effects must be included in order to prevent omitted variable bias. In other words, this specification attempts to remove the entity-specific individual characteristics (like automation), that are uncorrelated to common ownership, but may impact or bias the markups.

To ensure that that the random effects model was preferred over a fixed effect specification in this analysis, a 'Hausman test' was run again, this time including regressions with both concentration indices – MHHI Δ and HHI.[57] This test, as discussed in section *VI.C.2*, is a test to see whether or not the unique errors are correlated with the regressors. The results from this test using MHHI Δ presented a chi-squared value of .14, which is greater than .05 (i.e. not significant) and the null hypothesis is not rejected. Given that, in order to analyze markups at the company-specific level, a random effects regression is used.

The random effect model specified in the following section defines individual companies as entities. Following this approach, the subsequent section will use fixed effects at the pairing-

57 In section *VI.C.2* two separate 'Hausman tests' were run for MHHI and HHI separately. The test with MHHI showed preference for a random effect model; while the test with HHI showed preference for a fixed effect model.

specific level and analyze the relationship between each coupling's addition to overall MHHI Δ and the respective markup between the two airlines.

A. *Random Effect – Company Level*

In this specification, the logarithm of markup for company *c* at quarter *t* is regressed on the MHHI Δ and the HHI – the outcome variable is denoted as $Markup_{c,t}$. Both calculations were used when calculating MHHI Δ; specification (1) displays the original MHHI Δ calculation while specification (2) displays the proportional control assumption of MHHI' Δ. In both specifications, the HHI levels are the same. The random effect regression is specified below and table 6 displays the results from equation (4):

$$\boldsymbol{Log(Markup)_{ct} = \beta \mathrm{MHHI}\Delta_t + \gamma HHI_t + \alpha + \upsilon_{ct} + \epsilon_{ct}} \qquad \textbf{(4).}$$

Description: α is the constant term. υ_{ct} is the company-specific random effect: it measures the difference between the average markup at company *c* and the average markup in the entire industry; it can also be considered the 'between-entity' error. ϵ_t is the error term: it measures the error within the company; it can also be considered the 'within-entity' error.

Table 6: Random Effect – Company Level

Outcome Variable	*Markup*	*Markup*
Specification	*1*	*2*
MHHI Δ	0.000197***	
	(2.38e-05)	
HHI	1.52e-05	0.000137*
	(7.38e-05)	(7.51e-05)
MHHI' Δ		0.000181***
		(2.23e-05)
Constant	-1.925***	-2.249***
	(0.216)	(0.237)
Observations	198	198
R-squared		
Number of Companies	9	9
Random Effect	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Table 6 shows the regression results from the equation above. Equation (4) is a company-specific random effect regression that utilizes both calculations of MHHI Δ (refer to section *IV.A*) and is shown in both columns displaying specification (1) and (2) respectively. The outcome variable is markups at the company level; there are 198 observations because that is how many times a specific company had data available across the 37 quarters. All nine companies were included in this analysis. The asterisks (*,**,***) indicate statistically significant at the 1%, 5%, and 10% levels.

One purpose of this analysis was to complement the baseline specifications by looking at how markups changed at the company level, rather than using the mean and sum across the industry. In each specification there is a large and statistically significant positive effect of MHHI Δ – for both calculations – on markup. The coefficient of .000197 in the first specification, with random effects, implies that an increase in MHHI Δ from 2,296.9 (the minimum level of MHHI Δ across all 37 quarters) to 4,343.8 (approximately the average level of MHHI Δ across all 37 quarters) is associated with an increase in the markup of a company in the airline industry of 40.32%;[58] recall, in the baseline regression, using the same change in MHHI Δ resulted in the average markup changing 44.21%. Specification (2), which assumes proportional control in calculating MHHI Δ has a coefficient of .000181. So, although the estimated effect is similar, as discussed in section *IV.A* this comparison could have further implications. Ultimately, the larger coefficient on MHHI Δ, compared to that on MHHI' Δ renders the assumption that, when considering the interests of their shareholders, firm managers seem to emphasize how much control the shareholder has in regard to their voting rights. Although, given these results, that consideration seems quite minimal.

The coefficients on HHI are much stronger in this regression than they were in the baseline analysis when the outcome variables were average markup and industry total markup. Given that this index was included as a control, based again on the results from the comparison regression is section *VI.C.2*, its interpretation isn't meaningful. But, it seems, given these values, that the traditional market concentration index HHI is a more robust estimate of the markup for each specific company, rather than the average markup summed, or aggregated, across the industry. In other words, the model predicted in section *III.A*, in regard to this measure, seems to

[58] (4,343.8-2,296.9) * .0197 = 40.32%.

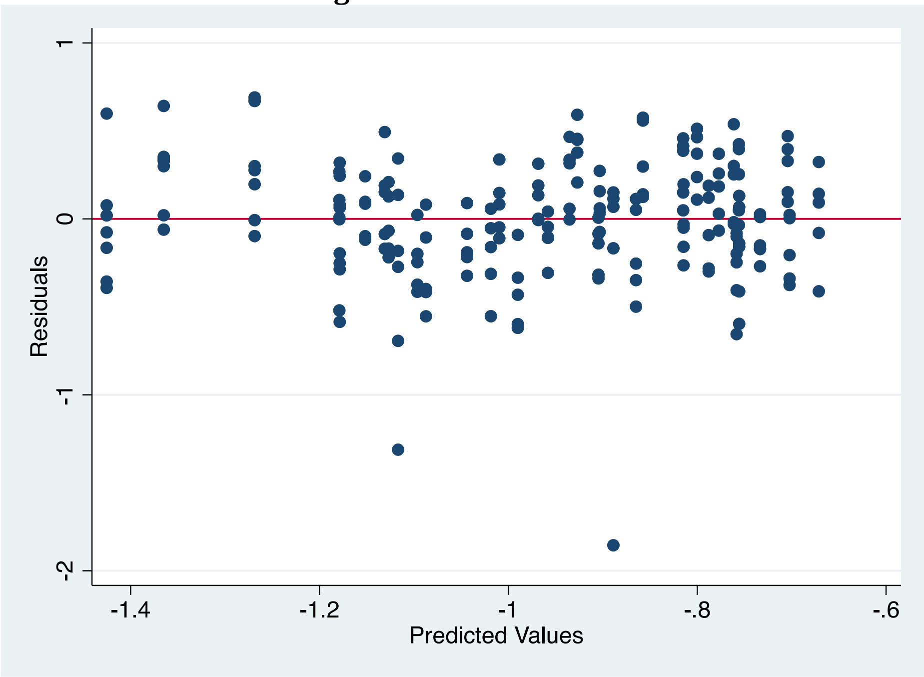
hold up better when looking at how market concentration effects individual companies. It is meaningful to note the similarity between the coefficients on MHHI' Δ and HHI in specification (2). Although MHHI' Δ is statistically significant at the .01 level, while HHI is only at the .1 level, intuitively, this seems to depict a relationship between market concentration and the way firm managers are influenced by shareholders. In the case of proportional control – MHHI' Δ – it seems that HHI, or market concentration, is correlated more profoundly with markups. In other words, when control is strictly determined by ownership, and not voting shares, the relationship between HHI and markups is more distinct. In sum, the random effects regression provides similar results to that in the baseline, and allows for an interpretation, and estimate, of how the markup for companies change based on industry wide MHHI Δ.

B. Company-Specific Analysis

Recall the argument about the intra-industry diversified shareholder and their assumed preference. When shareholder hold stakes across an industry, the common ownership theory presumes that they would prefer that industry-wide performance, and profit, to increase rather than individual corporate profit. Ultimately, for example, if a shareholder holds stake in firm *A* and firm *B*; and firm *A* undercuts firm *B*'s price in order to increase market share, the shareholder gains from firm *A*, but loses from firm *B*. Instead, they would rather that both firms act as their own monopoly and utilize anticompetitive practices; which for this paper, is assumed to be illustrated through markups. In order to better interpret this, an analysis of how industry-wide MHHI Δ – i.e., how airline firms are linked through common ownership – impacts the markup of each *specific* company separately is necessary. This differs from the random effect regression in equation (4); although that specification considered markups of each company, its purpose was to provide an alternative robustness test in the reduced form relationship by assuming the company-specific heterogeneity was uncorrelated to MHHI Δ. In order to measure the effects that common ownership has on each airline specifically, a random effects model need not be specified; ultimately, since each company is being analyzed separately, there is no unobserved heterogeneity across entities.

Before moving into the specifications of the regressions, refer to figure 6 for a residual plot of the regression (non-random effects) between markup (at the company level) and both concentration measures – i.e., equation (4) without utilizing random effects. The goal of this figure is to display the relationship between the predicted values of markups and the residuals of the model – which is the observed minus the predicted values. The prediction made by the model specified in section *VIII.A* is on the x-axis, and the accuracy of the prediction is on the y-axis. Each point is one company in one period. The distance from the line at zero is how bad the prediction was for that value; because, the residual is the difference between the observed and predicated values. Positive values for the residual on the y-axis mean the prediction was too low, and negative values means the prediction was too high; zero means the guess was exactly correct. Figure 6 illustrates an adequate model prediction for markups.

Figure 6: Residual Plot



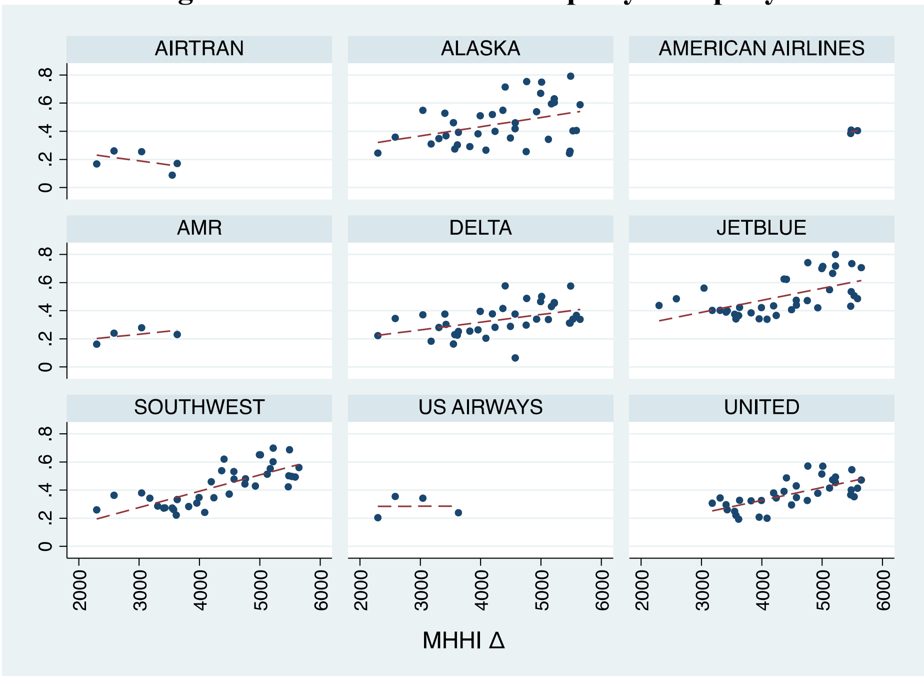
Notes: Figure 6 is a residual plot of the relationship analyzed in equation (4). This plot doesn't include the random effects of the regression. The residual values (which are the observed minus the predicted values) are on the y-axis; the predicted values from the independent variables MHHI Δ and HHI are on the x-axis. Each blue dot represents a company in a given period. Since the data points are relatively dispersed around the horizontal axis, the regression model used in section *VIII.A* was appropriate for the data.

