Empirical Studies of the Effects of Common Ownership

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Abstract

Much attention has been paid to the "common ownership hypothesis," the idea that institutional ownership of firms may soften competition in product markets and harm consumers. We review the methodologies of research that purports to find evidence of an effect and outline the limitations of certain approaches. We then explore how the hypothesis would affect merger analysis and the new relevance of deal structure. Finally we survey new approaches and settings other than prices where evidence of a common ownership effect is being investigated.

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Introduction

There has been a very active literature around the *common ownership hypothesis*, which suggests that when large investors own shares in many firms within the same industry, those firms have an incentive to soften competition by producing fewer units, raising prices, reducing investment, innovating less, or limiting entry into new markets. The core of the idea is quite simple: firms maximize shareholder value, but shareholders hold stakes in competitors; thus, firms may want to maximize some combination of their own profits and their competitors' profits to maximize the value of their investors' portfolios. The implications of this possibility are enormous: if firms place positive weight on rivals' profits when making strategic decisions, the entire economy of publicly-traded firms may have incentives to soften competition, resulting in significant harm to consumers. At the same time, this theory generates testable predictions: competition in product markets composed of private firms should look different from markets composed of public firms; financial events such as IPOs or privatizations should have product market effects; and changes in index composition should be detected in product markets.

This paper begins with an overview of the theory of common ownership including some examples to illustrate how common ownership implies that firms place "profit weights" on their rivals under the main assumptions of the model. We then show that there has been a large increase in common ownership over the past few decades that has resulted in large implied profit weights between firms throughout the US economy. The implication is that if firms are truly internalizing the effects of their decisions on their investors' portfolios, then our economy is likely to be far less competitive than thought.

We then illustrate the effect of the common ownership hypothesis on merger analysis. In both the HHI and PPI frameworks, we show that the increases in concentration implied by a merger are lower under the common ownership hypothesis than under standard competition. We illustrate this with a case study. Finally, we discuss how deal structure – a share swap versus a cash tender offer – has a direct implication of merger analysis under the common ownership hypothesis.

We then turn to the literature and examine the methods used in empirical work that suggests that common ownership leads to higher prices. We discuss a number of the critiques of the MHHI regression approach, including its limitations when products are not perfect substitutes and the difficulty having a causal interpretation of the regression results. We illustrate with an analytic example how the MHHI regression approach leads to spurious findings of an effect of common ownership on prices when no such relationship exists. We further show that instrumenting for common ownership (for example, using a merger in the financial world) does not address the issue of market shares contaminating the MHHI measure.

There is still much that we don't know about the common ownership hypothesis. This literature is evolving quickly with new methods, new settings, and new data being brought to bear on the question of whether or not firms are responsive to the incentives created by overlapping ownership.

The latest approaches use structural models to perform true statistical tests for conduct. We conclude the paper with a discussion of the most recent methods and settings being used to examine whether firms internalize these incentives.

1. Theory of Common Ownership

The theory of common ownership takes seriously an argument that economists often make informally. Why do firms maximize profits? Because, it goes, they answer to their investors. The theory of common ownership posits that firms seek to maximize the value of investors' portfolios. This raises two immediate problems. First, investors may own shares not only in my firm but also in my competitors. Second, each investor's portfolio may be vastly different from the next (or not), and investors may disagree about firm objectives.

Nearly all models of common ownership begin with the same two (mostly uncontroversial) assumptions, followed by two more subjective assumptions (Backus et al. (2020b)). The first assumption concerns the payoffs of many stakeholders (indexed by s) who hold a portfolio of investments in many firms (indexed by f). The stakeholders' payoffs, v_s, depend on two quantities: the profits of firm f, denoted by π_f, and the fraction of those profits that the stakeholder is entitled to, denoted by β_{fs}:

$$v_s = \sum_f \beta_{fs} \pi_f.$$

In practice, β_{fs} is the number of shares controlled by investor s relative to the number of shares outstanding. So, if an investor owns 5% of firm f, this implies this investor is entitled to 5% of firm f's profits.

The second assumption is that firms seek to maximize shareholder's payoffs. This raises the first challenge for this theory: how do managers decide what to do when their stakeholders disagree? Consider two investors that own 10% (5%) of American Airlines and 5% (10%) of Delta Airlines, respectively. The investors disagree on the action that American might take in a given situation, depending on their relative holdings of American vs Delta. If both airlines are considering entering a new route, the investor who has more American holdings prefers American enter the route, and vice versa for the Delta investor. To resolve this, the second assumption says, precisely, that the firm places a weight $\gamma_{fs} > 0$ on the payoff of stakeholder s and then makes choices that maximize an objective function, Q_f, a weighted average of stakeholder payoffs:

$$Q_f = \sum_s \gamma_{fs} v_s.$$

This framework is quite flexible and allows heterogeneity in the way that investor preferences affect the objective function of the firm. For example, one could put greater weight on insider portfolios, reflecting their influence over strategic decisions. Alternatively, one could set $\gamma_{fs} = 0$

for some investors and ignore their portfolios. The latter approach can rationalize own-firm profit maximization, if $\gamma_{fs} = 0$ for any investor s with holdings in rival firms."

To see the implications for firm decision–making, we draw out the implications of these assumptions step–by–step.[1] First, we plug shareholder payoffs (from the first assumption) into the objective function of the firm (from the second assumption).

$$Q_f = \sum_{\forall s} \gamma_{fs} \cdot \left(\sum_{\forall g} \beta_{gs} \cdot \pi_g \right).$$

Next, we isolate the profits of firm f and pull them out of the summation for clarity:

$$Q_f = \sum_{\forall s} \gamma_{fs}\beta_{fs}\pi_f + \sum_{\forall s} \gamma_{fs} \sum_{\forall f \neq g} \beta_{gs}\pi_g.$$

The final step is a normalization to denominate the objective function in terms of dollars of profits at firm f, which will make it easier to compare this objective function to the classical assumption of own–firm profit maximization. This is as innocuous as saying that we are going to maximize profits in pounds instead of dollars – the problem is the same – but to be precise, the resulting function is proportional to rather than equal to the original objective function (hence the $\propto$ below). To normalize, we divide by the coefficient on own profits π_f, $(\sum_{\forall s} \gamma_{fs}\beta_{fs})$, yielding the firm's objective function to maximize:

$$Q_f \propto \pi_f + \sum_{g \neq f} \underbrace{\left(\frac{\sum_{\forall s} \gamma_{fs}\beta_{gs}}{\sum_{\forall s} \gamma_{fs}\beta_{fs}} \right)}_{\equiv \kappa_{fg}(\gamma_f, \beta)} \pi_g.$$

Therefore, the firm f's objective is to maximize its own profits plus a weighted sum of the profits of its competitors, where the weight on firm g is κ_{fg}. Summarizing, the firm makes strategic decisions by maximizing:

$$\pi_f + \sum_g \kappa_{fg}\pi_g, \quad \text{where} \quad \kappa_{fg} \equiv \frac{\sum_s \gamma_{sf}\beta_{sg}}{\sum_s \gamma_{sf}\beta_{sf}}. \tag{1}$$

This objective function extends the classic model, in which firm f maximizes π_f alone. A useful and intuitive way to think about the difference is in terms of the common ownership *profit weights*, denoted by κ_{fg}, which represent the value to firm f of a dollar of profit generated for a competing

[1] These two assumptions can be traced back as far as Rotemberg (1984), and appears implicitly in the cross-ownership profit weights of Bresnahan and Salop (1986). In what follows we adopt the (γ, β) notation of O'Brien and Salop (2000), which studied the implied profit weights in the context of Cournot and Bertrand competition; see their Appendix C.

firm g. To anchor interpretation in familiar terms, if $\kappa_{fg} = 0$ whenever $f \neq g$, then we have standard own-firm profit maximization. If $\kappa_{fg} = 1$ for all f and g in the market, then the model is equivalent to market monopoly pricing (or, observationally, perfect collusion). Intermediate values effect a "partial merger" between f and g. Absent the remaining two assumptions, the setup is sufficiently general that it yields almost no testable predictions.

The controversial third assumption concerns what one uses for the weights γ_{sf}. Because these weights determine how the manager balances conflicting interests of stakeholders, these weights stand in for a model of corporate governance and control rights. While it may be tempting to interpret them as the outcome of an explicitly specified voting game, to our knowledge there is no rigorous micro-foundation in the literature.[2] This means that any choice of γ_{fs} will largely be an assumption, and one with possibly strong implications for the profit weights, κ_{fg}. Possibilities include assuming that γ_{fs} is nonzero only for investors meeting some minimal ownership criteria (such as 1% or 5% ownership), or governance criteria (such as only those with board seats), or treating different classes of investors differently (such as activist hedge funds versus index investors). Perhaps passive investment funds, especially those licensing a particular index to mimic where tracking errors are contractually limited, should receive low weights given the little choice they have in investment options. Clearly, if the weights placed on diversified investors are low, there will be limited effects from common ownership, while relatively large weights on larger investors will, for many firms, result in large profit weights.[3]

What unites the bulk of the literature on potential anti-competitve effects of common ownership is the assumption that $\gamma_{fs} > 0$ for nearly all shareholders who invest in firm f (and zero for everyone else). This includes both large and small shareholders, and both active and passive investors, including mutual funds, and exchange traded funds. By aggregating many highly diversified investors (such as index funds and ETFs) most of whom own less than 5% and rarely more than 10% of any firm, it is possible to have high values of κ_{fg}. The most common assumption in the empirical literature on common ownership is to assume *proportional control*, such that the manager weighs each shareholder in proportion to that shareholder's ownership stake in the firm, or $\gamma_{sf} = \beta_{sf}$.[4] That is, the firm places higher weights on investors that control larger stakes in the firm.

The final assumption concerns the nature of the game being played among the firms. For example, in Cournot games horizontal competitors set quantities (output) for a homogenous good and the price is such that the market clears. In Bertrand games, horizontal competitors set prices for potentially differentiated goods. In both cases, a larger value of κ_{fg} will tend to soften hor-

[2]This is perhaps not surprising, as "Arrow's Impossibility Theorem" is a classic result in the theory of social choice. Additionally, in order to model the voting game we would need to know the payoffs to the players in the downstream product market, a point on which we have been so far agnostic.

[3]In Egland et al. (2018), any investor categorized as an asset manager has their portfolio value down-weighted by a factor of 100 to reflect typical management fees, although this is somewhat ad hoc.

[4]This has the intuitive appeal of "one share, one vote", but is not derived from any specific model of voting.

izontal competition, restrict output, and increase prices. We could also consider a vertical game played between wholesalers and retailers where a larger value for κ_{fg} reduces the extent of double marginalization, expands output, and reduces prices. Still other games consider entry and exit, research and development expenditures, etc. It is this final assumption, specific to any individual empirical setting, that creates testable implications about what should be observed in product markets or in firm strategies.

1.1. Some Arithmetic

These profit weight objects of the firm objective function are clearly of interest, although, as we will show in a moment, there is no reason that these objects need be constrained between zero and one. Let us consider a few examples borrowed from Backus et al. (2021).

Example 1: Suppose there are three firms and four institutional investors. Firm 1 is controlled by an undiversified owner. Firms 2 and 3 have the following, identical structure: 60% held by a continuum of retail investors; 20% held by two undiversified institutional investors; and 20% held by a single common, diversified investor. This ownership structure is depicted in Table 1.

Table 1: Example 1 Ownership Structure

	Firm 1	Firm 2	Firm 3
Investor 1	100%	-	-
Investor 2	-	20%	-
Investor 3	-	-	20%
Investor 4	-	20%	20%
Retail Share	-	60%	60%

Notes: This table presents investor holdings in three firm for Example 1.

If we assume $\gamma_{sf} = \beta_{sf}$, i.e. proportional control, then profit weights can be computed directly from ownership data. Applying equation (1), we obtain the following profit weights: Firm 1, with independent ownership, maximizes its own profit alone, with weight $\kappa_{12} = \kappa_{13} = 0$. Similarly, firms 2 and 3, sharing no common owners with firm 1, place zero weight on its profits, so $\kappa_{21} = \kappa_{31} = 0$. However, because firms 2 and 3 have a large common owner, they place substantial weight on each other's profits: $\kappa_{23} = \kappa_{32} = 1/2$. This implies that these two firms value a dollar of profit at the other at 50 cents to a dollar of their own. It does not imply conspiracy or collusion – but rather, that the firms will naturally internalize the effect of their decisions on each other, in a way that softens horizontal competition. We have not specified the strategic interactions between the three firms, so there are no welfare implications at this point in the analysis, but the potential reduction in competition is substantial.

A remarkable feature of the example is that a moderate, 20% common ownership stake leads to a large, 50% profit weight. Part of this is coming from the 60% retail share, which is the portion of shares held by retail investors. Individual retail investors are assumed to be infinitesimally small

in the model, and so when we multiply γ and β in equation (1), their contribution effectively drops out, magnifying the influence of the institutional investors.[5] This mathematical artifice is perhaps not without intuition, given the low participation rates of retail investors in corporate governance, but it is essential to the conclusions. Indeed, it can have strong implications, as we illustrate in the next, more stylized example.

Example 2: Let there be two firms and ten investors. Each of the ten investors holds a 1% stake in firm 1, and so the retail share of firm 1 is 90%. Each of the ten investors also holds a x% stake in firm 2 (so $x \leq 10\%$), and so the retail share of firm 2 is (100 - 10x). This ownership pattern is summarized in Table 2.

Table 2: Example 2 Ownership Structure

	Firm 1	Firm 2
Investor 1	1%	x%
Investor 2	1%	x%
⋮	⋮	⋮
Investor 10	1%	x%
Retail Share	90%	(100-10x)%

Notes: This table presents investor holdings in two firm for Example 2. Note $10 \cdot x \leq 100$.

In such a world, by applying equation (1), we obtain that firm 1 places a profit weight of x on firm 2, and firm 2 places a profit weight of $1/x$ on firm 1. So, if $x = 3$, where the ten investors also each own 3% of firm 2, then firm 1 *prefers* firm 2's profits to its own by a factor of three. What would this mean in practice? It is difficult to fathom the market outcome where one competing firm makes decisions placing a significantly higher weight on rival profits than on own profits. If a competitor were as efficient as myself, then in a pricing game I should set my prices so high as to divert almost all sales to that firm whenever our products are substitutes.

Though the example is designed to be striking, it is not without precedent. The literature on "tunneling" has shown how the divorce of control rights and cash-flow rights create perverse behavior, in which an owner will wish to transfer assets and cash flows from one firm (the one in which the owner has low cash-flow rights) to another (the one in which the owner has high cash-flow rights), defrauding minority investors in the former firm (Porta et al., 1999; Johnson et al., 2000; Bertrand et al., 2002). However, there are major differences: first, in the tunneling literature, the divorce of control rights and cash-flow rights often comes from institutional structures (e.g., "golden shares"). Instead, in the theory of common ownership, this divorce is coming through investor concentration. If control rights (γ) are an increasing function of ownership share (β) as

[5]That retail investors drop out may not be an unrealistic feature of the model. For example, a recent report by ProxyPulse examined 3,379 proxy meetings in the first half of 2017 and found that while institutional investors own 70% of shares and vote them 91% of the time, retail investors holding the remaining 30% voted those shares only 29% of the time. "2017 Proxy Season Review", ProxyPulse. However, as we discuss later, it is important to consider large individual investors, e.g. insiders and founding families, when identifying the retail share, since it would be incorrect to treat them as atomistic.

they are in our example, which assumes $\gamma = \beta$, then an investor with a 10% ownership share has more influence than two investors with 5% each. And, if $\gamma \to 0$ as $\beta \to 0$, then retail investors have no influence. This dilution of control rights for small and fragmented owners affords outsized influence for the largest investors. Second, although though tunneling is possible for extremal values of $\kappa > 1$, under common ownership it is not necessarily the case that minority investors are harmed, relative to standard competition. If profit weights are roughly symmetric and approaching 1, then the theory we outline next predicts that prices will approach monopoly levels, in which case minority investors, like common owners, will benefit at the cost of consumer welfare (of course, any owners that don't have identical portfolios up to a scaling term do not generally agree on firm decisions).

