Common Ownership, Competition, and Top Management Incentives*

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Abstract

We present a mechanism based on managerial incentives through which common ownership affects product market outcomes. Firm-level variation in common ownership causes variation in managerial incentives and productivity *across firms*, which leads to *intra-industry* and *intra-firm cross-market* variation in prices, output, markups, and market shares that is consistent with empirical evidence. The organizational structure of multiproduct firms and the passivity of common owners determine whether higher prices under common ownership result from higher costs or from higher markups. Using panel regressions and a difference-in-differences design we document that managerial incentives are less performance-sensitive in firms with more common ownership.

JEL Classification: M12, L13, J33, G32, D21, L21

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"... areas of research that I, as an antitrust enforcer, would like to see developed before shifting policy on common ownership [are]: Whether a clear mechanism of harm can be identified ..."
—FTC Commissioner Noah J. Phillips, FTC Hearing on Common Ownership, December 6, 2018

"The organizational complexity of today's largest public companies makes it far from clear how—even if top managers receive an anticompetitive signal from their pay packages—those incentives affect those making pricing decisions throughout the organization. [...] For these reasons, I worry that the evidence we have today may not carry the heavy burden that, as a Commissioner sworn to protect investors, I would require to impose costly limitations."
—SEC Commissioner Robert J. Jackson, FTC Hearing on Common Ownership, December 6, 2018

1 Introduction

The common ownership hypothesis suggests that when large investors own shares in more than one firm within the same industry, those firms may have reduced incentives to compete. Firms can soften competition by producing fewer units, raising prices, reducing investment, innovating less, or limiting entry into new markets. Empirical contributions document the growing importance of common ownership and provide evidence to support the theory.[1] Prominent antitrust law scholars (Elhauge, 2016; Scott Morton and Hovenkamp, 2017; Hemphill and Kahan, 2020) claim that common ownership "has stimulated a major rethinking of antitrust enforcement." The Department of Justice, the Federal Trade Commission, the European Commission, and the OECD have all acknowledged concerns about the anticompetitive effects of common ownership and have even relied on the theory and evidence of common ownership in major merger cases.[2]

However, top managers (rather than investors) control firms, firms have hierarchical structures in which operational decisions are delegated to middle managers, and managers may not know the extent of their main investors' shareholdings in other firms. Therefore, skepticism that common ownership affects product market outcomes may be warranted given the lack of a clear mechanism

[1]Comprehensive surveys by Backus et al. (2019) and Schmalz (2018, 2021) summarize theoretical contributions and empirical studies providing market-, industry-level, and economy-wide evidence of the rise of common ownership and its economic effects.

[2]Solomon (2016) reported on an investigation based on Senate testimony by the head of the Antitrust Division, the Federal Trade Commission (2018) featured a hearing on common ownership, and Vestager (2018) disclosed that the Commission is "looking carefully" at common ownership given indications of its increase and potential for anticompetitive effects. For other recent activity, see OECD (2017) and European Competition Commission (2017).

that recognizes these agency problems and informational constraints. This has fueled a vigorous debate about whether existing evidence on common ownership has a plausible causal interpretation and, if it does, how to effectively address the resulting regulatory, legal, antitrust, and corporate governance challenges.

In this paper we show that managerial incentives can serve as a mechanism that connects common ownership to softer competition. Our mechanism requires neither communication/coordination between shareholders, managers, or firms nor market-level interventions by shareholders or even top managers. The predictions help organize a large set of existing empirical evidence of how prices, quantities, costs, markups, concentration, and governance choices depend on common ownership that thus far lacks a theoretical explanation. In contrast, common ownership mechanisms that require active common owner interventions and assume away agency problems and delegation within organizations generate predictions that are at odds with the empirical evidence. We document robust empirical support for the central (and previously untested) prediction that higher firm-level common ownership leads to less performance-sensitive incentives for CEOs. We show that common ownership is a first-order determinant of managerial incentives using panel regressions. We address identification challenges related to the endogeneity of ownership with a difference-in-differences design based on competitor index inclusions.

We begin our analysis by embedding a canonical managerial incentive design problem with moral hazard (Holmstrom and Milgrom, 1987) in a conventional model of strategic product market competition (D'Aspremont and Jacquemin, 1988; Kamien et al., 1992; Raith, 2003) with potentially diversified owners (Rotemberg, 1984). Our unified model captures the agency conflicts that exist between those who manage firms (top managers) and those who own them (investors), features organizational hierarchies (top and middle managers) with delegated decision-making, and reflects the common setting where large investors hold ownership stakes in several firms in the same industry. The central driving force is that performance-sensitive managerial compensation encourages productivity-improving managerial effort, which in turn has two effects. First, in a setting where product prices are fixed, productivity-improving managerial effort increases firm profitability and is desirable for all types of owners. Second, with endogenous product prices, productivity enhancements also cause firms to set lower prices which reduces the profitability of competing firms and goes against the interests of common owners. Common owners are therefore more willing to tolerate managerial slack and productive inefficiency at their portfolio firms. The model thus predicts a negative relationship between common ownership and the sensitivity of top management incentives to firm performance. It also provides an explanation for the passivity of common owners who allow top managers to "enjoy the quiet life."