The following regressions were run for each company in each period. The logarithm of markup for each company at quarter *t* is regressed on the MHHI Δ and the HHI – the outcome variable is denoted as $Markup_{Airline,t}$. Both calculations were used when calculating MHHI Δ; specification (1) displays the original MHHI Δ calculation while specification (2) displays the proportional control assumption of MHHI' Δ. In both specifications, the HHI levels are the same. The company-specific regressions are specified in equation (5) below and figure 7 displays these relationships between the MHHI Δ calculation and markups:

$$\boldsymbol{Log(Markup)_{Airline,t} = \beta \mathrm{MHHI}\Delta_t + \gamma HHI_t + \partial_t} \quad \textbf{(5).}$$

Description: ∂_t is the error term: it captures all other factors which influence markups other than the market concentration index.

Figure 7: MHHI Δ and Markups by Company



Notes: Figure 7 is a scatter plot for each company that displays the relationship analyzed in equation (5). The traditional calculation of MHHI Δ was used – refer to section *IV.A*. The blue dots represent data for the given quarter, between 2010q1 and 2019q1, that the company was included in. The linear fit line represents the line of best fit and refers to a line through the scatter plot of data points that best expresses the relationship between those points. The dotted red line represents the raw correlation between markups and MHHI Δ. As shown, some companies have less data points that others – refer to footnote 29. As shown, the majority of the companies illustrate a positive raw correlation between markups and MHHI Δ.

As mentioned, the goal of this section, and analysis, was to look at how each individual airline company is affected by common ownership. Section *VII.A* displayed results that rendered both a positive and statistically significant relationship between MHHI Δ and both the average markup and the industry total markup. In other words, the assumption that markups would reflect the notion that intra-industry diversified shareholders prefer an industry-wide profit increase rather than corporate-specific profit increase – presuming this interest is taken into account by firm managers – was satisfied. In the previous section *VIII.A* this theory was further supported using a random effect regression to analyze company markups, rather than average markup, while controlling for heterogeneity across companies. Now, referring back to the original assumption, although it was hypothesized that industry profits would increase, it need not be the case that each company generated a higher markup when common ownership increased;

ultimately, in any industry, it would be unrealistic for all the firms to benefit from increasing their price. Those companies will less market share – and less power to retain consumers, regardless of price changes – could be harmed when their more powerful competitors seek to minimize competition. If this is the case, the assumption about firm managers looking to satisfy the interests of their largest shareholders – who happen to be intra-industry diversified – can be broken down by company-specific performance. Likely, since the previous results displayed an industry-wide performance increase, as reflected through markups, this could be potentially caused primarily by the actions of firms with larger market shares; because ultimately, their anticompetitive practices will not deter as many customers. In sum, it is reasonable to make the hypothesis that the firms with less market share will not render a positive causal relationship between MHHI Δ and markups. Table 7 displays the results from equation (5).

Before moving into an interpretation of the results, one notable issue with using the company-specific regression technique is that some companies have very little observations; e.g., AirTran, AMR, American, and US Airways all have five or less. Because of this, it is difficult for the model to estimate a causal relationship between MHHI Δ and the markup of these companies. With that being said, for this analysis, it might be more beneficial to focus only on the other five companies – Alaska, Delta, JetBlue, Southwest, and United. Additionally, American was taken out of the analysis because the model wasn't able to properly predict a relationship for this company specifically given the availability of data.

Table 7: Company-Specific Analysis

Company	AirTran	AMR	Alaska	Delta	JetBlue	Southwest	US	United
Outcome Variable	*Average Markup*	*Average Markup*	*Average Markup*	*Average Markup*	*Average Markup*	*Average Markup*	*Average Markup*	*Average Markup*
Specification	*1*	*1*	*1*	*1*	*1*	*1*	*1*	*1*
MHHI Δ	-0.00035	0.0069	0.00013**	0.00017**	0.00016***	0.00028***	0.001	0.00027***
	(0.00034)	(0.00027)	(0.00006)	(0.00007)	(0.00004)	(0.00004)	(0.001)	(0.00005)
HHI	-0.001	0.0017	0.00027	-0.00007	-0.00011	-0.0001	0.002	0.00006
	(0.001)	(0.001)	(0.00019)	(0.00023)	(0.00013)	(0.00013)	(0.002)	(0.00016)
Constant	1.106	-6.944	-2.124***	-1.678**	-1.130***	-1.846***	-7.471	-2.400***
	(1.658)	(2.460)	(0.570)	(0.669)	(0.374)	(0.378)	(4.767)	(0.572)
Market Share	1.9	15	2.8	18.6	3.4	10.6	8.4	17.7
Obs.	5	4	37	37	37	37	4	34
R-squared	0.598	0.862	0.166	0.137	0.336	0.588	0.630	0.463
Specification	*2*	*2*	*2*	*2*	*2*	*2*	*2*	*2*
MHHI' Δ	-0.001	0.003	0.00011*	0.00015**	0.00016***	0.00027***	0.004	0.00023***
	(0.00033)	(0.002)	(0.00006)	(0.00007)	(0.00004)	(0.00004)	(0.002)	(0.00005)
HHI	-0.001	0.008	0.00035*	0.00003	-0.000	0.00008	0.012	0.00017
	(0.001)	(0.007)	(0.0002)	(0.00023)	(0.00013)	(0.00013)	(0.005)	(0.00018)
Constant	3.466	-28.621	-2.296***	-1.927**	-1.432***	-2.347***	-39.737	-2.569***
	(2.030)	(24.418)	(0.625)	(0.731)	(0.402)	(0.403)	(15.781)	(0.632)
Market Share	1.9	15	2.8	18.6	3.4	10.6	8.4	17.7
Obs.	5	4	37	37	37	37	4	34
R-squared	0.779	0.561	0.152	0.127	0.351	0.602	0.869	0.425

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Table 7 shows the results from the equation above. Equation (5) is a company-specific regression that utilizes both calculations of MHHI Δ (refer to section *IV.A*) and is shown in all columns displaying specifications (1) in the first half of the rows and specification (2) in the last half of the rows. The outcome variable is markup at the company level; the observations differs for each company depending on the availability of the data – refer to footnote 29. The market share included is equal to the average market share that the company had over all the quarters they were included in. American was taken out of the analysis given the availability of data.
The asterisks (*,**,***) indicate statistically significant at the 1%, 5%, and 10% levels.

As shown, the coefficients on MHHI Δ are quite similar for both forms of calculation. Five out of the eight companies showed positive and statistically significant relationships.[59] For example, the coefficient of .00016 for JetBlue in specification (1) implies that an increase in MHHI Δ from 2,296.9 (the minimum level of MHHI Δ across all 37 quarters) to 4,343.8 (approximately the average level of MHHI Δ across all 37 quarters) is associated with an increase of 32.7% in the company's markup.[60] Similar to the results displayed in previous sections, the HHI doesn't seem to be a robust and significant index in estimating markups.

[59] These include Alaska, Delta, JetBlue, Southwest, and United. This is consistent for both specifications.
[60] (4,343.8-2,296.9) * .016 = 32.75%.

With regard to assumption made previously, that being, the companies with less market share would likely see lower markups when their bigger, more powerful, competitors use anticompetitive practices to increase industry-wide profit (and with that, their own specific profit) the average market share for each company was included as a point of reference in table 7. Although this measure is implicitly included in the calculation of the MHHI Δ, it is useful to compare the coefficient magnitudes with average market shares. The four companies with the highest average market share in the years they were included (not considering American) were AMR, Delta, Southwest, and Untied. All four of these companies had positive coefficients, and all but one rendered statistical significance at the .05 level – that one being, AMR, who – as mentioned – has only four observations. The four companies with the lowest market shares were AirTran, Alaska, JetBlue, and US Airways. Half of these companies had coefficients that were both positive and statistically significant, and the other half were not statistically different than zero. In regard to the hypothesized relationship between market share and markups when firms use anticompetitive practices, the results showed by the bottom half of firms is less conclusive. The next section uses another panel data regression approach to analyze how the markups between each pairing is impacted based on their (the pairings') addition to the overall calculation of MHHI Δ that year.