1.2. The Origin of MHHI

The Modified Herfindahl-Hirschman Index (MHHI), which played a large role in the early empirical literature on this question, arises as the solution to the manager's objective in equation (1) when firms play a Cournot (quantity setting) game where they choose their own output q_f and therefore have the following objective:

$$\max_{q_f} \pi_f(q_f, q_{-f}) + \sum_g \kappa_{fg} \pi_g(q_f, q_{-f}). \tag{2}$$

In this game, firms produce identical goods and simultaneously choose output to maximize their objective function such that the equilibrium price balances quantity demand with quantity supplied. This means that $\pi_f = (P(Q) - mc_f) \cdot q_f$ where $P(Q)$ is the inverse demand curve as a function of the total output $Q = \sum_f q_f$ and mc_f is firm f's marginal cost. Firms optimal choices of q_f are determined by the following first-order condition:

$$\begin{aligned} P - mc_f &= -\frac{\partial P}{\partial Q}\left[q_f + \sum_g \kappa_{fg} q_g\right] \\ \frac{P - mc_f}{P} &= -\frac{1}{P}\frac{Q}{Q}\frac{\partial P}{\partial Q}\left[q_f + \sum_g \kappa_{fg} q_g\right] = -\frac{1}{\eta}\left[s_f + \sum_g \kappa_{fg} s_g\right]. \end{aligned} \tag{3}$$

The expression above is simplified using the fact that the inverse-elasticity of demand is $\frac{1}{\eta} = \frac{Q}{P}\frac{\partial P}{\partial Q}$, and that the market share of firm f is given by $s_f = \frac{q_f}{Q}$. This expression is convenient because it relates the Lerner index markups $\left(\frac{P - mc_f}{P}\right)$ to the elasticity of demand η and the market share of firm f, s_f. Common ownership augments this expression with an additional term $\sum_g \kappa_{fg} s_g$. This leads to higher markups if $\kappa_{fg} > 0$, because firms behave as if they are have larger market share and more market power.

One can obtain the relationship between markups and common ownership at the market level

by multiplying equation (3) by the market share s_f and summing across all firms. This gives us the share-weighted average markup in the market as a function of demand elasticity, market shares, and profit weights:

$$\sum_f s_f \frac{P_f - MC_f}{P_f} = \frac{-1}{\eta} \underbrace{\sum_f \sum_g \kappa_{fg} s_g s_f}_{MHHI}, \quad \text{where} \quad MHHI = \underbrace{\sum_f s_f^2}_{HHI} + \underbrace{\sum_f \sum_{g \neq f} \kappa_{fg} s_f s_g}_{MHHI\Delta}. \tag{4}$$

Cowling and Waterson (1976) famously related the HHI and the inverse elasticity ($1/\eta$) to the average markup, which was influential in bringing concentration ratios into the analysis of horizontal mergers. The expression above extends this insight from the HHI to the Modified HHI (MHHI) in the case of common ownership.[6] It is common to decompose the MHHI into two parts: the familiar HHI (since $\kappa_{ff} = 1$), and the additional component that arises because of common ownership, often labeled the $MHHID$ or $MHHI\Delta$. As a preview, this derivation and equation (4) motivated the empirical approach in a number of early papers, as price appears on the left, $MHHI\Delta$ on the right, and so a regression of prices on HHI and $MHHI\Delta$ seemed reasonable, although it is important to note that the left side of the equation is actually share-weighted average markups, not price, and that this derivation is based on certain strong assumptions.

1.3. An Alternative to MHHI

The relationship between $MHHI$ and share-weighted average markups depends on the nature of competition between firms (homogeneous products and quantity setting). If one starts with equation (1) as before, but assumes that firms simultaneously set prices for differentiated products (Bertrand competition instead of Cournot), one gets a different result. Now, firms behave according to the following objective function:

$$\max_{p_f} \pi_f(p_f, p_{-f}) + \sum_g \kappa_{fg} \pi_g(p_f, p_{-f}). \tag{5}$$

Profits in this setting are given by $\pi_f = (p_f - mc_f) \cdot q_f(p_f, p_{-f})$ and if we take derivatives, we get:[7]

$$q_f + p_f \cdot \frac{\partial q_f}{\partial p_f} = mc_f \frac{\partial q_f}{\partial p_f} - \sum_g \kappa_{fg} (p_g - mc_g) \frac{\partial q_g}{\partial p_f}$$

The first two terms are familiar, while the third term is new. It captures an opportunity cost: the profits on sales that would have been diverted to my competitors had firm f sold fewer units. According to the theory of common ownership, firm f values the profits of competitor g according

[6] This was first derived in Bresnahan and Salop (1986), though the expression above more closely follows the derivation in O'Brien and Salop (2000).

[7] Here we have assumed single-product firms, but the math extends easily to multi-product firms (albeit with more notation) since $\kappa_{ff} = 1$ for products produced by the same firm.

to weights κ_{fg}. If products are net substitutes, then prices will be strictly higher than they would be in a world in which firms maximize only own-firm profits. Firms will now behave as if they have higher marginal costs, and will set higher prices.

To obtain the $PPI(\kappa)$ measure of O'Brien and Salop (2000), divide the first-order condition through by $\frac{\partial q_f}{\partial p_f}$, and re-write in terms of the own–price elasticity (η_{ff}) and the diversion ratios $D_{fg} = -\frac{\partial q_g}{\partial p_f} / \frac{\partial q_f}{\partial p_f}$:

$$p_f + \underbrace{\left[\frac{\partial q_f}{\partial p_f}\right]^{-1} \cdot \frac{q_f}{p_f}}_{=\eta_{ff}} p_f = mc_f - \sum_g \kappa_{fg}(p_g - mc_g) \underbrace{\frac{\partial q_g}{\partial p_f} / \frac{\partial q_f}{\partial p_f}}_{=-D_{jk}},$$

$$\underbrace{p_f \left(1 + \frac{1}{\eta_{ff}}\right)}_{\text{marginal revenue}} = \underbrace{mc_f}_{\text{marginal cost}} + \underbrace{\sum_g \kappa_{fg}(p_g - mc_g) D_{fg}}_{\substack{\text{marginal opportunity cost} \\ \text{of diverted sales}}},$$

$$p_f = \left(\frac{\eta_{ff}}{\eta_{ff} + 1}\right) \left[mc_f + \underbrace{\sum_g \kappa_{fg}(p_g - mc_g) D_{fg}}_{=PPI(\kappa)} \right]. \tag{6}$$

The expression in (6) represents the best response of firm f and relates prices to the own-price elasticity of demand η_{ff} and the effective opportunity cost, which is the firm's marginal cost and the cost of diverted sales. The $PPI(\kappa)$ captures the opportunity cost of sales diverted to the rival, where D_{fg} represents the diversion ratio and $(p_g - mc_g)$ is the price-cost margin. This has a direct relationship to the UPP measure found in Werden (1996) and Farrell and Shapiro (2010) and in the 2010 update to the Horizontal Merger Guidelines. A UPP calculation models a merger as a change from $\kappa_{fg} = 0 \to 1$ for the merging parties, and trades this off against potential marginal cost reductions. The $PPI(\kappa)$ calculation shows that common ownership effects a "partial merger" from $\kappa_{fg} = 0$ to a value determined by ownership patters and the weights that firms place on their investors $(\beta_{fs}, \beta_{gs}, \gamma_{fs})$.

In the same way that UPP calculations require more data than HHI calculations, the $PPI(\kappa)$ requires more information than the $MHHI(\kappa)$ calculation: firm-specific diversion ratios, which are more difficult to estimate, and price-cost margins, which are typically not known. It also possesses the same advantages: that one can allow for differentiated products and price-setting competition. Another advantage is that UPP and PPI are not so sensitive to market definition (so long as one can estimate diversion ratios).[8] The $PPI(\kappa)$ also has many of the same disadvantages that UPP does: while one can easily sign the price effect, even with knowledge of mc_f and the elasticity η_{ff} one can't make predictions about the magnitudes of price increases, because (6) merely represents

[8] See Conlon and Mortimer (2020) for a discussion of estimating diversion ratios from data.

the best-response of firm f, not a prediction of an equilibrium price.[9]

1.4. MHHI Regressions as Structure-Conduct-Performance

The $MHHI$ expression in (4) appears to suggest a possible template for empirical analysis and testing for common ownership effects. First, decompose the $MHHI$ into two parts: the familiar concentration measure HHI and the innovation $MHHI\Delta$ that arises because of internalizing common ownership effects. Then, observe whether or not share-weighted average markups are correlated with $MHHI\Delta$ after controlling for HHI. Implicitly this requires observing share-weighted average markups for several (independent) markets, and having a sufficient model of γ_{sf} so that one could calculate $MHHI\Delta$. If there were no effect of common ownership on firm behavior, then the true κ_{fg} terms would be zero and the $MHHI\Delta$ term should have no relation to markups; if a relationship between $MHHI\Delta$ and markups were found, some researchers interpreted that as evidence that firms do in fact respond to common ownership incentives.

This approach resembles the Structure-Conduct-Performance (SCP) regressions that were popular in Industrial Organization up through the 1980s.[10] The central conceit of the SCP literature was to regress measures of firm performance (profits, prices, and investment) on measures of market concentration (market shares, Herfindahl Indices (HHI), etc.), often using data across industries, though single-industry studies were also common in this earlier literature, see Weiss (1991) for an overview. Much of the early empirical literature measuring the impact of common ownership on prices (such as Azar et al. (2018b), Azar et al. (2016), Antón et al. (2018), Kwon (2016)) can be viewed as an extension of the SCP approach, primarily exploiting variation within a single industry (airlines, banks, or pharmaceuticals) across time or markets. Here we review some of the criticisms of the SCP approach more generally, many of which still apply to $MHHI$ regressions.[11]

Denoting firms by f, markets by m, time periods by t, and market shares by s, many early empirical common ownership papers run SCP-style regressions of the form:

$$\log p_{fmt} = \beta_0 + \beta_1 \underbrace{HHI_{mt}}_{\sum_f s_{fmt}^2} + \beta_2 \underbrace{MHHI\Delta_{mt}}_{\sum_f \sum_{g \neq f} \kappa_{fgt} s_{fmt} s_{gmt}} + \beta_3 \log s_{fmt} + \varepsilon_{fmt}. \tag{7}$$

These papers tend to find both that concentration is associated with higher prices ($\beta_1 > 0$), and also that higher effective concentration from common ownership is associated with higher prices ($\beta_2 > 0$).

One drawback is that approach is susceptible to many of the same critiques that plagued the original SCP literature. The first major complaint is the original theoretical one. A relationship like

[9] We would need to solve the simultaneous system of best-responses for all players to obtain equilibrium prices. This is the "full merger simulation" approach of Nevo (2000).

[10] The beginning of the SCP approach in Industrial Organization is frequently attributed to Bain (1951) and the end of the SCP approach is frequently marked by the retrospective in Schmalensee (1989).

[11] For a more complete (and contemporary) discussion of these limitations, please consult Berry et al. (2019).

(7) should exist only if the firms are engaged in a game of simultaneous quantity setting for homogeneous products (Cournot competition). If firms are actually engaged in differentiated Bertrand price-setting, then the regression equation in (7) is mis-specified, and a significant positive coefficient on β_2 may no longer be interpreted as evidence of common ownership softening competition. We show this with an example in Section 5. With different demand shocks in different markets, they show that a spurious correlation is likely even when firms ignore common ownership in pricing.

This second complaint about the SCP approach is often attributed to Demsetz (1973) and more broadly to the "Chicago School" of the 1970s. The thought experiment takes and re-allocates some market share from a high cost, low share firm to a low cost, high share firm. This sort of reallocation would increase both share-weighted average markups and concentration measures, but would reduce prices and expand output. Thus while concentration rises, the reallocation would be unambiguously good for both consumer surplus and industry profits.[12] Thus, if firms have different costs structures, such regressions are unreliable. At the time, one way to address this concern was including own market share in (7) and interpreting a positive coefficient on β_3 as vindication that larger firms were more efficient. Why? Well if one takes the Cournot model seriously then the *cause* of high share is low costs.

A third related complaint is that even if firms are engaged in Cournot competition, the theoretical model from (4) provides at best a relationship between share-weighted average markups and concentration, while the regression approach generally attempts to establish a relationship in (7) between *prices* and concentration. This is in part a limitation of available data. Very rarely are accurate data on marginal costs available to researchers, thus making it hard to construct a measure of the share-weighted average markup.[13] Using prices in place of markups is not innocuous. If one firm experiences a reduction in marginal cost, the underlying Cournot model says we should anticipate both an increase in that firm's share and a reduction in the market price. However, the effect on concentration measures is ambiguous and depends on whether the firm experiencing the cost reduction was a large firm or a small firm. Regression equations like (7) implicitly assume that these kinds of cost shocks either don't happen (costs don't vary) or have no effect on market outcomes. To be more explicit, unmodeled cost shocks could cause changes in both prices and shares without any direct causal relationship between the two, thus enabling a researcher to detect a spurious relationship in $(\beta_1, \beta_2, \beta_3)$. As far back as Demsetz (1973) it was known that even under perfect competition, increasing marginal costs could be easily mistaken for a price-concentration relationship.

[12] Another famous (and simple example): in the perfectly competitive model with upward sloping supply there exists a mechanical relationship between HHI and price even though all firms are price takers, and so HHI cannot have a causal effect on prices charged by firms. That is, industry concentration would have no causal effect on prices even though a regression would show a statistically significant relationship.

[13] Even when cost data are available reported measures such as "costs of goods sold" reflect measures like average variable cost rather than the cost of producing the marginal unit, see Fisher and McGowan (1983) for additional discussion. Other controversies involve the role of advertising or customer acquisition which is frequently treated as a fixed rather than a variable cost in accounting data.

A fourth critique which synthesizes many of these objections and is often associated with Bresnahan (1989), is that the relationship between prices and concentration (market shares) in (7) is an equilibrium relation that may represent either a supply curve or a demand curve (or more likely, neither). Put simply: Which "causal relationship" between price and quantity are we trying to identify? Absent specific exclusion restrictions, regression analysis might not identify any meaningful economic relationship. This problem is further exacerbated by the fact that exclusion restrictions required by instrumental variable (IV) approaches are hard to find. The classic argument for exclusion of an instrumental variable is "something that appears in another equation." The challenge arises because both prices and market shares are equilibrium outcomes (linked by first-order conditions), and most relevant variables would affect both supply and demand; thus, almost nothing can be excluded.[14] That is, the econometric problem of *simultaneity* is much more challenging than the typical omitted variable problem that plagues most regression analyses.

To be clear, this criticism doesn't suggest that uncovering the relationship between concentration (or common-ownership) and prices is hopeless, but rather that it is often obscured by regressions like (7). Instead, one must first separate demand from supply, and consider the resulting system in equilibrium.[15] The demise of the original SCP literature is summarized in Schmalensee (1989), which concludes by noting that this line of research...

> "... has taught us much about how markets *look*, especially within the manufacturing sector in developed economies, even if it has not shown us exactly how markets *work*."

This view has led most empirical researchers today to view regression approaches like (7) as descriptive, or suggestive of relationships, rather than proof.

2. The Rise of Common Ownership

The theoretical model of Bresnahan and Salop (1986) that underlies (1) and (4) dates back to the 1980s. These early models of common ownership were designed to understand joint ventures between two or three stakeholders, such as those between GM and Toyota. Why has this topic resurfaced more recently?