The model also generates additional predictions on how firms set product prices across different markets. First, within the same industry, more commonly-owned firms place greater weight on competitors' profits. Therefore they have optimally weaker managerial incentives that lead to higher costs, and thus higher prices than less commonly-owned "maverick" firms. Maverick firms place less weight on competitors' profits and therefore endogenously provide stronger incentives to their top managers, are more productive, set lower prices, and obtain greater market shares. Second, even though top managers can only exert a single firm-wide productivity-improving effort (rather than several market-specific ones), commonly-owned firms compete less aggressively in markets in which they face other commonly-owned firms than in markets in which they face maverick firms. The model proves that a standard firm-level corporate governance mechanism is sufficient for common ownership to affect firm behavior and product market outcomes (differentially across markets within the same industry). Specifically, it can cause the previously documented (but hitherto theoretically unexplained) intra-industry market-level correlations between common ownership and product prices (positive), output (negative), and product market concentration (negative).

Understanding this new mechanism is important for industrial organization and competition policy. Common ownership leads to higher consumer prices, but the source of this anticompetitive effect depends on the organizational structure of firms and on whether common owners actively or passively intervene with corporate strategy. For example, we show that when pricing decisions are delegated to product category managers, common ownership leads to lower productivity and higher costs. Only if pricing decisions were centralized with the top manager or if investors directly chose prices themselves would common ownership cause higher markups. Therefore, tests of common ownership that exclusively focus on markups may not detect the anticompetitive impact of common ownership and may underestimate the extent of associated welfare losses. The welfare losses caused by productive inefficiency can be even larger than those caused by increased markups.

Crucially, the mechanism we propose does *not* rely on (i) owners having access to sophisticated market-level incentives or communications to steer product market behavior in different markets,

(ii) top managers knowing the ownership structure of either their own firms or their competitors, (iii) top managers making detailed market-specific strategic choices (e.g., setting prices), or (iv) explicit or tacit collusion among managers, firms, or shareholders. Instead, our mechanism relies only on unilateral changes in the firm's objective, on top managers who exert firm-wide, productivity-improving effort solely based on their own explicit incentives, and on the delegation of product market choices to middle managers who maximize profits based on market demand and firms' cost structures alone. Combining standard assumptions in corporate finance, organizational economics, and industrial organization is all that is necessary to generate the above-mentioned predictions about firm governance, managerial incentives, and product market behavior. Moreover, less realistic mechanisms of common ownership that assume away managerial agency problems and organizational delegation, and instead assume active interventions by common owners, are at odds with our empirical evidence on managerial incentives.

We empirically confirm the central prediction of a negative relation between common ownership and the performance sensitivity of top management compensation, through which the causal link between common ownership and product market outcomes is established in our model. Using theoretically informed measures of common ownership from the industrial organization literature (Boller and Scott Morton, 2020; Backus et al., 2021b) that are also closely linked to our theoretical framework, we document a strong and robust negative relationship between a firm's common ownership and the wealth-performance sensitivity (the most comprehensive measure of explicit incentives) of its top manager.

In panel regressions, we estimate that an interquartile range shift (25th to 75th percentile) of the firm-level degree of common ownership is associated with a 10.5% reduction in CEO wealth-performance sensitivity. This result remains robust to using various alternative measures of managerial incentives, common ownership, and industry definitions. Across all dimensions (i.e., managerial wealth-performance sensitivities, common ownership measures, and industry definitions) of the full matrix of robustness checks, our coefficient estimates are consistently negative, with similar economic magnitudes and statistical significance levels.

Whereas managerial incentives, productivity improvements, competitive actions, market shares, and profits are endogenously determined in our model, firm ownership is assumed to be exogenous. We therefore need to address the empirical concern that endogenous ownership confounds the interpretation of the negative correlation between common ownership and managerial incentives reported in our panel regressions. Specifically, we employ a difference-in-differences design to investigate whether the negative relationship between the strength of managerial incentives and common ownership is also present when we only use the increase in common ownership from additions of industry competitors to the S&P 500 index. In this design, treated companies are index incumbents (i.e., firms that are already in the S&P 500 index) who experience the addition of an industry competitor to the index. The ownership of these treated companies is unaffected. What does systematically change is that the treated firms' (pre-existing) shareholders who track the S&P 500 index increase their stakes in the treated firms' *industry competitors* following the index addition of these competitors. In other words, index additions of competitors increase the shareholder profit weights of treated index incumbents but do not change their ownership structure. Following the inclusion of industry competitors in the S&P 500, the treated index incumbents experience a significant increase in the portfolio weights their owners attach to rival profits and the compensation of their top managers becomes significantly less sensitive to their firms' performance. This negative effect on CEO wealth-performance sensitivity is gradual: it is not present before the inclusion of the competitor into the index and increases in magnitude over time following the index inclusion event.