C. Fixed Effect – Pairing Level

As mentioned in section *VI.B*, if ownership data on all nine airline companies were available in a given quarter, there would have been 72 different arrangements of pairings: *n(n-1)* where *n* is the number of firms.[61] When avoiding duplicate pairings – i.e., aggregating JetBlue-Delta and Delta-JetBlue to just one pairing – there are 36 total pairing possibilities. This analysis

[61] As mentioned in section *VI.B* each pairing is included twice when calculating the MHHI Δ; i.e., JetBlue-Delta and Delta-JetBlue differ in their contribution to this index. Refer to footnote 38.

utilizes the pairing specification of 36 pairings and introduces a nuanced form of MHHI Δ – this will be referred to 'MHHI Δ addition.' In terms of this new variable, MHHI Δ addition calculates how much each pairing contributes to the overall MHHI Δ in a given quarter. Refer to the equation below for an interpretation of MHHI Δ addition. Instead of considering all firms *j* and *k*, the MHHI Δ addition utilizes just the two firms in the pairing (firm *1* and firm *2*). Additionally, MHHI Δ addition considers both duplications for each coupling and aggregates the addition from both combinations (firm *1* – firm *2* and firm *2* – firm *1*).[62] Ultimately, the sum of MHHI Δ addition across all pairings in a given quarter equals the overall MHHI Δ in that quarter. Refer to the equations below (which compare MHHI Δ addition and the traditional MHHI Δ):

$$MHHI\ \Delta\ addition_{1\ and\ 2\ (1-2\ and\ 2-1)} = \sum_1 \sum_2 s_1 s_2 \left(\frac{\sum_i \gamma_{i,1}\beta_{i,2}}{\sum_i \gamma_{i,1}\beta_{i,1}} + \frac{\sum_i \gamma_{i,2}\beta_{i,1}}{\sum_i \gamma_{i,2}\beta_{i,2}} \right),$$

$$MHHI\Delta = \sum_j \sum_{k \neq j} s_j s_k \frac{\sum_i \gamma_{i,j}\beta_{i,k}}{\sum_i \gamma_{i,j}\beta_{i,j}} = MHHI\ \Delta\ addition_{j,k}.$$

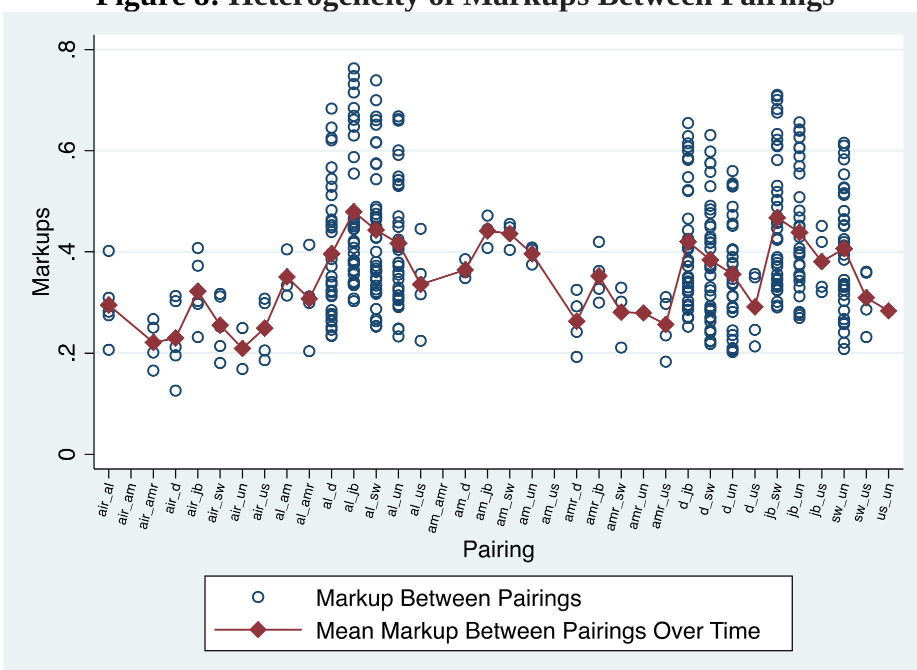
The MHHI Δ addition can also be calculated using the proportional control assumption established in section *IV.A* – this will be denoted as MHHI' Δ addition. 33 out of the 36 pairings were included in the following analysis and the analysis in section *VIII.D*. Three pairings weren't included because they didn't have any data points that overlapped; i.e., they were never included in the same quarter in the TR data set. Similar to the specifications in the *VIII.B*, this model uses panel data, and with that, given the heterogeneity of markups across companies, a fixed or random effect technique needs to be applied. In other words, markups for each pairing may be influenced by the same omitted factors that would influence their own specific markup, and if not controlled for, this could create an omitted variable bias.[63] Referring back to the hypothetical

[62] MHHI Δ addition for Delta and JetBlue = MHHI Δ Addition$_{\text{Delta-JetBlue}}$ + MHHI Δ Addition$_{\text{JetBlue-Delta}}$.

[63] In other words, the heterogeneity shown in figure 3 is relevant when considering the markups between pairings. Ultimately, the individual specific effects at the company level are just portrayed onto whatever pairing that company is included in.

example explained above in section VIII, if markups for JetBlue were inherently higher based on their use of automation, and the cost reduction this provides, then this would be reflected in their markup number and have no relation, or correlation, to common ownership. Similarly, when considering the JetBlue-Delta pairing, this would have the same impact on the mean average markup of this coupling. With that being said, figure 8 displays the heterogeneity in the markups between the two companies across all 36 pairings. Markup, in this case, represent the average between the two companies in a pairing in a given quarter – i.e., the sum of the markups in both companies divided by two.

Figure 8: Heterogeneity of Markups Between Pairings



Notes: Figure 8 shows how the markups for each pairing differs from their mean markup over time (between 2010q1 and 2019q1) and compares this with the other pairings in the entire industry. The blue circles represent the markup between each pairing in each specific quarter; the red diamonds represent the mean markup between a pairing over all quarters that both airlines were included in. These markers are connected to illustrate the heterogeneity – or difference – between the mean markups (across all quarters) of each pairing. The graph was plotted for the periods between 2010q1 and 2019q1.
Source: Compustat fundamentals quarterly – North America.

To determine if fixed or random effects better fits the data, another 'Hausman test' was run, where the null hypothesis is that the preferred model uses random effects and the alternative hypothesis is that the preferred model uses random effects. The results from this test using a regression of markups between pairings on MHHI Δ addition and HHI presented a probability chi-squared value of .0, which is less than .05 (i.e., significant) and the null hypothesis is rejected.[64] Given this, a fixed effect regression was used to analyze how the MHHI Δ addition for each pairing influenced the markups between the two companies. Intuitively, this means that the unobserved variable that created the heterogeneity across pairings is correlated in some way to the MHHI Δ addition of that pairing; in other words, the unobserved variables do not change over time and any changes in the markups between pairings must be due to factors other than these fixed characteristics. The importance of this analysis, and the fixed effect regression, is that the MHHI Δ addition values implicitly fall into entity-specific categories (i.e., the pairings); and given this, it is necessary to control for characteristics of these different parings, which could ultimately be the inherent components that may influence markups and are unrelated to common ownership. If a regular OLS model was used, omitted variable bias will result if the relevant control variables weren't all included. One plausible issue with using fixed effects is if these unobservable factors are not time-invariant – i.e., if they move up and down over time within the pairings in a way that is correlated to MHHI Δ addition – there could be reverse causality concerns; which means, shareholders may increase their stake because they are aware the markup of a company is going to increase in the future, or conversely decrease their stake if the opposite is true. Authors AST (2018) address many possibilities of these concerns and refute them properly. Given this paper's model, and the goal of simply analyzing the reduced form relationship, no such robustness tests are conducted.

The fixed effect regression specification is below. The logarithm of the markup between pairing *p* in quarter *t* is regressed on the MHHI Δ addition and the HHI – the outcome variable is

[64] The traditional calculation of MHHI Δ was used to calculate the MHHI Δ addition for this test.

denoted as *Markup*$_{pt}$. Markup between the two companies was calculated by taking the sum of their individual markup in a quarter and dividing by two. Both MHHI Δ calculations were used when calculating MHHI Δ addition; specification (1) displays the original MHHI Δ addition calculation while specification (2) displays the proportional control assumption of MHHI' Δ addition; which is the same variation constructed section *IV.A* – in terms of proportional control – to the MHHI Δ addition equation displayed above. In both specifications, the HHI levels are the same and resemble one number for the entire industry – this measurement is not specific to the pairing and is included as a control. Equation (6.a) is the standard fixed effect model; equation (6.b) is another way to utilize fixed effect and uses binary variables; these equations are specified below:

$$\boldsymbol{Log(Markup)_{pt} = \beta MHHI\ \Delta\ Addition_{pt} + \gamma HHI_t + \alpha_p + \upsilon_{pt}} \qquad \textbf{(6.a),}$$

Description: α_p is the pairing-specific fixed effect: it measures the unobserved time-invariant company effect. It is considered the unknown intercept for each company. υ_{ct} is the error term.

$$\boldsymbol{Log(Markup)_{pt} = \beta_0 + \beta_1 MHHI\ \Delta\ Addition_{1pt} + \cdots \beta_k MHHI\ \Delta\ Addition\ \Delta_{k,pt} + \delta_2 E_2 \ldots + \delta_n E_n + \gamma_1 HHI_t + \upsilon_{pt}} \qquad \textbf{(6.b).}$$

Description: δ_n is the coefficient for the binary regressors (pairings). $E_n$is the entity (pairing) n. Since there are binary dummies, there is *n-1* pairings included in the model. The subscript *k* represents each different pairing.

Both equations are equivalent: the slope coefficient on MHHI Δ addition is the same from one pairing to the next. The pairing-specific intercepts ($\alpha_p$in equation (6.a)) and the binary regressors ($E_n$in equation (6.b)) have the same source – that being, the unobserved variable that varies across the pairings but not over time. Table 8 displays the results.