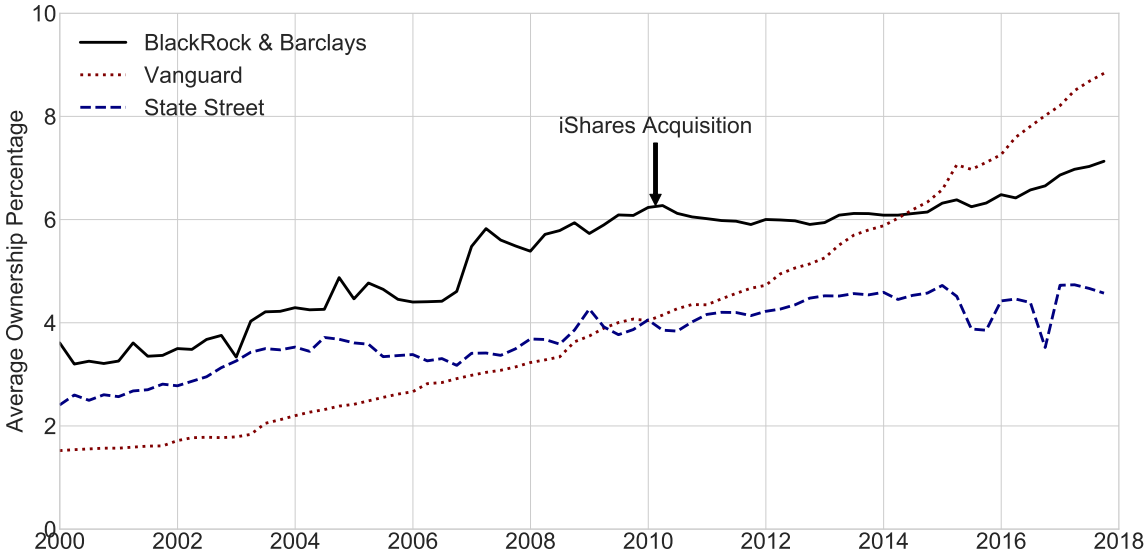
The ensuing decades between the 1980s and today saw a rise both in diversification of investors across broad market indices, and later in the increasing concentration among money managers. The introduction of 401(k) defined-contribution retirement plans in 1978 led to a expansion in diversified portfolios and mutual fund managers in the 1980s (such as Fidelity); later index funds

[14] Fixed costs have been proposed as a potential instrument for concentration or the number of firms, but are notoriously difficult to measure. Other proposed instruments for concentration include mergers undertaken for unrelated reasons.

[15] This is sometimes conflated with using "structural" models. Separately modeling supply and demand is one way to account for the fact that prices and quantities are jointly determined (and has the advantage of permitting quantification of counterfactuals), this approach can also inform identification without a fully specified model, e.g. using supply– or demand–shifting instruments and a model of long–run industry equilibrium, as in Syverson (2004); Backus (2020), on the cost side, and Conlon and Mortimer (2020) on the demand side.

(such as Vanguard) in the 1990s; and finally exchange-traded funds, or ETFs, in the 2000s (such as those offered by Barclay's/Blackrock (iShares) and State Street SPDRs). At the beginning of 2018, the four largest asset managers (Blackrock, Vanguard, State Street, and Fidelity) managed over $16 trillion in assets, and for 88% of firms on the S&P 500 Index, the largest shareholder was one of those four asset managers. Figure 1 specifically plots, over time, the average percent of S&P 500 firms held by Blackrock, Vanguard, and State Street over time. Blackrock here includes holdings by Barclays, whose iShares product was acquired in 2009. These three major firms went from each holding under 1% of a typical S&P 500 firm to holding roughly 5% (State Street) to over 7% (Vanguard).[16]

Figure 1: Ownership of S&P 500 Firms



Notes: This figure depicts the average percentage ownership of S&P 500 listed firms by Blackrock/Barclays, Vanguard, and State Street. Data are from our scraped and parsed dataset of raw 13(f) filings. The vertical line depicts the date of the acquisition of Barclay's iShares business by Blackrock. The plot represents the sum of positions for both Barclay's and Blackrock for all periods (including pre-acquisition).[Source: Backus et al. (2021)].

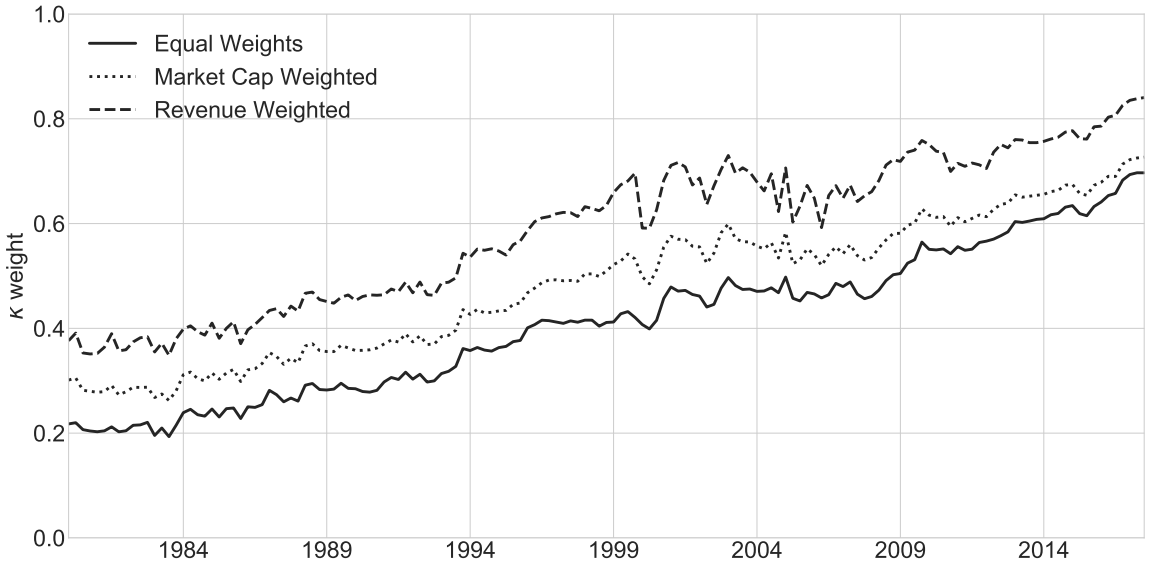
The new empirical research agenda began around 2011, due to the ingenuity of Azar (2011) to investigate a hypothesis that had been largely disregarded. One key innovation, was the rediscovery of the (likely forgotten) central idea in Rotemberg (1984), that managers act to maximize shareholder value, including shareholders cross-holdings in other firms. The twist was to adapt the $MHHI$ approach of Bresnahan and Salop (1986) from small numbers of participants in joint ventures to thousands of diversified investment managers.

Accounts in the financial press tend to link the hypothesis that common ownership softens

[16]These three investment managers were chosen given their emphasis in the literature and large holdings at the end of the sample, but we cannot rule out that other investment managers could also be plotted here and would show qualitatively similar patterns.

competition to the rise of these "big three" asset managers in particular. The more relevant question is what has happened to common ownership incentives (as measured by κ_{fg} in (1)) over the past several decades? The figure below is from Backus et al. (2021) and plots the average profit weight κ_{fg} between S&P 500 firms, under the assumption of proportional control ($\gamma_{fs} = \beta_{fs}$) that is prevalent in empirical work. Figure 2 implies that for a typical firm in the S&P 500, the profit weight for any other firm in the S&P 500 implied by the common ownership hypothesis has increased from approximately 0.2 in the 1980s to approximately 0.7 in the late 2010s. This increasing trend suggests that today the degree of common ownership is both substantial and widespread. While the

Figure 2: Average Profit Weights for S&P 500 Firms, 1980-2017



Notes: This figure depicts the average common ownership profit weight (under proportional control $\beta_{fs} = \kappa_{fs}$) for pairs of S&P 500 firms by quarter from 1980 through 2017. [Source: Backus et al. (2021)]

degree of common ownership in the economy has been growing steadily over time, Figure 2 doesn't tell us whether or not managers internalize these incentives. However, if managers did internalize those incentives they would treat $1 of profits of other S&P 500 listed firms as 70 cents of their own profits. This would imply that an industry with 10 symmetric firms under common ownership would be less competitive than an industry with two identical firms absent common ownership effects.

If firms were to internalize incentives from common ownership as the theory in (1) suggests, the potential economy-wide effects would be massive, much larger than say a typical 3:2 horizontal merger. This leads Backus et al. (2021) to conclude that common ownership effects are, to paraphrase, "big if true." Given the empirical patterns in common ownership holdings and the potential effects of firms internalizing these incentives, the potential for effects on the economy

warrant serious investigation.

2.1. Structural Remedies?

Some voices have called for so called "structural remedies", including breaking up large institutional investors, such as Steele (2020). In reality, breaking up large institutional investors would have little effect on incentives from common ownership. Why? Because almost all investors now invest in almost all firms, diversifying their portfolio. Borrowing again from Backus et al. (2021), below is a figure that shows that if the government were to split BlackRock and Vanguard each in half, average profit weights among S&P 500 firms would go from 0.7 to 0.62. Therefore, this major intervention would do little to accomplish its purported policy goal.

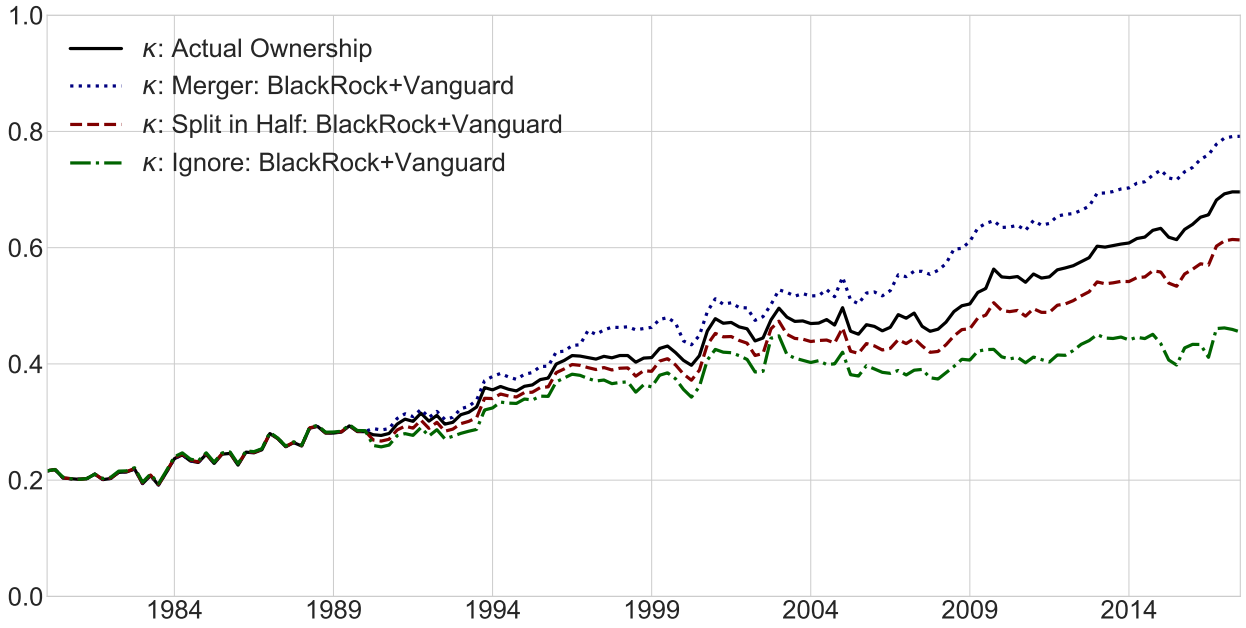


Figure 3: Alternative Ownership Structures for BlackRock and Vanguard

Notes: This figure depicts the average common ownership profit weight (under proportional control $\beta_{fs} = \kappa_{fs}$) for pairs of S&P 500 firms by quarter from 1980 through 2017 under alternative structural remedies. [Source: Backus et al. (2021)]

3. Merger Analysis with Common Ownership

An important issue is how the presence of common ownership affects the analysis of horizontal mergers. This section first reviews how standard merger analysis would account for potential common ownership effects, first in a Cournot setting, then in a differentiated products Bertrand setting. It then considers a real-world proposed merger that was blocked and shows that the common ownership hypothesis may imply weaker enforcement under prevailing legal standards in some cases. Finally, it shows that deal structure may affect merger effects in a way that suggests stronger enforcement actions for stock-swap acquisitions.

3.1. Merger Analysis

Under Cournot competition, the change in the HHI from a merger of (f, g), which we write $\Delta HHI(f, g)$ is simply twice the product of the shares:

$$\Delta HHI(f, g) = 2\, s_f\, s_g$$

In the presence of common ownership this is modified in two key ways. The first is that if the firms are internalizing common ownership incentives, then because the two firms have already "partially merged," the reduction in competition is mitigated by the extent to which common ownership has already softened competition – however, were a party to a merger to make this claim, they would be admitting to anticompetitive conduct prior to the proposed merger. In essence, the "full merger" no longer changes incentives by the same amount if firms were already behaving according to the common ownership hypothesis. The analogue to the above HHI change, $\Delta MHHI(f, g)$, is given by:

$$\Delta MHHI(f, g) = (2 - \kappa_{fg} - \kappa_{gf})\; s_f\, s_g + \sum_h \Delta\kappa_{fh}\, s_f\, s_h + \sum_h \Delta\kappa_{gh}\, s_g\, s_h. \tag{8}$$

Instead of multiplying the product of merging party shares $s_f\, s_g$ by two, we multiply by $(2 - \kappa_{fg} - \kappa_{gf})$. Thus higher levels of common ownership among merging parties (larger κ), will lead to smaller reductions in post-merger competition if competition had already been softened via common ownership prior to the merger.

The second way that $\Delta MHHI$ is different is that the merger might change the degree of common ownership between the merging and non-merging parties. This comes about because the ownership structure of the merged entity may not be identical to the ownership structure of (f, g) pre-merger. This is accounted for with $\Delta\kappa_{fh} = \kappa_{mh} - \kappa_{fh}$ which represents the difference in κ between the merged firm m and each party pre-merger. While it is possible to construct mergers that lead to large values of $\Delta\kappa_{fh}$, we expect the major difference to come from the $(2 - \kappa_{fg} - \kappa_{gf})$ term.[17]

We observe a similar effect when we look at how the presence of common ownership affects the UPP calculation for a merger between (f, g) in the context of differentiated product markets. If

[17] An example would be that if Vanguard owned 10% of firm f and none of firm g while BlackRock owned 10% of firm g and none of firm f, and both Vanguard and BlackRock owned 5% of firm h; in this case a merger which led to BlackRock and Vanguard each owning 5% of the merged firm would also better align their interests between the merged firm and h. While illustrative, this tends not to be an accurate description of the empirical distribution of investor holdings.

one allows for common ownership effects, the UPP calculation can be generalized to:[18]

$$UPP_f = [\Delta mc_f + (1 - \kappa_{fg}) \cdot (p_g - mc_g) \cdot D_{fg}]. \tag{9}$$

where D_{fg} is the diversion ratio. As in the Cournot case, the greater the extent to which the firm internalizes its effect on the rival, the smaller the effect the merger has on the firm's opportunity cost. Thus a pre-merger $\kappa_{fg} = 0.75$ would imply that the required marginal cost reduction would only be 25% as large as would be required absent common ownership to have no upward pricing pressure – again, if a merging party were to make this claim in support of their proposed merger, it would be an admission that the merging parties were not fully competing prior to the merger. This required reduction is *decreasing* in κ_{fg} under the common ownership hypothesis.

Under both Cournot and differentiated Bertrand competition, the impact that common ownership has on prospective merger evaluation – if firms are indeed internalizing these incentives – is similar. When firms partially internalize the business stealing effects they have on competitors pre-merger, this reduces the scope by which the merger can increase the internalization. In other words, because the pre-merger period becomes less competitive under common ownership, the merger reduces competition by a lesser extent. This has the potential to interact with merger screens that are based on both levels of concentration and the change in concentration effected by the merger. Unilateral effects calculations like UPP focus only on the change in incentives and not the extent of market power pre-merger and thus only detect the latter. Were the common ownership hypothesis to be true, this might imply reduced enforcement action against horizontal mergers, at least under unilateral effects analysis, while creating a massive potential to pursue other types of remedies in cases where competitors have high profit weights on one another.

3.2. Example: Proposed Aetna-Humana Merger

Consider the proposed merger between Aetna and Humana, which was announced in July of 2015. The two companies are competitors, and a judge ruled in January of 2017 that the merger should be blocked;[19] the firms abandoned the merger the following month.

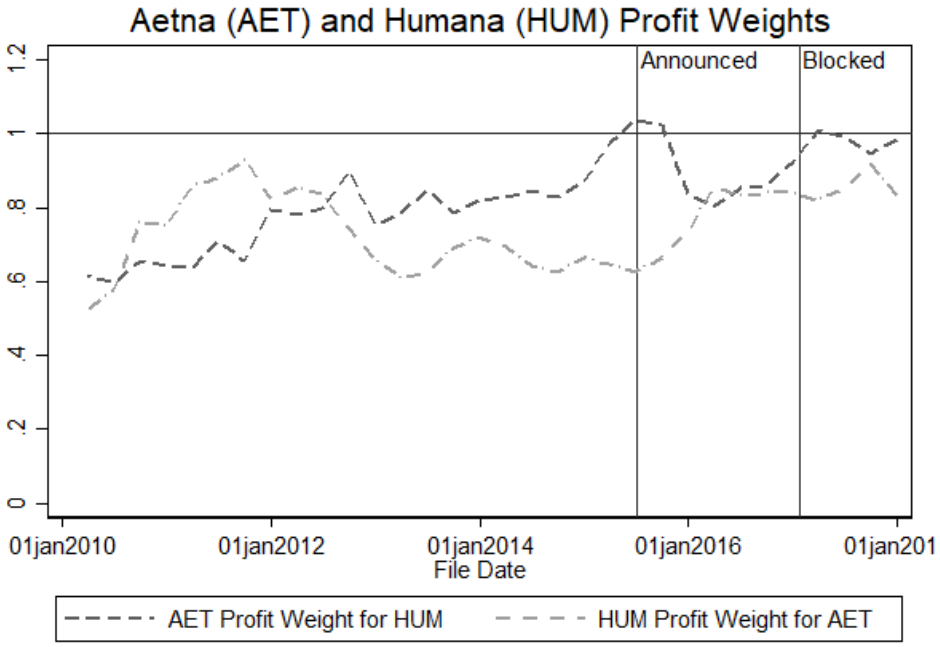
In McClane and Sinkinson (2020), the authors document the implied profit weights the two firms had on each other, under the proportional control assumption, over the last decade. This is reproduced in Figure 4 below.

As is clear, both firms had high implied profit weights on the other based on a large amount of overlapping ownership. In fact, at the time the merger was announced, Aetna placed a profit weight of greater than 1 on Humana, with Humana placing a weight of closer to 0.6 on Aetna. One might first question that if the two firms were indeed partially merged to this extent through common

[18] Just like the last two terms in (8), there is also an effect on $PPI(\kappa)$ that arises from the change in the $\kappa_{fh} \to \kappa_{mh}$ to non-merging firms. The change in this effect from the merger is given by $\Delta PPI(\kappa) = \sum_h \Delta\kappa_{fh}(p_h - mc_h)D_{fh}$, which could be positive or negative but is likely to be less important than the direct effect on UPP_f.

[19] United States of America et al v. Aetna Inc. et al, 2017.

Figure 4: Profit Weights for Aetna and Humana



Notes: This figure depicts the implied profit weights that Aetna and Humana had for each other, based on Thomson Reuters S34 data. Calculations are based on the proportional control assumption of $\gamma = \beta$. [Source: McClane and Sinkinson (2020)]

ownership, why was a formal merger necessary. This observation alone raises doubts about firms fully internalizing the common ownership effects predicted by the hypothesis.

The judge ultimately ruled that the merger would not be in the interest of consumers. In the classic framework, these two firms merging would take the profit weights from 0 to 1; if the firms are already internalizing the effects of common ownership, then the merger would take Humana's profit weight on Aetna from 0.6 to 1, and wouldn't affect Aetna's profit weight on Humana much at all. Therefore, any price effect of the merger would be very small if the common ownership hypothesis were true, as the firms were already partially merged due to common ownership. Conversely, the required compensating marginal cost reduction such that this merger would have no effect on prices is much smaller under the common ownership hypothesis than under the classic model of own-firm profit maximization. Thus, counter-intuitively, if the common ownership hypothesis were true, it is less likely that this merger should be blocked as it would be less likely to increase prices.

This example highlights the impact of considering common ownership in merger evaluation. Interestingly, since Aetna's profit weight on Humana was greater than 1 at the time the merger was announced, it should have wanted to "tunnel" profits to Humana as discussed in Section 1. Aetna ended up paying a $1 billion fee to Humana when the merger was abandoned.

3.3. Deal Structure

In McClane and Sinkinson (2020), the authors make the novel observation that deal structure – whether a merger is completed through a stock swap or a cash tender offer, for example – has implications for competition under the common ownership hypothesis. The main point they make is that it is very unlikely for the deal structure to be neutral with respect to profit weights on other firms. Here we show how stock-swap mergers can have unexpected effects on profit weights while cash offer mergers do not.

Consider a merger between Firm 1, which has 100 shares outstanding at a price of \$10, and Firm 2, which has 50 shares outstanding at a price of \$5. Suppose Firm 1 simply issues 25 new shares to buy Firm 2, exchanging 2 shares of Firm 2 for each new share of Firm 1. This completes the merger.

Suppose Firm 3 also operates in the same market as Firms 1 and 2. Further suppose the following are the ownership patterns: there is a common owner that owns 10% of Firm 1, 5% of Firm 2, and 20% of Firm 3. Besides that, each of the three firms has an undiversified owner that own 30% of them. The rest of each firm is held by small retail investors.

The implied profit weights that Firms 1 and 2 had on Firm 3, prior to the merger, were:

$$\kappa_{13} = 0.2 \text{ and } \kappa_{23} = 0.108.$$

However, after the merger, the merged firm will have a profit weight on Firm 3 of 0.2597, a fair bit higher than either of the weights of the merging firms.[20] That is, even ignoring that the profit weights for Firms 1 and 2 on each other went to 1, the combined firm now places a higher profit weight on Firm 3 than either of the merging firms. Why is this? The merger diluted the impact of the undiversified investors, as they now own the same value of a larger firm.

Notably, if the deal had instead been a cash tender offer by Firm 1 for Firm 2, the merged firm's profit weight on Firm 3 would have been unchanged from Firm 1's profit weights, assuming that ownership patters did not change as a result of the merger. The implications here are twofold: first, deal structure affects how a merger should be evaluated under the common ownership hypothesis. Second, this highlights a way in which merger enforcement should be stricter when taking into account the fact that undiversified shareholders are diluted by equity-based mergers.

4. Timeline of Empirical Work

The first empirical work focused primarily on the relationship between increasing degrees of common ownership (as measured by versions of $MHHI$) and increasing prices and began with the dissertation work of Azar (2011). Inspired by (4) which relates share-weighted markups to common ownership measures under particularly strong assumptions, such as Cournot competition, the

[20] The merged firm now has two undiversified investors holding 24% and 6% of the merged firm; the diversified investor owns 9% of the merged firm. Firm 3's ownership is unchanged.

first generation of analyses typically employed panel regressions where data are gathered both in the cross section and over time. These approaches would regress some outcome of interest on a measure of common ownership, as well as fixed effects for the unit of observation and time periods. Such panel regressions are typically interpreted as descriptive and not causal, many papers would combine this approach with an exogenous change to common ownership, such as the 2003 Mutual Fund Scandal, or BlackRock's 2009 acquisition of Barclay's iShares business. However, these methods have been criticized for the reasons discussed above in Section 1.4. For example, while it is true that these financial events generate "good" variation in common ownership, they do so identically in all markets (e.g. the κ values do not vary across markets).[21] Therefore, in order to have any cross-market variation, measures such as $MHHI\Delta$ combine the κ terms with differences in market shares, leading to "bad" variation, in that market shares and prices are likely to be correlated for many different reasons apart from any common ownership effect. In other words, using financial transactions that change common ownership addresses the endogeneity of common ownership but does not address the issue of simultaneity between market shares and prices.

A second generation of analyses recognized that $MHHI\Delta$ was a flawed measure of common ownership and considered other measures of an effect aside from price. Newham et al. (2018) looks at entry into generic pharmaceutical markets and regresses the binary outcome variable of entry on different measures of common ownership, including κ, to show that common ownership is associated with a lower probability of entry. That is, they find that a higher level of common ownership between two firms is associated with a lower probability of generic entry by one firm when the other loses patent protection. Other papers realized that having more financial market events would maximize the amount of exogenous variation in common ownership. For example, Boller and Scott Morton (2020) look at abnormal stock returns for a company when a competitor is added to a major stock index, exogenously increasing the amount of common ownership. Antón et al. (2020) use the same approach to show that common ownership has an effect on the "Wealth-Performance Sensitivity" (WPS) measure of Edmans et al. (2009), an important link in the literature as it is relevant to the question of mechanisms (more discussion in Section 7).

Going forward, the central question of whether prices reflect common ownership incentives is most likely to be addressed using structural models of demand and supply. As noted above in Section 1.3, the effect in differentiated product markets – likely the correct model for nearly all product markets – relies on understanding diversion ratios among competing products. This requires estimating a flexible model of demand to see if prices respond to changes in common ownership incentives differently around products with higher or lower diversion ratios. Backus et al. (2020a) proceed along this route, estimating demand for ready-to-eat cereal.

[21] Antón et al. (2020) develop a theory model that predicts cross-market variation in prices from common ownership through a model of managerial effort.

4.1. Panel Regressions

The workhorse model for most early work was to regress a market-level measure of price on HHI and $MHHI\Delta$, as well as some controls, as described by equation (7). The central idea is that a positive coefficient on $MHHI\Delta$ was evidence that prices were higher in markets where common ownership was higher. This relationship is true in the context of markups in equation (3), although that equation is based on the assumption of homogenous Cournot competition. Outside of that setting – for example, if firms produce differentiated products – that relationship does not hold, and there is no interpretation for a positive or negative coefficient on $MHHI\Delta$ in that context. Further, the true relationship under those strong assumptions is between markups, which are unobserved, and the measures of common ownership. To use prices as a proxy for markups requires further assumptions, such as that marginal costs must be constant at scale and common across firms. These assumptions make pure panel regressions unappealing.

For example, the main idea in Azar et al. (2018a) (henceforth "AST") is to examine the relationship between airline prices (as measured by fare-per-passenger) and route-level concentration and common ownership (measured by HHI and $MHHI\Delta$ respectively). They use the Department of Transportation's DB1B database, which is a standard dataset used by academics studying airlines. A route m is a (non-directional) combination of city pairs that can be served by either nonstop or connecting service. The authors define a market as a city-pair route and quarter t combination. They then run two sets of regressions which resemble the SCP regression from (7) with a number of additional controls X_{fmt} (distance interacted with quarter fixed effects to capture fuel costs, demographics of each city, indicators for Southwest and other low-cost-carriers (LCCs) on that route, etc.) and two-way fixed effects (TWFE) denoted by γ. The first analysis looks at the prices of individual carriers f:

$$\log p_{fmt} = \beta_1 HHI_{mt} + \beta_2 MHHI\Delta_{mt} + \theta X_{fmt} + \gamma_t + \gamma_{fm} + \varepsilon_{fmt}. \tag{10}$$

The second looks at the passenger weighted average prices for the entire route:

$$\log p_{mt} = \beta_1 HHI_{mt} + \beta_2 MHHI\Delta_{mt} + \theta X_{mt} + \gamma_t + \gamma_m + \varepsilon_{mt}. \tag{11}$$

The goal of these regressions is to estimate and interpret β_2, the relationship between prices and the $MHHI\Delta$ measure of common ownership. The headline finding is that a 1,000 point increase in the $MHHI\Delta$ is associated with a $1.5\% - 2.2\%$ increase in prices in (10) and a $2.0\% - 3.3\%$ increase in prices in (11). Two-way fixed effects estimators are popular because they allow the researcher to control for unobservable heterogeneity at the route level or the route-carrier level, as well as unobservable heterogeneity across time. However, they can be somewhat opaque in conveying precisely which variation in the data is being used to learn about β_2. In the presence of these fixed effects, we can only learn about β_1 and β_2 from markets (city-pairs) where HHI_{mt} and

$MHHI_{mt}$ vary across time within the market.

We discuss some examples that could potentially provide variation in $MHHI\Delta_{mt}$ and HHI_{mt} within a route over time. The best case scenario might be that $\kappa_{fg,t}$ varies across pairs of firms and quarters more or less at random, while everything else remains fixed. In this case HHI_{mt} and X_{mt} don't vary over time within a market, and are eliminated by the fixed effect γ_m. Here the the idea is that as $\kappa_{fg,t}$ varies, different routes are differentially exposed to the "shock" to common ownership. The degree of exposure to the shock depends on $s_f \cdot s_g$ in the $MHHI$ term. That is, if common ownership between Delta and American increases, we look at the markets where both Delta and American have high share and see if prices increase more in those markets than in others. This is the core of the strategy in (10) and (11).

Consider another example. Suppose an airline receives a shock that increases its marginal cost on a particular route; for example, maintenance issues mean a newer fuel efficient aircraft is replaced by an older, less fuel efficient aircraft. This is likely to lead to higher prices by that carrier on that route, and higher average prices on the route overall. The effect on HHI depends on whether or not the carrier's market share is reallocated to larger firms or smaller firms, and is ambiguous. Because $MHHI = \sum_f \sum_{g \neq f} \kappa_{fg} s_f s_g$, reallocation in market share will have an ambiguous effect that depends on whether share is reallocated among pairs of firms with larger κ values (more common ownership) or whether the reallocation leads to more symmetry in shares (larger values of $s_f \cdot s_g$). Perhaps the more troubling issue is that the marginal cost shock didn't change anything about the patterns of common ownership, and yet it could be potentially detected as a positive or negative coefficient on the relationship between $MHHI\Delta$ and price. A similar issue arises if one considers a carrier-route specific demand shock. Suppose that Delta opens a new passenger lounge in Orlando, or renovates the gate area and this encourages switching from passengers of other airlines on that route. This is unobserved to the researcher, and can have a direct impact on both the prices and the market shares of Delta on a particular route. The idea that unobservable shocks to demand or marginal cost might cause changes in both prices and shares is exactly the "simultaneity of share" critique of the SCP literature in the previous section. This is the main threat to the strategy in (10) and (11).

Another early study in this empirical literature is Azar et al. (2016) ("ASR"). This paper extends the $MHHI$ framework to allow for firms to own stakes in competitors directly, referred to as "cross ownership." While uncommon in most product markets, this is a common arrangement among financial firms, which are the focus of the paper. As a theoretical matter, the Generalized HHI ($GHHI$) measure is not conceptually different from the $MHHI$ measure.