Table 8: Fixed Effect – Pairing Level

	Equation (6.a)		Equation (6.b)		Equation (6.b)	
Outcome Variable	*Markup*	*Markup*	*Markup*	*Markup*	*Markup*	*Markup*
Specification	*1*	*1*	*2*	*2*	*3*	*3*
MHHI Δ Addition	0.000618***	0.000618***			.000618***	
	(8.59e-05)	(8.59e-05)			(8.59e-05)	
MHHI' Δ Addition			0.000640***	0.000640***		0.000640***
			(8.41e-05)	(8.41e-05)		(8.41e-05)
HHI	-0.000161***	-0.000161***	-.000151***	-.000151***	-0.000161***	-.000151***
	(5.32e-05)	(5.32e-05)	(5.21e-05)	(5.21e-05)	(5.32e-05)	(5.21e-05)
AirTran-Alaska		OMITTED		OMITTED	-0.264**	-0.231*
					(0.130)	(0.129)
AirTran – American		-0.310*		-0.326*	-0.575***	-0.557***
		(0.180)		(0.179)	(0.144)	(0.143)
AirTran – Delta		-0.299*		-0.323*	-0.563***	-0.554***
		(0.170)		(0.169)	(0.130)	(0.129)
AirTran – JetBlue		0.0880		0.0871	-0.176	-0.144
		(0.170)		(0.169)	(0.130)	(0.129)
AirTran – Southwest		-0.154		-0.158	-0.418***	-0.389***
		(0.170)		(0.169)	(0.130)	(0.129)
AirTran – United		-0.353		-0.362	-0.617***	-0.593***
		(0.224)		(0.223)	(0.196)	(0.195)
AirTran – US Airways		-0.196		-0.230	-0.461***	-0.461***
		(0.180)		(0.179)	(0.144)	(0.143)
Alaska – American		0.139		0.0950	-0.126	-0.136
		(0.196)		(0.195)	(0.163)	(0.162)
Alaska – AMR		-0.0125		-0.0525	-0.277*	-0.284**
		(0.180)		(0.179)	(0.144)	(0.143)
Alaska – Delta		0.264**		0.231*	OMITTED	OMITTED
		(0.130)		(0.129)		
Alaska – JetBlue		0.532***		0.524***	0.268***	0.293***
		(0.130)		(0.129)	(0.0631)	(0.0631)
Alaska – Southwest		0.406***		0.383***	0.142**	0.152**
		(0.130)		(0.129)	(0.0625)	(0.0621)
Alaska – United		0.322**		0.296**	0.0582	0.0647
		(0.131)		(0.130)	(0.0638)	(0.0633)
Alaska – US Airways		0.0882		0.0517	-0.176	-0.179
		(0.180)		(0.179)	(0.144)	(0.143)
American – Delta		-0.454**		-0.505**	-0.718***	-0.736***
		(0.218)		(0.217)	(0.188)	(0.185)
American – JetBlue		0.350*		0.315	0.0857	0.0843
		(0.196)		(0.195)	(0.163)	(0.162)
American – Southwest		-0.0349		-0.0734	-0.299*	-0.304*
		(0.205)		(0.205)	(0.173)	(0.172)
American – United		-0.312		-0.394*	-0.577***	-0.625***
		(0.214)		(0.216)	(0.184)	(0.184)
AMR– Delta		-0.435**		-0.568***	-0.700***	-0.799***
		(0.185)		(0.189)	(0.150)	(0.153)
AMR – JetBlue		0.132		0.101	-0.132	-0.130
		(0.180)		(0.179)	(0.144)	(0.143)
AMR – Southwest		-0.345*		-0.398**	-0.609***	-0.629***
		(0.185)		(0.185)	(0.150)	(0.149)
AMR – United		-0.253		-0.249	-0.517*	-0.480*
		(0.296)		(0.294)	(0.277)	(0.274)
AMR – US Airways		-0.254		-0.233	-0.518***	-0.464***
		(0.181)		(0.179)	(0.145)	(0.143)
Delta – JetBlue		0.314**		0.265**	0.0498	0.0341
		(0.130)		(0.130)	(0.0624)	(0.0621)
Delta – Southwest		-0.121		-0.161	-0.385***	-0.392***
		(0.140)		(0.140)	(0.0798)	(0.0784)
Delta – United		-0.800***		-0.875***	-1.064***	-1.106***
		(0.189)		(0.190)	(0.148)	(0.147)
Delta – US Airways		-0.319*		-0.153	-0.584***	-0.385***
		(0.185)		(0.180)	(0.150)	(0.144)
JetBlue – Southwest		0.444***		0.425***	0.179***	0.194***
		(0.130)		(0.129)	(0.0624)	(0.0620)
JetBlue – United		0.366***		0.329**	0.102	0.0982
		(0.131)		(0.130)	(0.0638)	(0.0634)
JetBlue – US Airways		0.218		0.118	-0.0459	-0.113
		(0.180)		(0.180)	(0.144)	(0.144)
Southwest – United		-0.0921		-0.114	-0.356***	-0.345***
		(0.142)		(0.142)	(0.0835)	(0.0803)
Southwest – US Airways		-0.0337		-0.0280	-0.298**	-0.259*
		(0.180)		(0.179)	(0.145)	(0.143)
US Airways – United		-0.253		-0.292	-0.517*	-0.523*
		(0.296)		(0.295)	(0.277)	(0.275)
Constant	-0.778***	-0.894***	-0.831***	-0.916***	-0.630***	-0.685***
	(0.130)	(0.168)	(0.129)	(0.166)	(0.145)	(0.142)
Observations	441	441	441	441	441	441
R-squared	0.114	0.360	0.125	0.368	.360	.368
Number of pairing	33		33			
Fixed Effect	YES	YES	YES	YES	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Table 8 shows the results from the equations above. Equation (6.a) and (6.b) are pairing-specific fixed effect regressions that utilize both calculations of MHHI Δ addition (refer to section *IV.A*). The original calculation is shown in the first and second columns and displays specification (1); the alternative calculation is shown in the third and fourth column and displays specification (2). Equation (6.a) is shown in the first and third column, while equation (6.b) is shown in the second and fourth column. The two equations produce the same results – as shown by the coefficients on both calculations of MHHI Δ addition; the only difference between the equations is equation (6.b) uses regressors variables and displays dummy variable reports for each pairing. The outcome variable is markup at the pairing level; there are 441 observations because that is how many times all the pairings, in total, had data available across the 37 quarters. There are 33 total pairings because AirTran-American, American-AMR, and American-US Airways were all omitted because data was not available for both of the companies in the same quarter; AirTran-Alaska was omitted for multi-collinearity purposes. The fifth and sixth column display specification (3) which is discussed below; ultimately, this specification changes the original omitted pairing in equation (6.b) – AirTran-Alaska – to a more prevalent pairing – Alaska-Delta.
The asterisks (*,**,***) indicate statistically significant at the 1%, 5%, and 10% levels.

By including fixed effects, this model controlled for the average differences across pairings in any observable or unobservable predictors – such as MHHI Δ addition or markups. The coefficients on MHHI Δ addition and MHHI' Δ addition soak up all the across-pairing action. After controlling for pairing fixed effects, in both specifications, there is a large and statistically significant effect of the MHHI Δ addition between pairings and the markups between pairings. Within each specification, the results – as seen in the coefficient values of .000618 on MHHI Δ addition and .000640 on MHHI' Δ addition – from both equations are the same.[65] Four pairings were omitted from the estimation – AirTran-Alaska was omitted for multi-collinearity purposes; AirTran-American, American-AMR, and American-US Airways were all omitted simply because data was not available for both of the companies in the same quarter. For example, AMR (American was formally known as AMR) merged with US Airways to create American Airlines in November 2013; given that, it makes sense that American Airlines (the product of the merger) and both US Airways and AMR had no overlapping ownership – i.e., they had no addition to MHHI Δ. In sum, there are 33 total pairings that have overlying data and ownership; and with that, have MHHI Δ addition available.

The coefficient of .000618 on MHHI Δ addition in the first specification implies than an increase in MHHI Δ addition from 3.14 (the minimum level of MHHI Δ addition across all pairings and all 37 quarters) to 364.45 (approximately the average level of MHHI Δ addition across all pairings and all 37 quarters) is associated with an increase of 22.33% in the markups (the mean between a pairing) of airline pairings.[66] The effect is similar in specification (2), with the coefficient of .000640 implying that an increase in MHHI' Δ addition from 6.3 (the minimum level of MHHI' Δ addition across all pairings and all 37 quarters) to 396.5 (approximately the

[65] Specification (3) – which is the last two columns will be explained in further detail later on in this section.
[66] (364.45-3.14) * .0618 = 22.23%.

average level of MHHI Δ addition across all pairings and all 37 quarters) is associated with an increase of 25% in the markups (the mean between a pairing) of airline pairings.[67] The HHI in both specifications is negative and statistically significant; and although, again, this measurement is included as a control, this renders the assumption that the industry-wide market concentration doesn't positively impact the markup between companies when also considering an index that measures common ownership.

Interpreting the coefficients on each specific pairing is a much more complex process. These numbers are reported relative to the omitted pairing in the model, which in this case is AirTran-Alaska. Since this group only had five total observations, it makes sense to run the regression again and omit a pairing that is more prevalent. Because ultimately, it is difficult to use these coefficient values to establish statistical significance when the comparison group only has minimal observations. With that being said, equation (6.b) was run again and the pairing Alaska-Delta (which has 37 quarter observations of MHHI Δ addition) was omitted. The results are displayed under specification (3) of the same table; both calculations of MHHI Δ addition were used.

In this specification, there are no changes to the coefficients on both calculations of MHHI Δ addition and HHI; ultimately, the only thing that changes are the coefficients on the pairings. In terms of their interpretation, specification (3) allows for the omitted group Alaska-Delta to be omitted and thus, since that pairing is much more prevalent, this provides for a more reasonable estimate of the δ_n coefficient for each pairing.[68] Previously, in specifications (1) and (2) the model omitted the AirTran-Alaska pairing, so the predicted markup for this pairing was

[67] (396.50-6.30) * .0640 = 25%.
[68] Which, recall, is the coefficient for the binary regressors (pairings).

the constant term or β_0. Now, the predicted markup for AirTran-Alaska, relative to the omitted intercept from Alaska-Delta, in specification (3) is the new $\beta_0 + \ \beta_{Airtran-Alaska}$.

- Specification (1) and (2): Predicted markup for AirTran-Alaska = $\beta_0 = -.894$
- Specification (3): Predicted markup for AirTran-Alaska = $\beta_0 + \ \beta_{AirTran-Alaska} = -.630 + (-.264) = -.894$

In sum, the constant term β_0 represents the intercept for the omitted pairing; and to quantify the predicted markup for the other pairings, the constant must be added to the pairing-specific intercept. Put differently, the results displayed in specification (1) and (2) refer to the intercept of each pairing relative to the AirTran-Alaska intercept; while in specification (3) the intercepts of each pairing are reported relative to the Alaska-Delta pairing. In all cases, the effects of the pairing-specific coefficients are reduced when omitting the more prevalent pairing Alaska-Delta; evidently because, that pairing has a stronger and more positive estimate of markups than that of AirTran-Alaska. Nonetheless, when analyzing these results, it is most important to consider the coefficient on MHHI Δ addition; which shows that the contribution between pairings to overall MHHI Δ seems to be positively and significantly correlated to that pairings' markup.

Again, and as the results have portrayed consistently, the difference in the coefficients between the two calculations of MHHI – which in this case is MHHI Δ addition and MHHI' Δ addition – have been quite similar. But, as shown in the contrast between specification (1) and (2), this is the first time where the MHHI' calculation produced a larger estimate than the traditional calculation.[69] Although, when examining the intercepts at the pairing level, the comparison, in terms of size, between specification (1) and (2) changes quite variably, and in

[69] The coefficient on MHHI Δ addition is .000618 while the coefficient on MHHI' Δ addition is .000640.

total, the difference is consistently quite small. Ultimately, given these results, and the model estimates done prior, it is safe to assume and conclude that there isn't a significant distinction between the way firm managers are influenced by their shareholders in regard to control versus ownership. Additionally, an alternative assumption can be made that each specific shareholder used in this analysis had similar quantities of ownership and control for a given company in a given year.[70] Realistically firm managers likely place more of an emphasis on the mere shares their owners have when making pricing decisions – which, for this paper, are assumed to be reflected in their markups – and consider the control rights more when governance decisions need to be made. In sum, it is difficult to derive a difference between the two cases – case 1 and case 2 – mentioned in section *IV.A*.