The empirical approach in ASR is to run panel-regressions similar to (10) with controls for market (county) level observables X_{mt} and the market cap of the bank Q_{ft} (meant to proxy for

cost variables):

$$y_{jfmt} = \beta \cdot GHHI_{mt} + \theta \cdot X_{mt} + \lambda \cdot Q_{ft} + \gamma_j + \gamma_t + \varepsilon_{jfmt}.$$

Much like AST the strategy involves two-way fixed effects (for branches j and time periods t). Since common ownership is national, the variation in $GHHI$ comes from the relative market shares in different markets, as well as differences in levels of institutional ownership (due to, for example, a bank being included or excluded from a financial index). This makes it difficult to disentangle the effect of HHI from $GHHI$, which is more challenging than in AST. The authors find that higher levels of $GHHI$ are associated with less attractive terms for consumers (higher fees, maintenance fee thresholds, and lower interest rates on deposits).

4.2. Instrumenting for $MHHI\Delta$ (or κ)

The authors of AST were clearly aware of the critiques to the panel regression approach and focused on a second approach to address potential critics:

> When interpreting the coefficient on $MHHI\Delta$, one should keep in mind that market shares (which enter both $MHHI\Delta$ and HHI) are potentially endogenous in ways that are likely to negatively bias this coefficient. An investor with holdings only in one airline should increase her stake if she correctly (and before the rest of the market) anticipates an increase in firm profitability.

However, most of the discussion in the paper is concerned with the other potential endogeneity problem, which can be thought of as the "endogeneity of κ." There the concern might be that investors anticipate higher airline prices in the future and increase their holdings today (i.e. higher prices cause higher κ).

The main way the authors address the potential "simultaneity of share" is in Table 6 of AST. Here they use the variation in ownership κ induced by the acquisition of Barclay's iShares business by Blackrock in the first quarter of 2009. They compute implied change in the $MHHI\Delta$ as follows:

$$\text{Implied Change in } MHHI\Delta_m = \sum_f \sum_{g \neq f} \Delta\kappa_{fg,2009q1} \cdot s_{fm,2009q1} \cdot s_{gm,2009q1}.$$

This object measures how much the Blackrock/Barclay's acquisition would have changed common ownership (as measured by $\kappa_{f,g,t}$) under the pre-acquisition (Q1 2009) levels of ownership. It interacts the change in κ_{fg} with the pre-acquisition market-shares (Q1 2009) for each pair of airlines to form an estimated change in $MHHI\Delta_m$ for each market. In other words, it measures how acquisition would have changed $MHHI\Delta_m$ if both market shares s_{fmt} and other ownership patterns $\kappa_{fg,t}$ had remained fixed at the Q1 2009 level. Notice that this does not vary with time.

The strategy in Table 6 of AST looks at the change in prices route-by-route before and after

the Blackrock/Barclay's event at various intervals, and compares that to the implied change in the $MHHI\Delta_{mt}$ above using the Q1 2009 values:[22]

$$\Delta_{2009Q1-\text{Post}} \log(p_{rj}) = \delta_{IV} \cdot \Delta_{2009Q1-\text{Post}} MHHI\Delta_m + X_{mf,2009Q1} + \varepsilon_{mf}.$$

These results are insignificant in (2010, 2011, 2013) but significant in (2012, 2014) and for the overall period, and similar in magnitude as before; a 1,000 point increase in $MHHI\Delta$ corresponds to a 4.6% increase in fares. The advantage of this approach is that while marginal cost shocks and demand shocks can still impact the price changes, by fixing shares at their Q1 2009 level, they can no longer cause changes in $MHHI\Delta_m$. However, they are no longer able to include the rich fixed effects of their earlier analyses.

Weaknesses to this approach stem from the fact that they rely entirely on variation across markets. First, they lose the ability to control for unobserved heterogeneity across markets with market fixed effects. In such a model, identification hinges on an unstated panel–style assumption: that innovations in prices, which are themselves an equilibrium object, are uncorrelated with pre-acquisition market shares conditional on the market–level controls. This non–primitive assumption would fail in the presence of dynamic elements in the underlying model, for example with capacity choices in a time-to-build model (reasonable for a setting such as airlines). Second, all of the variation comes from $\Delta\kappa_{f,g}$ (how the Blackrock/Barclay's event changes the ownership structure). This only varies across carriers and does not vary across markets. Therefore if the event led to large changes in $\Delta\kappa_{fg}$ for the legacy carriers but not the LCC's, and there was any other event between 2009-2012 that differentially impacted the legacy carriers and the LCC's (emerging from bankruptcy, mergers, or ushering in an "era of capacity discipline") one might mis-attribute the impact of this other event to $MHHI\Delta_m$.[23]

4.3. Criticisms, Responses, Replies

In part because AST reached such an unorthodox conclusion – that investor diversification and the growth or large passive managers like Blackrock had "caused" higher airline fares – it attracted a number of critiques, responses, and replies.

One source of controversy that is somewhat specific to the airline application is that there were several bankruptcies between 2002 and 2013 (American, Delta, Mesa, Northwest, United, and US Airways (twice)). The period also included three major mergers: Southwest-Airtran in 2010, United-Continental in 2012, and US Airways-American in 2013-2015. There exists some dispute about how to handle the bankruptcies as shareholders are generally wiped out and creditors take possession. The specifics of handling bankruptcies were central in the critiques of both Dennis

[22] In practice they include the observed change in $MHHI\Delta_m$ but then instrument for it with the implied change above. Absent any correlation with X_{mf} these two approaches would be equivalent.

[23] This issue is raised in Rock and Rubinfeld (2018).

et al. (2019) and a study commissioned by Blackrock: Egland et al. (2018). The former study set $\kappa_{fg} = \kappa_{gf} = 0$ for airlines during bankruptcy and obtained a small and insignificant result. The latter study instead dropped periods including major bankruptcies entirely, and showed that if one pooled across the three disjoint intervals without bankruptcies, one got a positive and significant result, but if one looked at each interval in isolation one got a null or negative and significant result.

The second source of controversy surround which assumption one places on γ_{fs}, the weight that the firm places on the investor's portfolio payoffs. Dennis et al. (2019) restricted attention to shares that investment managers report to have "sole" voting authority, as opposed to "shared," and revisit weighting in the regressions. Azar et al. (2018b) directly replies to this criticism by showing discrepancies in data construction on ownership and robustness of those authors' earlier paper. The Egland et al. (2018) study reduces the weight placed on investors classified as "asset managers" (approximately 73% of airline shares) by multiplying it by 1% so that $\gamma_{fs} = .01\beta_{fs}$ (to reflect typical asset management fees). This has the effect of all but eliminating the consideration given to large diversified investors and essentially assumes away concerns regarding common ownership with predictable (null) results. On a related note, Lewis and Chugh (2019) used a different data source to measure ownership β_{fs} and implicitly γ_{fs}. Instead of using the Thomson Reuters Spectrum (S34) database, which compiles SEC form 13f filings and is organized by investor, they used Thomson Reuters Ownership (OP) database, a premium product that is organized by firm and also attempts to collect information on insider holdings, and holdings by foreign investors through fund and insider disclosures. They find that the $MHHI_{mt}$ measures across the two sets of holdings data are not highly correlated (around 0.75) and find in some cases this may lead to a null result.

Additionally, Kennedy et al. (2017) attempt to recreate the Azar et al. (2018a) dataset and main results and then regresses prices on profit weights and instruments using the same Barclays-Blackrock merger, but also membership in the Russell 1000 index. They estimate a structural model with nested Logit demand and a parameterized ownership matrix. Overall, they find no support for the common ownership hypothesis in airline prices. In Azar et al. (2017), the authors of AST critique this response, noting that there are differences in how the two papers construct instruments as well as two large concerns with the Kennedy et al. (2017) analysis: unexpected signs in the first-stage regressions that call in to question the validity of the instruments, and the fact that structural estimates of costs are nonsensical.

4.4. Instrumental Approaches to Common Ownership

Based on the above, the primary issues in empirical studies of common ownership using regression analysis are the two separate endogeneity problems: (a) the endogeneity of market shares, a component of $MHHI\Delta$; and (b) the endogeneity of ownership itself. Because much of this literature has grown out of finance and accounting rather than economics, the principal concern has been the latter. That is, the concern that investors may increase investments in both companies within an

industry because they expect softer competition or higher profits and prices in the future. This need is worsened by the fact that ownership patterns and therefore κ values are at the firm-quarter level, and so exploiting geographic variation in common ownership is not possible unless some firms do not operate in all markets.

Therefore, researchers would like to have instruments that affect the level of common ownership in a market without directly affecting prices (or whatever the object of interest it). One instrument that has been used in several papers to date is the 2009 acquisition of Barclays Global Investors by Blackrock (see, for example, Azar et al. (2018a)). This combined the $1.7 trillion in assets that Blackrock had been managing with the $1 trillion that Barclays had been managing, creating a much larger common owner, with arguably zero direct impact on, say, airfares. Therefore, this potentially creates variation in the time series of common ownership that can be used to analyze prices in a product market. Another instrument that has been used is the 2003 mutual fund scandal, which revealed that a large number of mutual funds had engaged in "late trading" and "market timing." In the months and years following this revelation, vast amounts of capital were withdrawn from the affected mutual funds. This created plausibly exogenous variation in common ownership, depending on how much of a firm was owned by the affected funds prior to the scandal (see, for example, Antón and Polk (2014)).

Liu (2019) explores variation induced by mergers of financial institutions on hospital prices. That paper looks at several such financial mergers as shocks to κ_{fg} and finds a positive relationship between $MHHI\Delta$ and hospital prices. However, they find that the Barclay's/Blackrock acquisition has a large and statistically significant effect on hospital prices between five and six years after it takes place. In a similar study Yegen (2019), uses Compustat data and looks at reported market shares across many industries. They find that the relationship between common ownership and market share is largely driven by portfolio rebalancing effects following financial mergers. This can be interpreted as evidence against either product market effects of common ownership or using financial mergers in an instrumental variable strategy.

An additional challenge is that concentration measures like MHHI vary at the market level while the theory of common ownership implies asymmetries in profit weights across firms within the same market. In Backus et al. (2020a), the authors study the ready-to-eat cereal market using a structural model and exploit the fact that Kellogg's has large, undiversified owners for historical reasons; separately, Post changed hands many times and was at different points in time included or excluded from the S&P 500; and Quaker is part of a much larger organization (Pepsi), which has implications for profit weights. They find that simple price-MHHI regressions lead to spurious findings (in particular, a negative coefficient when regressing price on $MHHI\Delta$ and controls, implying that common ownership *lowers* prices under the assumptions of earlier work), and that using a structural approach finds no support for the common ownership hypothesis in ready-to-eat cereal pricing. It should be noted, however, that the authors are able to quantify the magnitude of

the effect of "turning on" the common ownership hypothesis: they estimate that price effects from common ownership, if firms behaved according to the model, would be larger than those from any possible 4-to-3 merger in the industry. This implies that the common ownership incentives have the potential to be very large, even if firms do not seem to respond to them in that context.

These instruments for ownership are still much easier to come by than the other problem, which is the "endogeneity of share". Simply having exogenous variation in ownership κ_{fg} does not protect against the critique of Bresnahan (1989) that unobserved cost and demand shocks can cause changes in both prices and shares.

5. Simulated Example of Empirical Challenge

This section presents a simulation exercise to highlight the the challenge of testing the common ownership hypothesis in the MHHI framework. As is shown, if there are different preferences over products in different markets, the MHHI approach can easily lead to spurious results in either a positive or negative direction. We show this in a simple linear demand framework where the intercept of one product's demand curve varies across markets, spurious correlation exists between $MHHI\Delta$ and prices even when firms ignore common ownership incentives.

We begin with two single-product firms playing a static (Betrand) pricing game, where they ignore any common ownership. Suppose that the ownership structure of the two firms is as firms 2 and 3 in Example 1 from Table 1: 60 percent of each firm is held by small, undiversified retail investors. 20 percent of each is held, respectively, by two large, undiversified investors. The final 20 percent of each is held by a single, diversified investor. We will now relabel these firms as 1 and 2 (ignoring the private firm). As earlier, we would then compute $\kappa_{12} = \kappa_{21} = 0.5$, and $MHHI\Delta$ $= 2 \cdot 0.5 \cdot s_1(a_1)\, s_2(a_1)$.

Our question is, under this null hypothesis of own-profit maximization, can we nonetheless find (spurious) evidence for common ownership using the MHHI approach?

We specify demand for both products as linear and given by:

$$\begin{aligned} q_1 &= a_1 - \alpha_1 \cdot p_1 + \beta_1 \cdot p_2 \\ q_2 &= a_2 - \alpha_2 \cdot p_2 + \beta_2 \cdot p_1. \end{aligned}$$

We assume symmetric marginal costs of zero so that $mc_1 = mc_2 = 0$. Under the assumption of own-firm profit maximization, best replies are given by:

$$\begin{aligned} p_1(p_2) &= \frac{a_1 + \beta_1 \cdot p_2}{2\alpha_1} \\ p_2(p_1) &= \frac{a_2 + \beta_2 \cdot p_1}{2\alpha_2}, \end{aligned}$$

Solving these two equations, we get optimal prices of:

$$p_i = \frac{2a_i\alpha_j + \beta_i a_j}{4\alpha_i\alpha_j - \beta_i\beta_j}.$$

The panel regression: We now allow for cross-market variation in a_1, the demand intercept. This could be due to the relative popularity or quality of the good changing across markets. We set $(a_2, \alpha_1, \alpha_2, \beta_1, \beta_2) = (100, 1, 1, 0.5, 0.5)$ and parametrize each "market" by a different a_1 which we vary over $[80, 100]$ so that:

$$\begin{aligned} q_1 &= a_1 - p_1 + \frac{1}{2} \cdot p_2 \quad \text{for } a_1 \in [80, 100], \\ q_2 &= 100 - p_2 + \frac{1}{2} \cdot p_1. \end{aligned}$$

We can calculate the relevant regression objects $p_1^*(a_1), p_2^*(a_1)$ as well as $HHI(a_1)$. We show these in Figure 5, where we plot both prices and $MHHI\Delta$ as a function of the demand intercept a_1 holding all other quantities fixed.

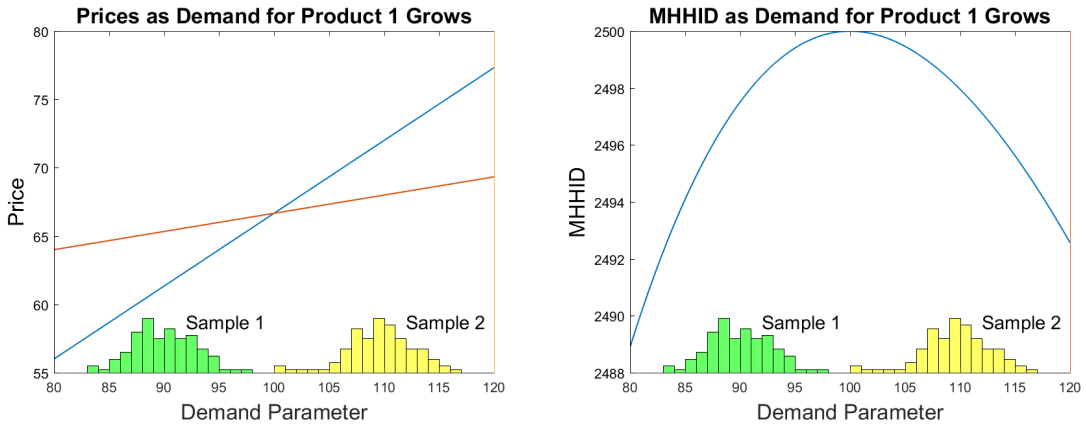


Figure 5: Analytic/Numerical Example: Varying Demand Intercept

Notes: This figure shows the equilibrium price and $MHHI\Delta$ for different demand intercept parameters.

For $a_1 < 100$ we find that there is a positive correlation between prices (p_1 in blue and p_2 in red) and $MHHI\Delta$, while for $a_1 > 100$ we find that there is a negative correlation between prices and $MHHI\Delta$. Therefore if the researcher observes sample 1, they will conclude that common ownership raises prices, and if they observe sample 2, they will find that common ownership lowers prices. Both results are spurious.[24]

[24]The clever observer will note that the expression for $MHHI\Delta$ here is log-linear, and so running the regression in logs would solve the problem. This is not generically true for $n > 2$ firms.

Instrumenting for common ownership: One response to the concern of the endogeneity of $MHHI\Delta$ has been to exploit the Blackrock-Barclays merger in 2010 and show that results are robust, quoting from the abstract of AST, which introduced this strategy, "even when we only use variation in ownership due to the combination of two large asset managers." The authors of AST instrument for $MHHI\Delta$ using the within-market variation alone, i.e. the change in $MHHI\Delta$ due to the merger. This addresses the endogeneity of ownership, but not that of market shares, and is still mis-specified if the true model is not Cournot.

An additional concern would be that variation in a_1 may be correlated with exposure to the Blackrock-Barclays merger, and so fail to clear the authors' own exogeneity hurdle. The following argument does not rely on such a claim.

Continuing with our example, suppose that that in the ownership structure of firms 2 and 3 in Table 1, the holdings of Investor 4 are the result of a merger of two symmetric investors. Therefore prior to the merger both investors held a 10% stake in both firms. This means that prior to the merger, we would compute $\kappa_{12} = \kappa_{21} = 1/3$. And so the differenced $MHHI\Delta$ (pre-merger minus post-merger) would be equal to: $2 \cdot (1/3 - 1/2) \cdot s_1(a_1)\, s_2(a_1)$.

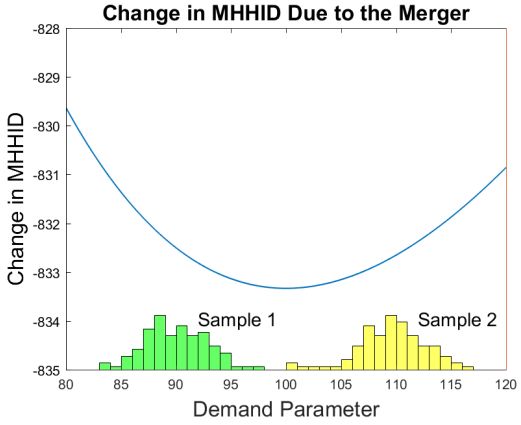


Figure 6: Analytic/Numerical Example: Merger of Investors

Notes: This figure shows the equilibrium change in $MHHI\Delta$ due to the hypothetical merger described in the text.

We plot this difference in Figure 6. What is immediately apparent is that the differencing exercise has not removed the endogenity of market shares. If the researcher observes sample 1, then in markets where there was a small increase in a_1, there would be a rise in prices and a decrease in $MHHI\Delta$. Therefore they would conclude that $MHHI\Delta$ and prices are negatively correlated. Alternatively, if the researcher observes sample 2, then in markets where there was an increase in a_1, there would be a rise in prices and a rise in $MHHI\Delta$, and they would conclude the opposite. The key insight is that the merger may have affected κ, but since the $MHHI\Delta$ measure interacts with market shares, the endogeneity problem remains. As a result, both results would again be spurious.

6. Different Approaches to Measuring the Effects of Common Ownership

Backus et al. (2020b) discuss different approaches to the measurement of common ownership, from purely descriptive approaches to approaches that specify a strategic game for firms. We will now survey different research designs throughout this literature.

6.1. Alternative Independent Variables

While the regression of prices on $MHHI\Delta$ is at least nominally motivated by theory (although requiring very strong assumptions), many papers have taken to regressing outcome variables such as price on different measures of common ownership ("right hand side" variables).

Gramlich and Grundl (2017) consider a similar analysis to ASR, also looking at retail banks, but focus primarily on certificates of deposit. They do not use $MHHI$ or $GHHI$ as a dependent variable. Instead their variable of interest is either $1 - \sum_g \kappa_{fg}$ (one minus the total weight a bank places on all rivals) and $\sum_g \kappa_{fg}$ (the sum of all incoming weight that rivals place on the bank). This has some advantages in that it does not involve market shares, and thus avoids the problems associated with regressions of prices on market shares. One disadvantage is that without market shares, it treats all rival banks within the county as equally close competitors. Their results are mixed. They find that as cross or common ownership increases, banks place more weight on rival profits. However, this is correlated with both lower yields on short term deposits (3 months) and higher yields on longer term deposits (6 and 12 months). They also find that as banks have higher κ_{fg} towards rivals, they have smaller market share, and as rivals have higher κ_{gf} towards them they have larger share. Taken together these results are mixed, and somewhat difficult to interpret as either evidence in favor of or against the common ownership hypothesis.

6.2. Alternative Dependent Variables

Another set of empirical papers have explored alternative outcomes measures ("left hand side" variables) and regressed these either on $MHHI\Delta$, or as in Section 6.1, alternative measures of common ownership. These papers are exploring outcomes other than price.

For instance, there are two recent papers that have studied the implications of common ownership in the pharmaceutical market, where considerations such as generic entry are an outcome of interest, as opposed to only price. This is a convenient market for study because it has well-defined product markets (molecules), and discrete opportunities for entry, e.g. the expiry of a patent and market exclusivity. Newham et al. (2018) exploits this latter discontinuity and studies entry choice of a generic drug manufacturer in the year and a half following the expiration of exclusivity, finding that common ownership between generic and branded incumbent manufacturers deters generic entry and results in 11-13% fewer generic entrants. This paper takes a reduced–form approach to the question instead of modeling the complex strategic entry game. The primary analysis is a regression of an indicator for a firm's choice to enter a generic market when a patent expires on

several different measures of common ownership. It is notable that this paper explores a new dependent regressor, while also showing results for a large set of independent regressors (i.e. different measures of common ownership).

Xie and Gerakos (2018) explores the role of common ownership in "pay–for–delay" settlements, wherein generic entrants extract rents for a promise to delay entry, preserving incumbent profits. They find that cross–holdings observed in the data can explain as much as a four percentage point increase in the likelihood of a settlement when a generic manufacturer has initiated a legal challenge to the patent.

Newham et al. (2018) notes the asymmetry that makes pharmaceuticals a particularly interesting setting: preventing entry is worth dramatically more to the branded manufacturer than the profits from entry of a generic, anticipating price competition and thin margins. Therefore, if it is feasible to protect the incumbent, the profit weights κ that implement this outcome need not be large. A limitation of both studies is the reduced–form implementation of the estimator — for instance, the linear probability model setup of Newham et al. (2018) implies that entry choices of generic manufacturers are independent, which is a strong assumption. The true model of how firms decide which generic markets to enter is complex (Scott Morton, 1999) as this is a strategic choice based on many factors, and the linear probability model is a reduced-form attempt to fit the true model. Nonetheless, this line of research is moving the literature forward, and highlights a promising environment for understanding the effects of common ownership, both in industry (pharmaceuticals) and in the strategic setting (entry and settlement choices).

Another interesting paper to explore both new independent and dependent regressors is Boller and Scott Morton (2020). In this paper, the authors exploit the fact that index inclusion events are a shock to common ownership and could be used to test for effects of common ownership. Of course, index inclusion for a particular firm is likely endogenous (beyond the specific timing), and so the innovation here is not to look at the firm that was added to the index, but to that firm's competitors who are already in the index. The authors therefore focus on stock returns of firms in the same industry as the firm that is added to the S&P 500 index. The idea is that if more common ownership does soften competition, then it should be seen in the share prices of competitors as share prices are thought to represent claims on future cash flows. The authors show that index exclusion events do indeed impact common ownership through raw institutional ownership levels as well as through κ measures. They then show that competitors of the firm added to the index see positive cumulative abnormal returns after the firm is added, consistent with the story above. Identification here is based on the specific timing of index inclusion events, which are generally "surprising," and a narrow window around inclusion for measuring effects. As a final exercise, they consider the many different measures of overlapping ownership that have been used in the data (including cosine similarity, Bray-Curtis, the "Capitalist Conspiracy" measure, measures of networks, and simple percentages of common blockholders within an industry) to see

what is correlated with the abnormal returns. They generally find significant correlations with κ and cosine similarity (which Backus et al. (2021) show is an element of κ), but not with the other measures.

6.3. Structural Analysis

The most recent approach to assessing the competitive effect of common ownership on prices is to estimate a full structural model and test competing conduct assumptions. A structural model is much more flexible than a linear regression framework, but is also much more demanding to estimate. A typical structural model of supply and demand in a product market today follows the contributions of Berry (1994) and Berry et al. (1995), and further developed by papers such as Berry et al. (2004) and Nevo (2000). The foundation is often a model of consumer demand, estimated using market share data, sometimes augmented by so-called "micro-moments" (Petrin, 2002), and combining this with a model of supply, where firms optimally set price given their cost structure. A key insight is that firms will choose prices differently under the common ownership hypothesis vis-a-vis the typical competitive Bertrand-Nash pricing approach. This potentially yields testable implications for the data.[25]

The advantage to the structural approach is that the model more closely resembles how we think product markets work: firms produce differentiated products and choose prices to maximize their objective function. The disadvantage is that – unlike a linear regression – estimation of such models is a complex endeavor.

Papers of this style include Backus et al. (2020a), where the authors exploit a) idiosyncratic variation in κ across firms, b) variation across geographies in consumer demographics, and c) variation across retailers in the assortments offered to study prices of ready-to-eat cereal. Their structural approach builds on the identification results of Berry and Haile (2014). The approach to conduct testing that they develop is quite simple, but it requires two arguments.

First, combining demand and a hypothesized model of conduct, they derive markups. Subtracting those markups from the observed price yields an estimate of marginal costs, for that hypothesized model of conduct. Second, they need instruments that are relevant to markups but independent of firms' marginal costs. Examples include demand-side variables such as demographic characteristics of the markets, as well as variables that measure product differentiation, such as the classic Berry et al. (1995) instruments.

Under the true model of conduct, these instruments will be, by construction, uncorrelated with the estimated marginal costs. But under a false model of conduct, since the markups will be incorrect, the estimate of marginal costs will be contaminated with mis-specification of the markups. And, since the instruments are relevant to markups, this means that the instruments

[25] Alternatively, one could estimate a conduct parameter to see to what degree firms internalize these incentives. Examples of this approach include Kennedy et al. (2017) and Park and Seo (2019) who both examine airlines but arrive at different conclusions.

will be correlated with the estimated marginal costs. Detecting this correlation is the basis of the test. They implement this approach in a Rivers and Vuong (2002) testing framework, and take particular care to exploit the nonlinear relationship between the instruments and markups, building on techniques developed to approximate the infeasible optimal instruments in demand estimation. Their results, across a variety of different sets of instruments, consistently favor own-firm profit maximization.

7. Mechanisms

An almost universal reaction to much of the research on common ownership is to ask *how* could this actually happen? Many fund managers say that they are passive investors and so they cannot be exerting influence over firms. One particular "straw man" argument made by some in the industry is that passive investors are by definition not interested in affecting management of the firms they hold shares in. A recent working paper (Shekita, 2020) documents 30 cases of common owners of competing firms exerting influence in one way or another with their portfolio firms. While this alone is not evidence of any common ownership effects, this anecdotal evidence is useful both to understand the channels through which these incentives may be passed, but also to highlight potential avenues of future research on this question.

7.1. Financial Incentives and Effort

A first criticism against the common ownership hypothesis is why an investment management firm would want this to occur. Lewellen and Lewellen (2017) directly investigates the financial motive of investment managers to engage with their portfolio constituents. The authors show that even small increases in portfolio value generate significant increases in management fees for managers. Thus, they argue an incentive exists to engage in any activity that increases the value of firms in a portfolio. A possible exception is for true index funds, which are required contractually to limit tracking error and thus are constrained in investment decisions.

A second criticism was that a large missing element of the literature is how would this effect actually occur between investors and firms. Antón et al. (2020) examines how executive compensation may be affected in a world of common ownership as a link between common ownership and actual product markets. In particular, they first develop a theory model of incentive design where managers choose how much effort to exert, and effort results in lower marginal costs. The model predicts that common ownership can result in higher prices through this incentive channel, and further that there may be cross-market differences in prices as well. They gather data on common ownership and on the "Wealth-Performance Sensitivity" (WPS) measure of Edmans et al. (2009) as a proxy for the unobserved internal firm incentives. Their empirical approach exploits index inclusion events, where a firm is added to a major index and experiences a surge in common ownership. They find that for firms who compete with an index entrant, WPS decreases, consistent

with their theory model.

While the above paper is about unilateral incentives, this outcome may relate to a wider literature on tacit collusion. A recent paper (Aryal et al. (2018)) noted outside of the context of common ownership how airlines may use earnings calls to signal cooperation through "capacity discipline".

Finally, there is the question of whether shareholder votes are a channel through which this effect may take place. He et al. (2017) study proxy voting by institutional investors and finds that diversified investors are more likely to vote against management. They conclude from this that diversified investors internalize corporate governance externalities, improving overall corporate governance.

7.2. Corporate Governance and Incentives

The model of common ownership, that firms maximize a γ-weighted sum of investors portfolios, given by β, is implicitly a model of corporate governance. Why exactly do firms care more about larger shareholders? If they have more voting power, how does that translate into effects on firm decision-making?

The literature has followed Rotemberg (1984) in assuming $\gamma_{sf} = \beta_{sf}$, for two reasons: first, for empirical tractability. As we discuss below, data on large institutional investors' shareholdings are publicly available. But second, there is little guidance from the corporate governance literature on how to best model γ. As an alternative, one could use Banzhaf power, a model of voting power borrowed from the political science literature.[26] Alternatively (and in a different context), Crawford et al. (2018) propose that firms with higher $\sum_f \beta_{sf}$ be given less weight γ_{sf}. In Backus et al. (2021), they follow Rotemberg (1984) in setting $\gamma_{fg} = \beta_{fg}$, but also show the sensitivity of their results from allowing γ to be a flexible function of β, which nests models of the world where larger shareholders are both over- and under-weighted in a firm's objective function. However, this is an area where new research in the corporate finance literature could yield great progress, and more work in this area is needed going forward. Beyond intuitive qualitative features – e.g., γ_{sf} ought to be monotone in β_{sf} – any parametric form seems arbitrary. In the presence of common ownership effects, though, we note that these forms may be empirically testable.[27]

Whatever the functional form, an oft-raised objection to the common ownership hypothesis concerns the conflation of ownership and management of assets. Large asset managers such as Blackrock and Vanguard work on behalf of their clients, who are the ultimate owners. Do they have a financial incentive to affect the coordination implied by common ownership? The common

[26] A voter's Banzhaf power is proportional to the number of winning coalitions in which they are a swing voter Banzhaf (1965). It is computed by first determining the set of all winning coalitions of voters. For each winning coalition, pivotal voters are identified. The Banzhaf power for a voter is the number of cases where that voter is found to be pivotal, divided by the total number of pivotal votes.

[27] For example, the common ownership weights κ_{fg} described above are very sensitive to increasing concentration among asset managers and increasing scale. In contrast, the weights proposed by Crawford et al. (2018) normalize out investor scale, and emphasize portfolio composition.

ownership profit weights κ assume that they do. While some work has endeavored to directly quantify their financial incentives to maximize the value of the assets they manage, a more direct reply is to perhaps take them at their word when they claim to represent the best interests of their clients. Moreover, there is extensive empirical evidence (see Brav et al. (2018), Gilje et al. (2020)) suggesting that they are, in fact, active in corporate governance. Whether their incentives are strong enough – or whether they take that fiduciary duty seriously enough – to want to soften competition in product markets is a difficult question with little direct empirical traction. Still less is known about the feasibility and costs of conveying such intentions to management. For this reason we believe that the debate ought to focus on the directly testable empirical predictions for economic outcomes – e.g. prices – in specific markets.