D. Pairing-Specific Analysis

Lastly, in order to better analyze how each pairing was affected by their quarterly addition to the overall value of MHHI Δ, a regression was conducted for each specific pairing. This allowed for a comparative interpretation of how the MHHI Δ addition of each pairing impacted the markup of the pairing specifically. Similar to the regression run in section *VIII.B* – equation (5) – this specification doesn't use fixed or random effects because each entity (in this case pairing, but companies for equation (5)) is regressed individually. It is similar to the equation above – in section *VIII.C* – in the fact that it considers the markup between the two firms in each pairing, but since each entity (paring) is treated separately, the unobserved heterogeneity issue that persisted prior isn't considered. Additionally, this analysis serves as an alternative robustness test in the reduced from relationship between the MHHI Δ addition and the markup between pairings – which presented statistical significance in the section prior (refer to

[70] In other words, if shareholder *i* had 3% ownership in firm *j* they likely had near 3% control in firm *j* – i.e., their shares were entirely made up of sole or share voting shares.

the coefficient value on MHHI Δ addition in table 8). Nonetheless, by looking at each pairing specifically, we can better interpret how firm couplings are impacted directly based on their addition to industry-wide common ownership.[71] Table 9 reports summary statistics of each pairing's respective MHHI Δ addition.[72]

Table 9: Pairing Summary Statistics

Pairing[a]	Observations	Mean	SD	Min	Max
AIR_AL	5	8.87	4.69	3.139	15.465
AIR_AMR	4	20.054	11.112	6.59	33.734
AIR_D	5	41.063	26.738	11.493	83.092
AIR_JB	5	16.482	7.591	6.16	24.327
AIR_SW	5	22.794	14.061	10.308	46.275
AIR_UN	2	39.744	20.197	25.462	54.025
AIR_US	4	20.175	10.352	12.048	34.136
AL_AM	3	85.376	28.116	68.129	117.82
AL_AMR	4	49.787	14.93	34.785	70.301
AL_D	37	137.233	49.517	49.157	226.356
AL_JB	37	28.285	14.075	10.417	60.91
AL_SW	37	94.897	33.044	30.396	154.919
AL_UN	34	148.032	66.097	36.718	261.829
AL_US	4	31.895	17.634	15.689	55.385
AM_D	3	1113.35	6.967	1106.798	1120.669
AM_JB	3	122.863	19.206	103.549	141.959
AM_SW	3	725.119	24.782	697.809	746.174
AM_UN	3	1019.891	50.422	981.254	1076.929
AMR_D	4	500.37	57.261	425.281	563.417
AMR_JB	4	75.207	17.343	54.884	95.796
AMR_SW	4	471.334	76.689	359.561	529.337
AMR_UN	1	258.69	.	258.69	258.69
AMR_US	4	163.662	46.181	109.494	211.883
D_JB	37	171.809	86.748	37.638	350.947
D_SW	37	716.841	336.961	77.635	1291.303
D_UN	34	1707.117	338.737	762.351	2111.459
D_US	4	470.721	93.494	333.127	534.122
JB_SW	37	131.903	74.483	27.633	288.188
JB_UN	34	169.163	72.306	33.446	346.556
JB_US	4	55.854	15.673	44.326	78.808
SW_UN	34	774.019	263.05	126.417	1183.767
SW_US	4	119.018	60.859	37.112	183.785
US_UN	1	282.558	.	282.558	282.558

Notes: Table 9 shows the summary statistics for each pairings' MHHI Δ addition level. The statistics displayed above for each pairing are the observation numbers – which includes how many times that pairing, or both companies, had data available together in a quarter; the mean level of MHHI Δ addition; the standard deviation (SD); and the minimum and maximum value of this variable. Only the traditional calculation of MHHI Δ addition was used in table 9.

[a] AIR = AirTran, AL = Alaska, AM = American, AMR=AMR, D = Delta, JB = JetBlue, SW = Southwest, US = US Airways, UN = United

[71] Similar to the way that Section *VIII.B.* complemented the random effect company-level regression in section *VIII.A*, this section – *VIII.D* – aims to complement the fixed effect pairing-level regression in the section above *(VIII.C)*

[72] The traditional calculation of MHHI was used here; but the comparison between pairings, in regard to MHHI' Δ addition is similar to that of this calculation.

AMR_UN and US_UN did not report standard deviations because they were limited to only one observation value. There are 33 total pairings reported; which is consistent with the overlying data presented in table 8. As shown, many of the pairings have low observations numbers. There are two reasons this may be the case for a pairing– one: the data on one of the two companies was not available in TR; two: the pairing didn't have an effect on overall MHHI Δ in some quarters (there was no common ownership between the two companies). Regardless, to mitigate the bias that these observation numbers may create, the interpretative focus can be generalized to the more prevalent pairings.

The following regression was run for each pairing in each period. The logarithm of markup between each pairing at quarter *t* is regressed on the MHHI Δ addition and the HHI – the outcome variable is denoted as $Markup_{pairing,,t}$.[73] Both calculations were used when calculating MHHI Δ addition; specification (1) displays the original MHHI Δ additional calculation while specification (2) displays the proportional control assumption of MHHI' Δ addition. In both specifications, the HHI levels are the same. The pairing-specific regressions are specified in equation (7) below and table 10 displays the results from equation (7):

$$\boldsymbol{Log(Markup)_{Pairing,t} = \beta \textbf{MHHI } \Delta \textbf{ Addition}_t + \gamma HHI_t + \partial_t} \quad \textbf{(7).}$$

Description: ∂_t is the error term: it captures all other factors which influence markups other than the market concentration index.

[73] Recall that the markup between each pairing is the average of their markups – the sum divided by two.

Table 10: Pairing-Specific Analysis

Pairing	MHHI Δ Addition	HHI	Constant	R^2	Pairing	MHHI' Δ Addition	HHI	Constant	R^2
Specification	*1*	*1*	*1*	*1*	**Specification**	*2*	*2*	*2*	*2*
AIR_AL	0.018	-0.000	-0.932	0.075	**AIR_AL**	-0.135	0.001	-2.074	0.497
AIR_AMR	0.003	0.000	-2.165	0.084	**AIR_AMR**	-0.016	0.002	-4.046*	0.968
AIR_D	-0.009	-0.000	-0.904	0.541	**AIR_D**	0.003	-0.001	-0.014	0.346
AIR_JB	0.030*	-0.001*	0.038	0.908	**AIR_JB**	0.035**	-0.001**	-0.359	0.948
AIR_SW	-0.011	-0.000	-1.106	0.447	**AIR_SW**	-0.046	0.001	-2.151	0.521
AIR_UN	0.000	-0.000	-0.614	1.000	**AIR_UN**	0.000	-0.000	-0.614	1.000
AIR_US	0.011	0.001	-2.981	0.376	**AIR_US**	0.003	0.001	-3.297	0.269
AL_AM	0.004	0.005	-13.042	1.000	**AL_AM**	0.007	0.018	-40.802	1.000
AL_AMR	0.013	-0.000	-1.442	0.435	**AL_AMR**	-0.027	0.003	-4.943	0.773
AL_D	0.004***	-0.000	-0.914**	0.303	**AL_D**	0.002***	-0.000	-1.35***	0.243
AL_JB	0.015***	-0.000	-0.958***	0.554	**AL_JB**	0.012***	-0.000	-1.07***	0.414
AL_SW	0.010***	-0.001***	-0.043	0.585	**AL_SW**	0.008***	-0.00***	-0.536	0.470
AL_UN	0.002***	-0.000	-1.096**	0.271	**AL_UN**	0.002***	-0.000	-1.142**	0.233
AL_US	0.014	0.000	-2.079	0.695	**AL_US**	0.011	0.000	-2.525	0.164
AM_D	0.012	0.020	-57.981	1.000	**AM_D**	0.003	0.015	-36.380	1.000
AM_JB	0.003	0.020	-45.687	1.000	**AM_JB**	0.003	0.020	-45.568	1.000
AM_SW	-0.001	0.016	-34.015	1.000	**AM_SW**	-0.002	0.016	-35.155	1.000
AM_UN	0.000	0.007	-17.234	1.000	**AM_UN**	0.000	0.007	-17.283	1.000
AMR_D	0.001	0.000	-1.792	0.040	**AMR_D**	-0.002	0.002	-4.390	0.774
AMR_JB	-0.008	0.001	-2.087	0.448	**AMR_JB**	-0.006**	0.001**	-3.394**	0.998
AMR_SW	0.010	-0.004	2.244	0.947	**AMR_SW**	0.013**	-0.007**	5.366*	0.996
AMR_US	0.008	-0.001	-0.041	0.947	**AMR_US**	0.009	0.001	-4.787	0.212
D_JB	0.002***	-0.000**	-0.251	0.361	**D_JB**	0.002***	-0.000**	-0.609*	0.416
D_SW	0.001***	-0.000*	-0.746**	0.500	**D_SW**	0.001	-0.000	-0.770	0.561
D_UN	-0.000	-0.000	-0.801	0.011	**D_UN**	0.000	-0.000	-0.544	0.020
D_US	0.013	-0.006	4.345	0.967	**D_US**	0.023*	0.021*	-49.729*	0.986
JB_SW	0.004***	-0.000***	0.055	0.715	**JB_SW**	0.004***	-0.00***	-0.073	0.811
JB_UN	0.003	-0.000	-0.231	0.543	**JB_UN**	0.004***	-0.00***	-0.280	0.687
JB_US	0.008	0.000	-1.676	0.691	**JB_US**	0.001	0.001	-2.316	0.931
SW_UN	0.001***	-0.001***	-0.104	0.404	**SW_UN**	0.001***	-0.00***	-0.267	0.525
SW_US	0.003	0.000	-2.088	0.895	**SW_US**	0.005	0.001	-3.743	0.898

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Table 10 shows the results from the equation above. Equation (7) is a pairing-specific regression that utilizes both calculations of MHHI Δ addition (refer to section *IV.A*) The original calculation is shown in the first column displaying specification (1) and the alternative calculation is shown in the fifth column displaying specification (2). The outcome variable is markup at the pairing level; refer to table 9 for the observation numbers. The two pairings were dropped from the 33 total included – US Airways-United and AMR-United; these pairings only had one observation – i.e., their data only overlapped in one quarter and this was not sufficient enough to make an estimation.
The asterisks (*,**,***) indicate statistically significant at the 1%, 5%, and 10% levels.

As mentioned, the goal of this regression was to analyze how each pairing, specifically, was impacted by their own addition to MHHI Δ. Section *VIII.C* used a fixed effect regression to show a positive relationship between the MHHI Δ addition and the markup between pairings. The results from table 10 show that the effect of MHHI Δ addition (specification 1) on markup between pairings is positive and statistically significant at the .01 level for the following pairings: Alaska-Delta, Alaska-JetBlue, Alaska-Southwest, Alaska-United, Delta-JetBlue, Delta-Southwest, JetBlue-Southwest, and Southwest-United. Specification (2) presents similar effects.

A limitation of this analysis, as discussed, is that some of the pairings have very little observation numbers. Additionally, given the pairings mentioned in regard to statistical significance, it seems that having appropriate observation numbers is necessary to predict a casual estimate – which make sense. With that being said, many other pairings have similar coefficient values to the pairings that exhibit a statistically significant effect, but the model doesn't recognize their estimate as being different than zero. Again, this is likely because the observation numbers were not sufficient enough to estimate an adequate relationship.

Because of this limitation, an additional specification was made to the regression specified in the section *VIII.C* – equation (6.a). A dummy variable was generated that equaled one if the pairing had 34 observations or greater; and equaled zero if not.[74] This qualification allows the fixed effect regression at the pairing level to utilize only the pairings with sufficient observation numbers. Expectedly, given the restraint presented in the results from table 10, the specification that includes the pairings that are more widespread should render a more significant result.

The fixed effect regression specification is below. The logarithm of the markup between pairings p in quarter t is regressed on the MHHI Δ addition, HHI and the dummy variable *OBS* – the outcome variable is denoted as $Markup_{pt}$. Both MHHI calculations were used when calculating MHHI Δ addition. Specification (1) displays the original MHHI Δ addition calculation when the *OBS* is equal to one. Specification (2) displays the original MHHI Δ addition calculation when the *OBS* is equal to zero. Specification (3) displays the displays the proportional control assumption of MHHI' Δ addition when the *OBS* is equal to one.

[74] There were 10 total pairings that had 34 observations or greater. They include Alaska-Delta, Alaska-JetBlue, Alaska-Southwest, Alaska-United, Delta-JetBlue, Delta-Southwest, Delta-United, JetBlue-Southwest, JetBlue-United, and Southwest-United. There were 23 total pairings with less than 34 observations. Recall, the total number of pairings is 33 – AirTran-American, American-AMR, and American-US Airways don't have overlapping data.

Specification (4) displays the displays the proportional control assumption of MHHI' Δ addition when the *OBS* is equal to zero. In all specifications, the HHI levels are the same and resemble one number for the entire industry – this measurement is not specific to the pairing and is included as a control. Equation (8) is the standard fixed effect model for this analysis. Table 11 presents the results.

$$\boldsymbol{Log(Markup)_{pt} = \beta MHHI\ \Delta\ Addition_{pt} + \gamma HHI_t + OBS_t + \alpha_p + \upsilon_{pt}} \quad \textbf{(8).}$$

Description: α_c is the company-specific fixed effect: it measures the unobserved time-invariant company effect. It is considered the unknown intercept for each company. υ_{ct} is the error term.

Table 11: Observation Dummy Variables

Outcome Variable	*Markup*	*Markup*	*Markup*	*Markup*
Specification	*1*	*2*	*3*	*4*
MHHI Δ Addition	0.000606***	0.00202**		
	(8.90e-05)	(0.000802)		
HHI	-0.000154***	-0.000280**	-0.000154***	-0.000143
	(5.84e-05)	(0.000131)	(5.69e-05)	(0.000127)
MHHI' Δ Addition			0.000668***	-8.63e-05
			(8.79e-05)	(0.000372)
Constant	-0.736***	-1.066***	-0.782***	-0.894***
	(0.149)	(0.263)	(0.146)	(0.276)
***OBS* equal to**	**1**	**0**	**1**	**0**
Observations	358	83	358	83
R-squared	0.118	0.119	0.143	0.024
Number of pairing	10	23	10	23
Fixed Effect	YES	YES	YES	YES

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Notes: Table 11 shows the results from the equation above. Equation (8) is a pairing-specific fixed effect regression that modifies the regression in equation (6.a) by adding a dummy variable *OBS* that controls for the observations available for each pairing. This equation utilizes both calculations of MHHI Δ addition (refer to section *IV.A*). The traditional calculation is shown in the first and second columns and displays specifications (1) and (2) respectively; the alternative calculation is shown in the third and fourth column displaying specifications (3) and (4) respectively. The outcome variable is markup at the pairing level; there are 358 observations in specification (1) and (3); there are 83 observations in specifications (2) and (4). This number totals to the 441 total pairing observations displayed in table 8.
The asterisks (*,**,***) indicate statistically significant at the 1%, 5%, and 10% levels.

As predicted, the coefficient in specifications (2) and (4) – when the *OBS* equaled zero – renders less significance than the coefficients in specifications (1) and (3) respectively; for the MHHI' Δ addition, this distinction is quite large. The coefficient value of .000606 on MHHI Δ addition in specification (1) implies that an increase in one of the ten included pairings' (refer to footnote 74) addition to total MHHI Δ from 10.42 (the minimum level of MHHI Δ addition across all 10 pairings in all 37 quarters) to 398.20 (approximately the average level of MHHI Δ addition across all 10 pairings and all 37 quarters) is associated with an increase of 22.5% in the markup (the mean between a pairing) of these pairings.[75] On the other hand, in regard to specification (2), the coefficient value of .00202 on MHHI Δ addition implies that an increase in one of the remaining 23 included pairings addition to total MHHI Δ from 3.14 (the minimum level of MHHI Δ addition across all 23 pairings in all 37 quarters) to 219.03 (approximately the average level of MHHI Δ addition across these 23 pairings and all 37 quarters) is associated with an increase of 43.6% in the markup (the mean between a pairing) of these pairings.[76] This interpretation allows us to differentiate between the available observations in regards to the interpretative effect of MHHI Δ addition.

Lastly, in regard to the previous section, *VIII.C*, the coefficient of MHHI Δ addition was 0.000618 and statistically significant at the 0.01 level – refer to table 8. Here, as shown, the coefficient on MHHI Δ addition is also significant, and very close to that value. Thus, when designating the parameters of the analysis to include the dummy variable, the overall impact of MHHI Δ addition doesn't change much – which is expected given that the less prevalent parings, included in that section, don't offer many observations and thus won't impact the overall effect much. Similarly, the coefficient on MHHI' Δ addition previously was 0.000640 and now, given these results, it is 0.000668.

75 (398.20-10.42) * .0606 = 22.5%.
76 (219.03-3.14) * .202 = 43.6%.

IX. MHHI Δ & HHI Over Time

The airline industry experienced significant changes over time. In addition to the all the mergers (refer to section *VI.C*) many airlines faced bankruptcy periods. Typically, these bankruptcies could cofound the above results because shareholders have "no de jure control rights" during this time, as AST (2018, p. 23) notes. But, given that the markup data compiled from Compustat was dropped to match the observation numbers from TR – refer to footnote 29 – there were no quarters in which ownership was available on a companies but the markup was zero – i.e., a bankruptcy period. In other words, there was 198 market share observations across all companies and quarters; 1980 shareholder observations (198 times 10 shareholders per company in each quarters); and 198 total observations for markups. Regardless, the airline industry had undeniable shifts – like any major industry – and the last form of analysis aims to examine whether the effect of MHHI Δ and HHI on markups have been similar over time. In other words, this section investigates the change in magnitude of these measures by interacting both MHHI Δ and HHI with year dummies.

Table 12 reports the summary statistics, by year, of MHHI Δ, MHHI' Δ and HHI. Recall from section *V.A*, that given the Euromonitor data available, yearly market share data was aggregated to the quarters; and because HHI is simply just a sum of the squared market shares of the firms in the industry, this number does not change over the quarters. Additionally, this is the reason for years 2012-2017 and 2019 having no standard deviation or difference in minimum and maximum values. Years 2010, 2011, and 2018 had different quarterly values of HHI given the inclusion/subtraction of companies based on mergers and data availability. As shown, besides the HHI, the levels of MHHI Δ and MHHI' Δ change a lot throughout the years.

Table 12: Concentration Summary Statistics

MHHI Δ					
Year	**N**	**Mean**	**SD**	**Min**	**Max**
2010	4	2888.947	582.759	2296.864	3631.963
2011	4	3526.509	220.059	3308.32	3821.67
2012	4	3443.23	197.726	3178.744	3614.914
2013	4	4203.184	218.263	3993.635	4493.426
2014	4	4412.973	426.614	3956.229	4926.995
2015	4	4752.149	429.6	4368.367	5221.935
2016	4	5280.954	388.241	4762.644	5648.799
2017	4	5205.1	229.519	4994.04	5530.194
2018	4	5098.271	510.809	4570.769	5587.02
2019	1	5472.71	.	5472.71	5472.71
MHHI' Δ					
Year	**N**	**Mean**	**SD**	**Min**	**Max**
2010	4	3635.627	573.32	3273.277	4490.744
2011	4	3623.041	253.209	3339.241	3937.43
2012	4	3607.141	156.954	3382.807	3733.489
2013	4	4247.107	433.629	3823.329	4838.815
2014	4	4736.314	729.134	3645.605	5175.136
2015	4	5326.757	347.116	5025.836	5702.058
2016	4	5627.07	118.567	5481.53	5737.225
2017	4	5524.983	181.085	5262.37	5664.682
2018	4	5833.149	403.926	5450.156	6203.819
2019	1	6213.328	.	6213.328	6213.328
HHI					
Year	**N**	**Mean**	**SD**	**Min**	**Max**
2010	4	2085.32	194.045	1794.252	2182.342
2011	4	2838.736	91.04	2702.177	2884.256
2012	4	2883.36	0	2883.36	2883.36
2013	4	2861.576	0	2861.576	2861.576
2014	4	2849.396	0	2849.396	2849.396
2015	4	2811.042	0	2811.042	2811.042
2016	4	2752.331	0	2752.331	2752.331
2017	4	2683.263	0	2683.263	2683.263
2018	4	2438.563	289.891	2187.51	2689.615
2019	1	2177.562	.	2177.562	2177.562

Notes: Table 12 shows the summary statistics by year for MHHI Δ, MHHI' Δ and HHI. The statistics displayed above are the observation numbers (N) – which simply corresponds to the 4 quarters of data included in each year (besides 2019); the mean level of the variable; the standard deviation (SD) and the minimum and maximum value the variable. Even though, as mentioned, HHI – besides 2010, 2011, and 208 – was the same in all 4 quarters, the summary statistics reports all 4 quarter observations. There is no standard deviation (SD) for both calculations of MHHI Δ in 2019 because 2019q1 was the only quarter used in the calculation for this year; opposed to the other years, where there were 4 quarters included. Additionally, in 2019, there is no difference between the min and maximum values. The reason for no standard deviation for HHI in 2012-2017 and 2019 is mentioned in the paragraph above.