8. Survey of Recent Topics in Common Ownership

The model in Section 1 is consistent with the most controversial claims of prior work, that common ownership creates incentives for firms to set higher prices. However, firms do much more than set prices. They make R&D choices, they engage in vertical contracting, and participate in a plethora of other activities for which it is not obvious that common ownership is a threat. Indeed, it may be efficiency-enhancing. For example, if common ownership arises between two vertically-oriented firms such as a retailer and a supplier, then common ownership may help to mitigate double marginalization (although it is worth noting that if such concerns were large, firms in such situations have better tools to align incentives, such as contracts). Alternatively, López and Vives (2019) show that the welfare implications of common ownership are ambiguous in the setting of R&D spillovers. The point being that while the literature has been focused on price-setting (and perhaps reasonably so, given the potential antitrust implications), there are other games in which the welfare effects of common ownership are not decisively negative.

This observation raises an important empirical point for future work. It may be that as the literature unfolds, the clearest evidence on common ownership will come not from pricing games, but from models of entry, product positioning, R&D, or other strategic interactions. Modeling these other implications will generate many additional testable empirical implications for the theory, and is an open area for research.

While the majority of the early literature focuses on prices, a number of more recent papers have suggested alternative manifestations of the common ownership hypothesis. For example, Antón et al. (2018) examines an upside of common ownership: the potential for greater R&D incentives. The paper gathers a few different measures of patents as well as R&D expenses and models them as a function of common ownership. Theory makes ambiguous predictions as technological spillovers would be a benefit if firms take rival profits into account when making R&D decisions. However, if innovation simply leads to business-stealing, then the common owners would not want it. Empirically, the authors show a positive correlation between common ownership and

both inputs and outputs of R&D in a series of panel regressions with two-way fixed effects.

8.1. New Applications in Finance

Two recent working papers examine common ownership through the lens of Venture Capital (VC), where firms invest in multiple early-stage firms. While most of the common ownership literature has focused on ownership through public markets, VC firms may actually align incentives of competing firms through private markets. A first paper, Eldar et al. (2020), exploits the availability of "corporate opportunity waivers," which exempt directors from the risk of litigation from advising multiple firms at the same time. They show that common ownership leads to more director overlap at startup firms with these waivers in place, a plausible mechanism for how common ownership incentives could be transmitted. The authors perform a difference-in-differences analysis using the staggered introduction of such waivers in different states, and find that common ownership of startups by VC firms means that these firms are able to raise more capital, are more likely to survive, and have better outcomes. The second paper, Li et al. (2020), specifically examines pharmaceutical startups. They group projects by narrow drug categories and examine whether or not the presence of common owners decreases a firm's decision to proceed with development if a rival has a successful Phase I clinical trial. They find limited evidence that this is the case: this occurs in concentrated product markets and for particular types of products. The results have ambiguous welfare consequences, as a social planner would very much like to eliminate duplicative research spending, but would also like to see robust product market competition.

Even before the recent surge of empirical interest in common ownership, the common ownership hypothesis was proposed to reconcile the following puzzle in finance. It is known that on the announcement of a merger, the target firms' share value typically increases, and the acquirer's share value decreases. Why would the acquirer's shareholders permit such value-destroying behavior? Matvos and Ostrovsky (2008) contend that it is because many of the acquirers shareholders are also shareholders of the target, and therefore internalize the gains in the latter's share value. A particular appeal of this line of work is that the mechanisms are more transparent than in the case of product-market effects of common ownership — that it can be documented in shareholder voting. The paper does exactly that, finding that such shareholders with stakes in both the target and the acquirer are more likely to vote in support of the merger.

This application of the theory is an example of what Backus et al. (2021) refer to as an example of "tunneling," the transfer of profits from one firm to another where the former puts a profit weight (κ) greater than one on the latter. Unlike the theoretical effects of common ownership on pricing, which tend to benefit common owners and undiversified investors alike, such tunneling explicitly harms the share value undiversified investors in the acquiring firm.

Subsequent debate concerning the Matvos and Ostrovsky (2008) hypothesis has raised concern that the gains in the share value of the target firm may not fully offset the losses in the share value

of the acquirer (Harford et al., 2011). Anton et al. (2020) point out that this is an incomplete accounting; if there are product-market effects of the merger, which may or may not be amplified by common ownership, then common owners' holdings in rival firms will also help to offset the losses in acquirers' share value. Plugging cumulative abnormal returns into the objective function implied by common ownership, i.e. allowing the firm to place positive weight on the share price of rivals, they find positive returns for the acquirer, and also document a positive correlation between holdings in rivals and voting in support of the merger. Here, as in the original work by Matvos and Ostrovsky (2008), the analysis is descriptive.

8.2. Summary of Papers

Tables 3 and 4 provide a high level summary of a number of different papers regarding common ownership.

9. Conclusions

We find that while the existing correlations explored in this growing literature are provocative and important, the methods and measures used to date make it difficult to draw clear conclusions. We believe that these early contributions are the beginning of a literature rather than the end, and that before major policy measures can be enacted we need first to test these hypotheses in more settings, using modern methods; and second, to better understand the mechanisms by which such effects are generated. Our criticisms of this literature mirror those made by empirical IO economists of the literature on prices and concentration indices. However, this also guides our thinking for new directions – just as merger analysis moved from concentration indices to careful modeling of demand and pricing, these same tools can be applied to the analysis of common ownership. In Backus et al. (2020a) we take a step in this direction and offer new tools for testing conduct, however we believe that there is room for more work in this area.

9.1. Research Must Use Sound Empirical Methods

We need good sources of variation in firm incentives from overlapping ownership in order to study potential effects. Financial market transactions are a promising source of exogenous variation, as under a null hypothesis of no common ownership effect they should be irrelevant to product markets, while if common ownership incentives are being transmitted to firms, there often should be product market effects. However, while this may help address the endogeneity of ownership patterns, it is not a silver bullet for the simultaneity problem of approaches based on measures such as $MHHI$.

9.2. Research Should Spread to More Empirical Settings

A number of new studies in different industries would help identify whether common ownership effects are indeed systematic. The theory suggests that seemingly unimportant events such as privatizations should generate noticeable effects in product markets; this is plainly testable. However, there is also a great need for more research on the corporate governance and "mechanism" issues around how such incentives could be transmitted to managers.

A number of mechanisms have been proposed, with much attention being paid to executive compensation (see Antón et al. (2020)). Other potential mechanisms involve direct communication between investors and managers on capacity (Aryal et al. (2018)) or investment decisions. Another potential mechanism is through corporate governance actions. Common owners may be more likely to side with management against activist investors, or to oppose management strategies which lead to stronger competition within the industry. Large common owners may also seek to shape the agenda for voting at annual meetings.

9.3. Data Deficiencies Must be Corrected

Above all, more data need to be made available to researchers to spur more analysis of this topic. A recent proposal in front of the Securities and Exchange Commission (SEC) would increase the threshold for reporting of securities by institutional investors from its current level of $\$100M$ of assets under management to $\$3.5B$.[28] This would effectively end research into common ownership as holdings would for the most part not be observable. Furthermore, the quality of 13F filings could be improved as there are numerous documented cases of mistakes in filings and in commercial databases of the filings (see Appendix A.1 for more details). Researchers can only conduct rigorous research if they have quality data sources.

[28]SEC Press Release 2020-152, "SEC Proposes Amendments to Update Form 13F for Institutional Investment Managers; Amend Reporting Threshold to Reflect Today's Equities Markets."

Appendices

A. Data and Measurement Challenges

This section describes the different data sources available to study the common ownership hypothesis and discusses some associated challenges. If one is interested in studying common ownership, one would ideally be able to know the complete set of shareholders at a given point in time for the set of firms being studied. The reality of data availability is far from ideal: large asset managers report holdings of US securities as of the last day of each quarter with a 45-day delay, and those reports themselves often contain errors. Below we discuss a number of challenges in studying common ownership.

A.1. Data on Common Ownership

Data on holdings of large investors come from multiple original sources and are also aggregated and distributed by third-party data firms. In particular, institutional investment managers that manage over $100 million in "Section 13(f)" securities, which are defined by the SEC, must file a form 13(f) with the SEC on a quarterly basis to report their holdings. These reports include the CUSIP (Committee on Uniform Security Identification Procedures) number for each security held, which can be used to interface these data with other datasets. This is the primary source of data used in assessing common ownership. In addition, mutual funds must report their holdings on a semi-annual basis at the individual fund level using form N-30D. All of these filings are available on the SEC's EDGAR platform going back to 1999, when electronic filing became mandatory; Thomson Reuters makes these data available going back to 1980 in different commercial datasets such as the so-called "S34" dataset, which is available to researchers through platforms such as Wharton Research Data Services (WRDS).

Ancillary datasets are often used in conjunction with the Thomson Reuters dataset. A first is from CRSP, the Center for Research in Securities Prices, which contains data on share prices as well as the number of shares outstanding, and is indexed by what is called a `PERMNO` for each security. CRSP also maintains lists of stock market index composition for a large set of indices. WRDS created a crosswalk from `CUSIP` codes to `PERMNO` codes. A second dataset often linked to the Thomson Reuters data is Compustat, which can be searched by `CUSIP` or their own proprietary `GVKEY` variable, and contains firm filings accounting data.

A.2. Data Challenges

There have been a number of data quality concerns relating to the Thomson Reuters 13(f) dataset (the S34 dataset) dating back to 2010. The dataset is commonly accessed through the WRDS platform, and WRDS has been active in trying to correct for a number of the data quality issues. Ben-David et al. (2018) identified a number of additional data quality issues with the Thomson

Reuters dataset. As of July 2018, WRDS has addressed a number of the concerns raised and produced an updated version of the S34 dataset.[29] However, some issues with the data relate to how they should be interpreted in light of the theory above, while other issues are strictly errata that must be corrected for. Below, we discuss various data issues and whether or not they have been addressed in the WRDS July 2018 update.

Short positions One oddity in the data is that on occasion, more than 100% of a firm's outstanding shares as reported by CRSP are reported as owned in the 13(f) filings for that quarter. One explanation is double-counting of shares due to short-selling: if investment firm A lends out shares to investor B, who then sells those shares to investor C to create a short position, both A and C may report owning the shares. Data on aggregate short positions is available via Compustat, but the actual identity of short sellers is unknown, making this a problem that is relatively easy to diagnose but almost impossible to correct. From a theoretical standpoint, only one agent per share should be able to exercise any control over the target firm at any point in time, and so this potential double-counting introduces some error into common ownership analyses. Christoffersen et al. (2007) investigate "vote trading" as an activist investor strategy, where shares are borrowed to exercise control at low cost, and find that "double voting" of lent shares is a pervasive phenomenon. The WRDS dataset presents holdings as reported and so makes no correction for possible double-counting. Lewellen (2011) finds that shares reported exceeding shares outstanding to be a rare occurrence and of a small magnitude. Ben-David et al. (2018) recommends updating the shares outstanding variable in the S34 dataset to be the values found in CRSP whenever the two disagree.

Dual-class Shares Many publicly traded firms have multiple classes of shares with different levels of voting control. From a data reporting standpoint, this is not a concern, as the securities have different CUSIP designations. However, the theory models above effectively assume one vote per share. To the extent that this is not the case, then any implied profit weights are incorrect. In principle, when studying a particular setting, one could explicitly adjust for dual-class shares using the γ term. In practice, and in the descriptive exercise below, dual-class firms are removed from the sample. It should be noted that as with the retail investor share discussed below, different approaches to dual-class shares make very different predictions about profit weights under different models of common ownership.

Thomson Reuters S34 dataset WRDS and Thomson Reuters began to notice data irregularities in the S34 dataset in 2010. In addition, Ben-David et al. (2018) noted additional data issues, such as Blackrock disappearing from the dataset in 2014 and re-appearing with far too low a level

[29] In particular, 13(f) filings were mandated to be in an XML format staring in the third quarter of 2013, and WRDS has parsed these filings to guarantee accuracy of the Thomson Reuters dataset.

of assets in 2015. A collaboration between those authors, WRDS, and Thomson Reuters resulted in an updated dataset as of July 2018 that is believed to address a large number of the concerns raised. WRDS has released a document detailing the fixes.[30]

Retail and other small investors Given the reporting requirements for institutional investors features a specific cutoff for assets under management, the holdings of firms managing less than $100 million are not reported. Individual investors need not necessarily report holdings, although in many cases individual investors employ large investment management firms to manage their portfolio and so those holdings are reported by those investment managers. To the extent that an individual has large holdings at multiple investment management firms, the data will not necessarily reflect the "common" element of those holdings. From a theoretical point of view, this creates an additional problem: suppose we observe the ownership of 60% of a firm's common shares in the S34 dataset. The remaining 40% is held by diffuse investors about whom we know nothing. One assumption might be that these shares are held by atomistic investors, and so would each have $\beta_s = 1/N$, where N is shares outstanding. Another assumption might be that these investors are all undiversified and act in lock step, and so should be considered as one representative agent with $\beta_s = 0.4$. Both of these approaches could be justified, but would result in very different profit weights.

Insider Holdings The SEC requires "insiders" to make additional disclosures regarding holdings of a firm (forms 3, 4 and 5). An insider is defined as an officer, a director, or anyone owning 10% or more of a firm's shares. Researchers investigating a particular set of firms should investigate any insider holdings information to see if the holdings are being reported by a larger custodial institution. For example, Backus et al. (2020a) show that the Kellogg Foundation held a major stake in Kellogg's, but that the foundation's shares were reported in Bank of New York's 13(f) filings in many quarters. The foundation itself is not diversified and so this reporting mixed the holdings of an undiversified owner (the Kellogg Foundation) with the holdings of their diversified bank (Bank of New York).

Foreign firms Institutional investors do not need to report holdings in any firms that do not trade in US markets. Therefore, if a foreign firm competes in the US but does not trade on a US market, there is no data available on institutional ownership. We note, however, that foreign institutional investors are required to comply with the same laws as domestic investors, and so must file form 13(f) every quarter that they control more than $100M in US securities.

[30] S12/S34 Regenerated Data, accessed at `https://wrds-www.wharton.upenn.edu/documents/952/S12_and_S34_Regenerated_Data_2010-2016.pdf`

Aggregation One final point raised by Ben-David et al. (2018) and not yet addressed by WRDS is that there may be multiple entities reporting in the S34 dataset that are actually subsidiaries of one large entity. To make a simple example, in the final quarter of 2016, the following entities report holdings separately: "BLACKROCK INC," "BLACKROCK ADVISORS, LLC," "BLACKROCK ASSET MGMT IRELAND," "BLACKROCK INVESTMENT MGMT, LLC," "BLACKROCK JAPAN CO., LTD.," and "BLACKROCK INVT MGMT (UK) LTD." (each under a unique "mgrno" in the S34 dataset). If the control rights of these entities are coordinated, then one would want to consolidate them into one entity before computing profit weights. While this has not been addressed by WRDS, it is not difficult for an applied researcher to consolidate these entities.

Source Documents Finally, some researchers have noted that the source documents themselves – Form 13(f) filings made by institutional investors – contain errors. In particular, Anderson and Brockman (2018) document irregularities and caution the use of 13(f) filings in research or in investing. The authors of this current paper noticed when examining ownership of airlines that many filings contained errors around bankruptcy events. There are also many amendments to 13(f) forms, often filed months or years after the initial filing to correct errors. The SEC's Inspector General in 2010 noted several issues with how 13(f) filings are handled, see U.S. Securities and Exchange Commission Office of Inspector General (2010). As a result of the SEC IG report, the SEC changed how firms were to report their 13(f) holdings, moving to an XML-based format in 2013. This had the very positive effect of standardizing all 13(f) filings, which prior to 2013 exhibited wildly differing text formatting. This emphasizes the importance of manual data-cleaning when studying common ownership in particular industries.