Consistent with all prior analysis and specifications, there have been a total of 37 quarters analyzed. In terms of year dummies, each year besides 2019 – because quarter one was the only available data point for that year – has four quarterly observations included. The model below mimics the approach used for the baseline regression section *VII.A*; the only difference being, in order to quantify the effect that MHHI Δ and HHI had over time, they are interacted with year dummies.[77] The logarithm of average markup across all airlines at quarter *t* is regressed on the interaction between MHHI Δ and the year dummy variable *year*, and the interaction between HHI and the year dummy variable *year* – this outcome variable is denoted as *Average Markup*$_t$. Additionally, the logarithm of industry total markup, which is the sum of the markups per company at quarter *t*, is also regressed on the MHHI Δ and the HHI interacted with the year– this outcome variable is denoted as *Industry Total Markup*$_t$. The regressions to analyze MHHI and HHI over time are specified in equations (9.a) and (9.b) below. MHHI' Δ was not included in this analysis. Recall, the outcome variables in section *VIII* were not denoted as average markup or industry total markup. This is because, those regressions analyzed markups more specifically at the company and pairing-specific level; i.e., they either used random/fixed effects or were run separately for each company. Equations (9.a) and (9.b) differ in that the markups are compiled for the entire industry; they are specified below:

$$\boldsymbol{Log\ (Average\ Markup)_t = \beta_0 + \beta_1 \mathrm{MHHI}\ \Delta_t + \gamma_1 HHI_t + \delta_t \mathrm{MHHI}\ \Delta_t * Year + \theta_t HHI_t * Year + \partial_t} \qquad \textbf{(9.a),}$$

Description: $\beta_0$is the constant term. ∂_t is the error term: it captures all other factors which influence markups other than the market concentration index.

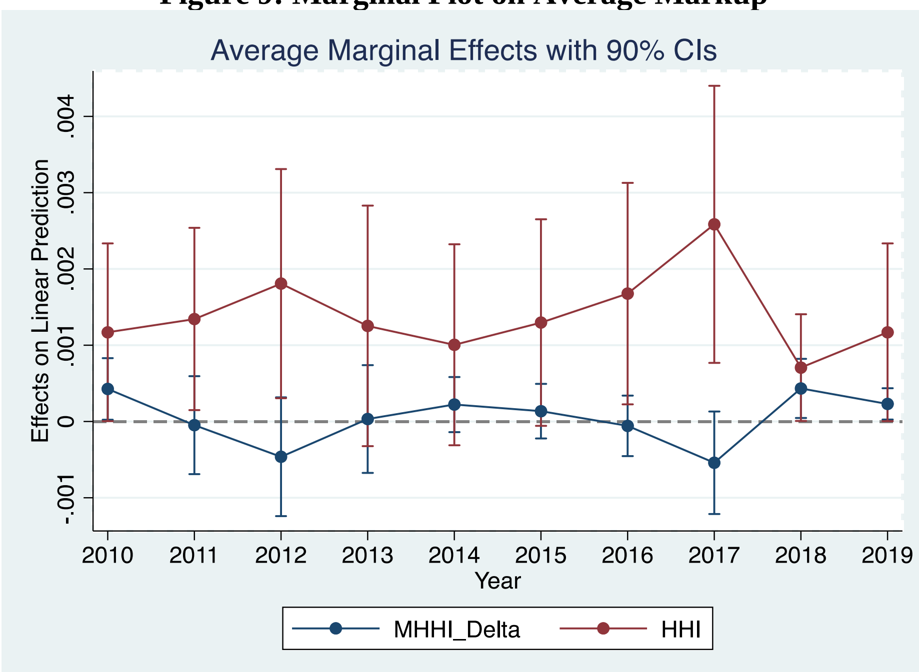
$$\boldsymbol{Log\ (Industry\ Total\ Markup)_t = \beta_0 + \beta_1 \mathrm{MHHI}\ \Delta_t + \gamma_1 HHI_t + \delta_t \mathrm{MHHI}\ \Delta_t * Year + \theta_t HHI_t * Year + \partial_t} \qquad \textbf{(9.b).}$$

Description: $\beta_0$is the constant term. ∂_t is the error term: it captures all other factors which influence markups other than the market concentration index.

[77] The outcome variables used in this analysis are average markup and industry total markup – the same ones used in the baseline regression in section *VII.A*. Given that these outcomes are aggregated and summed – in the case of industry total markup – across the industry, there is no need for fixed or random effect regression.

Interpreting these regression results based on their coefficient values is quite complex; ultimately, because of the interactions included, it is most useful to analyze the change in MHHI Δ and HHI by looking at their marginal effect over the years. With that being said, in order to look at the marginal effect of common ownership (MHHI) and market concentration (HHI) on the outcome variables, figure 9 plots the derivative of the mean predicted values of average markup and figure 10 plots the derivative of the mean predicted value of industry total markup; both are taken with respect to the MHHI Δ and HHI separately. In other words, these graphs serve as plots to study the interaction between the year dummy and the independent variable respectively. Quantitatively, it takes the numerical derivative of the independent variable with respect to MHHI Δ and HHI separately, and then calculates the mean.[78]

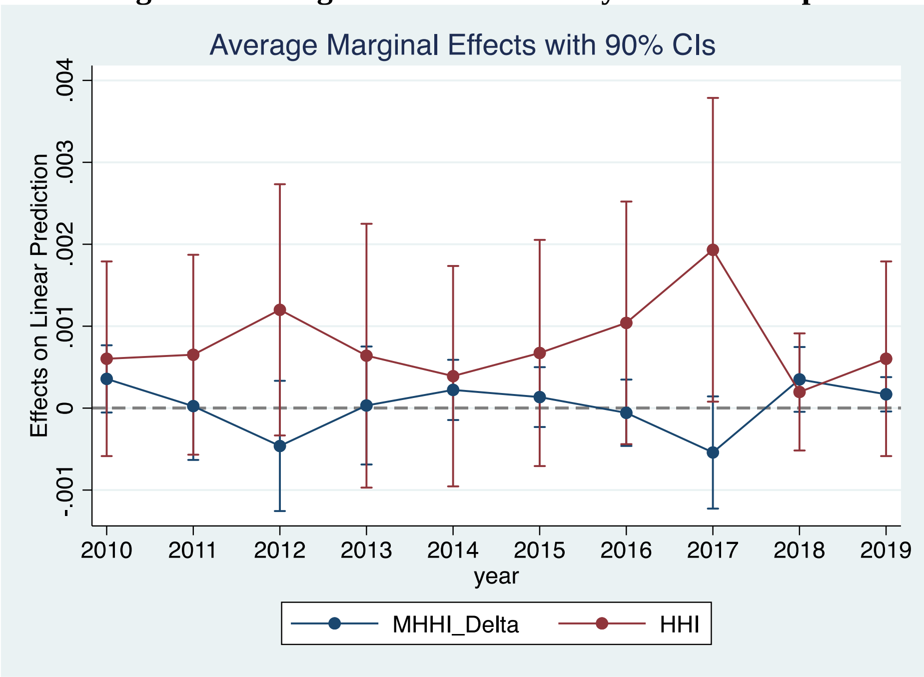
Figure 9: Marginal Plot on Average Markup



Notes: Figure 9 is a marginal effects plot based on the regression displayed in equation (9.a) – which is based on the specification that uses the dummy variable year to estimate the effect of MHHI Δ and HHI in each year. Only the traditional calculation was used in this analysis (refer to section *IV.A*); i.e., MHHI' Δ was not included The outcome variable is average markup and considers the average of the markups across the entire industry in a given quarter. The blue dots represent the points for MHHI Δ and the blue lines represent the 90% confidence interval; the red dots represent the points for HHI and the red lines represent the 90% confidence interval. The dotted gray line represents when the effects of linear prediction equals zero – i.e., at this point, the estimated effect is no different than zero. The y-axis represents the linear prediction values of the model.

78 This analysis focuses just on the traditional calculation of MHHI Δ and doesn't include the 'margins plot' for MHHI' Δ.

Figure 10: Marginal Plot on Industry Total Markup



Notes: Figure 10 is a marginal effects plot based on the regression displayed in equation (9.b) – which is based on the specification that uses the dummy variable year to estimate the effect of MHHI Δ and HHI in each year. Only the traditional calculation was used in this analysis (refer to section *IV.A*); i.e., MHHI' Δ was not included. The outcome variable is industry total markup and considers the sum of the entire industries markup in a given quarter. The blue dots represent the points for MHHI Δ and the blue lines represent the 90% confidence interval; the red dots represent the points for HHI and the red lines represent the 90% confidence interval. The dotted gray line represents when the effects of linear prediction equals zero – i.e., at this point, the estimated effect is no different than zero. The y-axis represents the linear prediction values of the model.

In regard to figure 9, the effect of MHHI Δ is positive in most years – i.e., 2010, 2013, 2014, 2015, 2016, 2018, 2019 – while the HHI index is positive in all years. In terms of statistical significance, the HHI index renders a consistently significant effect on average markup; and besides 2017 and 2018, the effect of linear prediction remains between .001 and .002. Given both MHHI Δ and HHI's average marginal effects, it seems that the impact that HHI has on average markup, when interacted with the year dummy, is more significant than that of MHHI Δ. But, in terms of change over time, MHHI Δ is more consistent. Moving to industry total markup, figure 10 renders a similar relationship over the change in magnitude of these variables. The major distinction comes from the difference in how closely related the points are for HHI and MHHI Δ; it seems that when considering the estimate for industry total markup, the two indexes possess values that are more similar to each other. For example, in 2018, figure 10 shows that the MHHI Δ and HHI effects cross over, while in the graph that relates average markups (figure 9), this is never the case. In sum, although when interacted with a year dummy variable the effect of MHHI Δ seems to be less dramatic, its effect over the years is quite consistent.

X. Conclusion

A. Overview

Over the last few decades the share of stocks in U.S. publicly traded companies owned by institutional investors has increased substantially. For example, from 2001 to 2013, institutional investors held 77% of the stock of all airlines operating in the average flight route (Elhauge, 2016, p.1). In sum, when the same set of investors hold shares in firms that naturally compete – i.e., these shareholders are intra-industry diversified – this common ownership has implicit impacts on the way the managers of these firms make pricing decisions. In other words, compared to the scenario where firms are controlled, and owned, by separate sets of investors, when they are commonly owned, their objective function seeks to maximize not only their own profits, but also combination of the profits of other firms in which its shareholders hold stakes in.[79] As the ownership shares of these intra-industry diversified shareholders continues to grow, antitrust regulators need to more carefully consider stock acquisitions; and additionally – perhaps by utilizing a market concentration index that takes into consideration common ownership

[79] Refer to section *III.C*.