Alternative Data Sources Due to the irregularities in the Thomson Reuters dataset, particularly around 2011-2013, the authors in (Backus et al., 2021) gather all original 13(f) filings from the SEC starting in 1999 (the era of mandatory electronic filing) and parse them to obtain holdings for S&P 500 firms.[31] The authors show examples where major firms are only reported to have a few institutional holders in the Thomson Reuters dataset in some quarters but in fact have many holders in the raw 13(f) filings. Some examples of the poor S34 coverage relative to the alternative dataset gathered by those authors are in the following section.

A.3. Descriptive Data

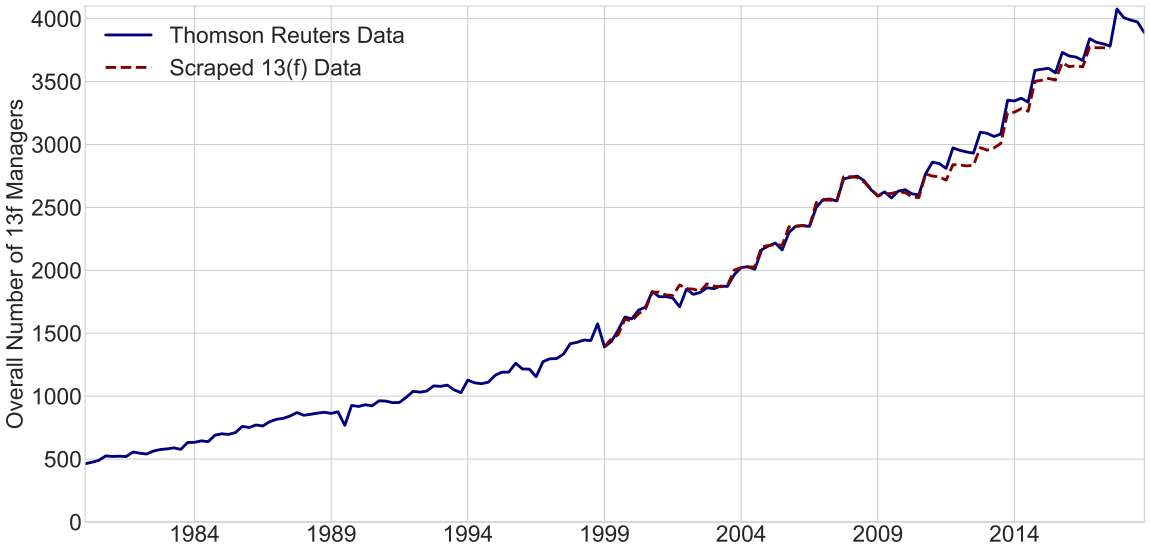
While there have been a number of analyses and rebuttals regarding the common ownership hypothesis, it is undeniable that a few large investment management firms have amassed large, diversified portfolios of all major publicly-traded firms over the past few decades through their mutual funds or exchange-traded funds. Below, we document some basic facts contained in the S34 dataset and

[31]The authors make the profit weights available for the firms they study and are happy to provide code to researchers interested in studying different firms.

our own novel dataset of 13(f) holdings about ownership of firms listed in the S&P 500 Index. It should be noted that descriptives based on 13(f) data require no market definition. While one firm may have an implied profit weight for another, if the two firms do not compete in a product market, it is unlikely that there would be any effect from common ownership. After examining the economy as a whole, we will pick some specific product markets to examine. We have made some data corrections to the dataset to, for example, consolidate all "BLACKROCK" entities, as well as consolidate all "STATE STR" entities.

As a starting point, Figure 7 shows the number of 13(f) managers reporting over time.[32] The number of such managers has greatly increased, and at least part of the increase is due to the nominal reporting barrier of $100M. One dollar in 1980 is worth approximately $3.24 in 2018, and yet the number of 13(f) investment managers has more than quintupled in that time. This suggests both substantial entry into the investment management space, and more diffuse management of investments over time.

Figure 7: Number of 13(f) Managers



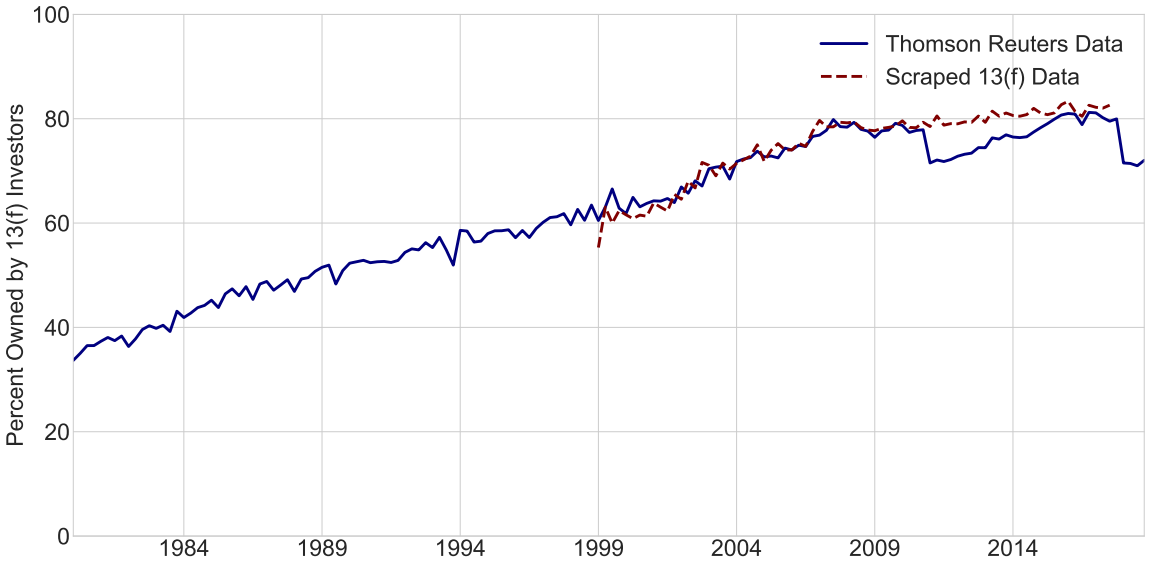
Notes: This figure depicts the number of 13(f) managers in the S34 dataset and in the authors' scraped and parsed dataset.[Source: Backus et al. (2021)]

In total, institutional ownership of the S&P 500 has grown tremendously over time. Figure 8 shows that institutional investors report ownership of approximately 80% of the outstanding shares, up from roughly 40% in the 1980s.

One concern about looking at the S&P 500 as a whole is that many of the firms are operating in separate markets, and so common ownership is unlikely to affect strategic decisions. For example,

[32] As a reminder, a 13(f) manager is a legal definition by the SEC. The relevant part of the definition is that the firm manages over $100M of securities.

Figure 8: Share of S&P 500 Ownership Over Time



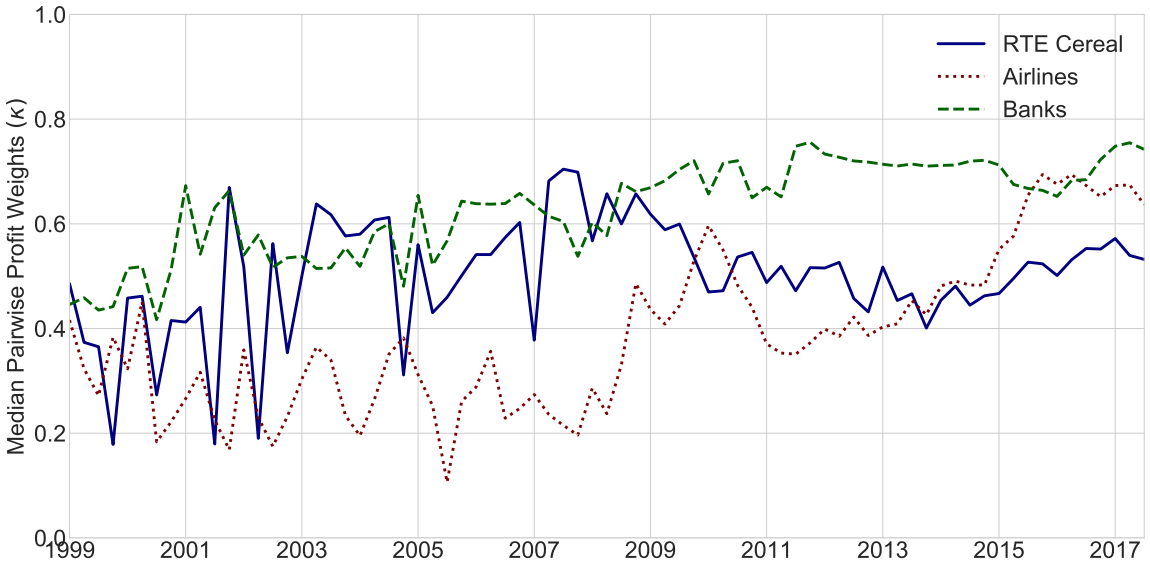
Notes: This figure depicts the sum of the holdings of investors in our dataset in a representative firm or, equivalently, what we are calling the institutional share of ownership. [Source: Backus et al. (2021)]

even if a pharmaceutical company and an airline share a large investor, since their decisions are unlikely to affect each other's profit, there is no change in incentives from common ownership. To address this, Figure 9 shows institutional ownership in three specific sectors: ready-to-eat cereal, airlines, and commercial banks. We hand-collect data on firms for the first two product markets and use the Compustat SIC code to classify commercial banks in the S&P 500 by their SIC code of 6021.[33] As can be seen, the overall trends in these specific product markets are similar, with large shares being accumulated by investment management firms over time. When looking at specific industries, larger swings in holdings are visible due to mergers, bankruptcies, entry, etc.

Finally, to highlight the data challenges with the Thomson Reuters S34 database, Figure 10 shows data for three S&P 500 securities around the 2011 window where the S34 dataset appears to have deficiencies. The plot shows, in solid color lines, the percent of shares outstanding reported to be held by 13(f) managers for three major firms: Alcoa, Xerox, and Coach in the S34 dataset. The solid lines show that prior 2011, 13(f) investment firms held between 60% and 90% of these firms. However, in 2011, that falls dramatically to under 10%, before reverting back in 2013 for one of the three firms. In dashed lines are the percent of shares outstanding found in our scraped and parsed dataset. The scraped data present a reasonable time series for institutional ownership of an S&P 500 firm.

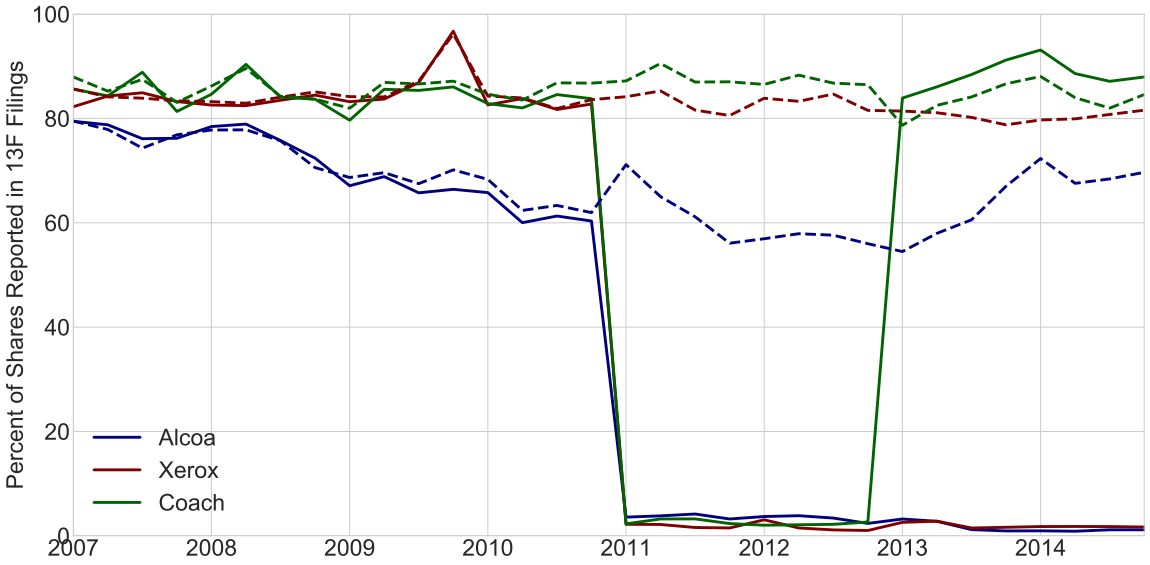
[33]This calculation therefore excludes privately held banks and credit unions that are likely to be narrowly held and thus overstate the overall common ownership effect for the banking sector.

Figure 9: Institutional Ownership of Firms Within Product Markets



Notes: This figure depicts the sum of the holdings of investors in our dataset in a representative firm or, equivalently, what we are calling the institutional share of ownership for airlines (left), and banks (right). [Source: Backus et al. (2021)]

Figure 10: Examples of S34 Coverage Issues



Notes: This figure sums the holdings of all 13(f) managers for three firms: Alcoa (permno: 24643, CUSIP: 03965L10), Xerox (permno: 27983, CUSIP: 98412110), and Coach (permno: 88661, CUSIP: 87603010). S34 data series are plotted solid lines, the authors' scraped and parsed data in dashed lines. [Source: Backus et al. (2021)]

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Table 3: Empirical investigations of the Common Ownership Hypothesis

Paper	Context	Instrument	Outcome Variable	Effect of CO	CO Harms Competition?
Initial Evidence					
Azar (2011)	Public Firms	None	Markups	Positive	Yes
Azar et al. (2016)	Banks	Cross-Section Variation	Fees, Interest Rates	Positive	Yes
Azar et al. (2018a)	Airlines	Blackrock-Barclays Merger	Fares	Positive	Yes
Cici et al. (2015)	Syndicated Loans	Discontinuity in Holdings	Transaction Likelihood	Positive	Yes
Freeman (2019)	Compustat Supply Chain	Mutual Fund Scandal	Relationship Ending	Negative	Yes
He and Huang (2017)	Public Firms	Bank Mergers	SIC Market Share	Positive	Yes
Responses, Replies					
Kennedy et al. (2017)	Airlines	Blackrock-Barclays, Russell 1000	Prices	No Effect	No
Dennis et al. (2019)	Airlines	Airport Market Shares	Prices	No Effect	No
Azar et al. (2018b)	Airlines	(Reply to Dennis et al. (2019))	-	-	-
Azar et al. (2017)	Airlines	(Reply to Kennedy et al. (2017))	-	-	-
Other Manifestations					
Antón et al. (2020)	Managerial Incentives	Blackrock-Barclays	Manager Wealth	Steeper	Yes
Antón et al. (2018)	Innovation	None	Patents	Positive	No
Newham et al. (2018)	Generic Drug Entry	Patent Timing	Entry	Negative	Yes

Table 4: Discussions, Criticisms, Recommendations of the Common Ownership Hypothesis

Paper	Context	Notes
Documentation		
Backus et al. (2021)	S&P 500	Document Rise of Profit Weights 1980–2017
Seldeslachts et al. (2017)	German Companies	Document increases in Common Ownership
Criticisms and Alternative Approaches		
Gramlich and Grundl (2017)	Banks	Suggest profit weight instead of MHHI.
O'Brien (2017)	Theory	No rationale for regressions of prices on any measure of concentration.
Schmalz (2017)	Theory	Compares industry talking points to data.
Gilje et al. (2018)	Mechanism	Derives alternative measure of CO effect from inattention.
Lewellen and Lewellen (2017)	Management Fees	Shows that investment managers have incentives to reduce competition.
López and Vives (2019)	Theory	Shows that common owners may incentivize innovation.
Backus et al. (2020a)	Methods	Structural testing for CO effect in cereal market.
Policy Recommendations		
Scott Morton and Hovenkamp (2018)	Policy	Current antitrust laws would allow enforcement action.
Posner et al. (2017)	Policy	Proposes restrictions for institutional investors
Patel (2018)	Policy	Argues for case-by-case analysis.