(MHHI) – recognize the anticompetitive implications that can result from horizontal shareholding.

The goal of this paper was to combine previous economic literature and theory on common ownership with a newly developed empirical approach to investigate whether shares held by intra-industry diversified shareholders create anticompetitive impacts. Starting with O'Brien and Salop's (2000) derivation of the modified Herfindahl-Hirschman Index (MHHI) – where they develop a model in which this index can be derived from a Cournot model of competition where firm managers attempt to maximize the weighted average of their shareholders' interests – the extent to which airline companies were connected, based on their shareholders, was quantified. Using MHHI Δ – which is the difference between the MHHI and HHI – as a reduced-form measurement of common ownership, the following empirical question was addressed: does common ownership, as measured by MHHI, have explanatory power for the markups of firms (which is used to reflect anticompetition), after controlling for the traditional market concentration index HHI. Unlike any of the literature before, this paper is the first study that considers the markups within a specific industry as the outcome variable to denote the monopolistic behavior resulting from horizontal shareholding. Given that O'Brien and Salop's (2000) model considered the relationship between market concentration and the market-share weighted average markups in an industry, this approach seemed – and was – applicable.

Following a model constructed by AST (2018), the U.S. airline industry was used to empirically analyze the relationship between common ownership and anticompetition – that reflected through changes in markups. The modified market concentration index – which is deemed as total market concentration – that accounts for the extent to which competitors are owned by the same investors (MHHI Δ in this case) rendered levels that implied increases in market concentration that were over 10 times higher than the threshold that raises antitrust concern and what is “presumed likely to enhance market power” in the case of a traditional merger, according to the according to U.S. Dep’t of Justice & Fed. Trade Commission, Horizontal Merger Guidelines § 5.3 (2010). Based on the previous economic theory – more specifically, O’Brien and Salop (2000) – the additional market concentration that is reflected by the culmination of common ownership within an industry would likely be reflected in markups.

An alternative calculation was developed for MHHI – denoted as MHHI’ – that assumed proportional control; meaning, the shareholder’s influence on firm managers depends strictly on their ownership, and not their voting shares. Throughout the analysis, the results from MHHI and MHHI’ were quite similar and this lead to two possible assumptions: (i) there isn’t a significant distinction between the way firm managers are influenced by their shareholders in regard to control versus ownership, and (ii) each specific shareholder used in this analysis had similar quantities of ownership and control for a given company in a given year. In a test to see which market concentration – HHI or MHHI – was more robustly related to markups, MHHI (both calculations) had a positive and statistically significant effect on all three outcome variables, while the HHI did not.[80] In the baseline regressions – using the HHI measurement as a control – the results implied that an increase in MHHI Δ from its minimum to average value is associated with an increase in the average markup in the airline industry of 44.21% and an increase in industry total markup of 35%. Additionally, keeping the HHI constant, average markup in a highly concentrated market are 54% higher because of common ownership, compared to a counterfactual world in which firms are separately owned or in which firms entirely ignore the anticompetitive incentives caused by common ownership.

[80] The outcome variables were markups, average markup, and industry total markup.

Moving to a more specified analysis, in order to analyze the impact that common ownership has at the company-specific level – i.e., the relationship between each company's markup and the overall MHHI Δ – a random effect regression implied that an increase in MHHI Δ from its minimum to average value is associated with an increase in the markup of a company in the airline industry of 40.32%. In an analysis of each company individually, regressions showed that five out of the eight included companies displayed results that rendered a positive and a significant effect of MHHI Δ on their markup. Additionally, the four companies with the highest market share had positive coefficients, and all but one rendered statistical significance at the .05 level.[81]

Following the company-specific analysis, a new way of measuring common ownership was derived in order to investigate how markups changed for each airline pairing – this was denoted as 'MHHI Δ addition.' A fixed effect regression – treating each pairing as a different entity – reported significant results, implying than an increase in MHHI Δ addition from its minimum to its average value is associated with an increase of 22.33% in the markup of airline pairings. Controlling for pairings with limited observations, this analysis was repeated; the results were consistent. In an analysis of each pairing individually, regressions showed that eight pairings displayed results that rendered a positive and a significant effect of MHHI Δ addition on their markups. Lastly, in order to examine whether the effect of MHHI Δ and HHI on markups have been similar over time, these measures were interacted with year dummies. The marginal effects plots illustrate that, in terms of average markup, the magnitude of HHI was positive in all years, while MHHI Δ was only positive in some; and in terms of industry total markup, the results were similar, but HHI and MHHI Δ were more closely related. In sum, the results from

[81] Recall from section *III.C* in terms of variables that effect MHHI Δ: the greater the market shares, the greater the market effect of management's decisions concerning competitive behavior, the higher the MHHI Δ

this paper suggests the potential for a deadweight loss and a wealth transfer from consumers to producers due to common ownership; and this is reflected in the change in markups.

B. Antitrust and Policy Implications

"Oh yeah totally, totally," Warren Buffet responds to CNBC's Becky Quick's question about being a 'passive investor' in regard to his potential concern with Berkshire Hathaway's increased stake in the airline industry potentially causing anticompetition. Since him – and many other CEO's of institutional investing firms – merely make investments and are not actively influencing the decision-making processes of management, anticompetition based on stock acquisitions is seemingly, to them, of little concern. In combination with author's Einer Elhauge theoretical framework (2016, pp. 1305-1310) about the 'passive investor,[82] this paper shows that regardless of whether or not institutional investors horizontal stock acquisitions were purely passive, these horizontal shareholdings raised the markups in the airline industry. Given that, these acquisitions are subject to challenge under § 7 of the Clayton Act and are not negated through the passive investor "exception."

If robust, this paper's finding's raise several questions about passive investors, antitrust regulation, and legislation regarding common ownership through horizontal shareholding. Ultimately, this thesis combines an application of previous theory with empirical results to challenge the traditional economic assumption that firms' fundamental objective is to maximize their 'own profit.' This paper makes a claim that shareholders may not agree with the profit maximization strategy of firms when they act as price takers; i.e., in their own self-interest. Shown through an empirical application of O'Brien and Salop's (2000) derivation of MHHI, the objective of the firm implicitly changes based on the incentives and interests of their largest

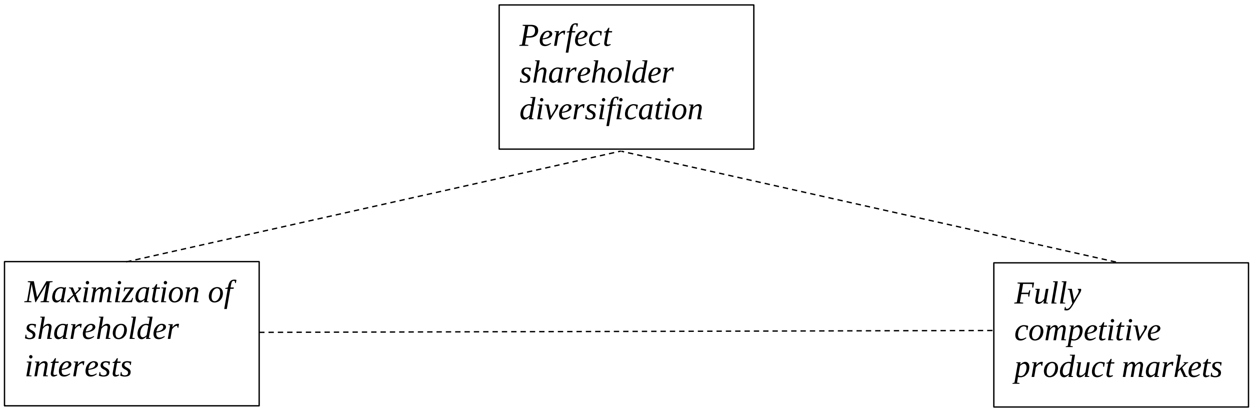
[82] As discussed in section *II*.

shareholders. For policy makers, considering the competitive risks of common ownership is no easy feat. Although, the literature on common ownership has increased substantially over recent years, the legal consideration given to this development by U.S. antitrust agencies is just beginning to gain traction.

According to Bloomberg Law (Feb 27, 2020), the Federal Trade Commission (FTC) signaled its interest in the subject at the end of 2019. Director of the FTC Office of Policy Planning, Bilal Sayyed, said during a speech at Georgetown University Law Center that antitrust law "recognizes that minority ownership and cross-ownership – ownership stakes in a competing company – can have anticompetitive consequences." After noting the empirical literature done in the airline industry – AST (2018) – and the banking industry – ARS (2019) – he notes that although the conclusions in this development are still variable, they are placing "a high priority on determining the merits of this position and any of the proposed remedies." U.S. antitrust agencies have made it clear that studying the competitive impact of common ownership is a priority; but as the economic research continues, the debate remains in its initial stages.

In terms of what needs to be considered, two implications of common ownership are clear: i) effective market concentration measures must consider both the number of firms and their market shares – i.e., HHI – but also the extent to which these firms are commonly owned, and (ii) since consolidation in the asset management industry contributes greatly to common ownership, further consolidation in the financial sector should be evaluated through a lens that recognizes the ramifications on product markets (Azar et al., 2017). Moving forward, proposing policies that are beneficial to all parties is challenging. AST (2018) mention a 'trilemma' that illustrates this difficulty in terms of the three goals that can't be simultaneously achieved: i) perfect shareholder diversification, ii) firm maximization of shareholder interests, and iii) preservation of competitive product markets. Referring to figure 11 below, in order to have perfect shareholder diversification while maximizing shareholder interests, markets can't be fully competitive. In order to have fully competitive markets and perfect shareholder diversification, then firm managers cannot include the interests of their shareholders in their objective function. Lastly, in order to have fully competitive markets and a maximization of shareholder interests, shareholders will not be perfectly diversified.

Figure 11: Common Ownership Trilemma



Notes: Figure 11 serves to illustrate the common ownership trilemma. In other words, all three boxes 'perfect shareholder diversification,' 'maximization of shareholder interests' and 'fully competitive product markets' cannot all be satisfied simultaneously.

In sum, the optimal tradeoff between these three goals is a highly debated and contentious topic that antitrust regulators and economists in the field must consider. Lastly, while this paper does not propose a solution for the trilemma displayed above, any policy propositions that are considered – in regard to the anticompetitive incentives of common ownership – must weigh the potential benefits to shareholders against the potential loss to consumers.

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Pledge

I pledge my honor that this paper represents my own work in accordance with University Regulations.

- *Matteo DeVincenzo*