Our paper contributes to the vast literature on managerial incentives reviewed by Murphy (1999) and Edmans and Gabaix (2016). More specifically, we add to the ample body of theoretical research (beginning with Hart (1983), Vickers (1985), Fershtman and Judd (1987), and Sklivas (1987)) and empirical work (including Kedia (1998), Joh (1999), Aggarwal and Samwick (1999), Cuñat and Guadalupe (2005), and Cuñat and Guadalupe (2009)) that examines the relationship between product market competition and managerial incentives. Our analysis shows that managerial incentives provide a mechanism linking common ownership to product market outcomes and that common ownership is an important factor affecting the aggregate incentive slope. However, we exclusively focus on explicit financial incentives and do not consider the role of implicit incentives resulting from the managerial labor market (Gibbons and Murphy, 1992; Fee and Hadlock, 2003; Coles et al., 2018; Cziraki and Jenter, 2021).

2 Theoretical Framework

We analyze the design of optimal managerial incentive contracts in hierarchical multiproduct firms that strategically compete against each other but may share common owners. Our theoretical framework combines specific, but standard assumptions from organizational economics, industrial organization, and corporate governance. We establish that managerial incentives can be a mechanism that links common ownership to product market outcomes under these assumptions.

Some of our assumptions capture realistic features of firm organization and strategic competition. Each firm has an organizational hierarchy (Tirole, 1986) in which a single top manager makes high-level decisions that affect productivity across the entire firm (Bandiera et al., 2020), but product-specific pricing decisions are delegated to several middle managers (Alonso et al., 2008; Rantakari, 2008; Bloom et al., 2012b; Alonso et al., 2015). Owners do not use product-level incentives for middle managers to steer competitive behavior differentially in different product categories, and middle managers are not aware of owners' portfolio holdings. Top managers also do not know the extent of their main investors' shareholdings in other firms. The only parameter that governs their behavior is their compensation contract.

Some of our other assumptions are purposefully restrictive. They are intended to rule out channels that may in practice affect competition between commonly-owned firms. For example, we do not allow for explicit or tacit collusion between firms or owners. In line with standard principal-agent models, we also do not allow for communication between owners and managers to directly soften product market competition. Neither investors nor top management communicate their preferences regarding product market competition to middle managers. Top managers do not (even need to) know who owns their firm. We examine the effects of relaxing some of these restrictions in extensions of the model.

2.1 Product Market Competition

Consider a single industry with n multiproduct firms.[3] There are m separate product categories (or geographically separate markets) and within each product category there are n differentiated products, one for each of the n firms. Thus, there are $n \times m$ products in the industry in total.

[3]Our analysis abstracts from inter-industry and general equilibrium effects of common ownership which are the focus of Azar and Vives (2021) and Ederer and Pellegrino (2021). We discuss the impact of common ownership on vertical firm relationships in Section B.5.

The model has two stages. Stage 1 is a standard principal-agent setup in which each firm's majority owner (she) proposes a public incentive contract to the firm's top manager (he). In stage 2, each firm's top manager can improve firm productivity (i.e., marginal cost) through costly private effort in response to the managerial incentives designed in stage 1. An empirical justification for this assumption is the presence of large and persistent differences in productivity levels across businesses (Syverson, 2011; Backus, 2020) that are strongly influenced by management practices (Bloom and Van Reenen, 2007; Bloom et al., 2012a, 2019, 2021). This productivity improvement is not market-specific; it applies to the production costs of all the products the firm produces. In stage 2, the firms also engage in differentiated Bertrand competition in which all of the firms' pricing specialists set product market prices to maximize firm profits, taking firm productivity determined by the top manager's effort choice as given.[4] As is customary, we assume that a manager's privately costly actions in stage 2 are non-contractible, but that firm profits are contractible. This allows managerial incentives to be contingent on firm performance. The model's timeline is summarized in Figure 1.[5]

Stage 1 —————————————————— **Stage 2**

Managerial Incentive Design

Majority owners (7) propose incentive contracts (s_i, α_i).
Managers accept (or reject) incentive contracts.

Product Market Competition

Managers (5) exert productivity-improving effort e_i.
Pricing specialists (6) set product market prices $p_{i,l}$.
Product market profits π_i are realized.

Figure 1. Model Timeline

Following Singh and Vives (1984) and Häckner (2000), we derive demand from the behavior of a representative consumer with the following quadratic utility function:

$$U(\mathbf{q}) = \sum_{l=1}^{m} \left[\mu \sum_{i=1}^{n} q_{i,l} - \frac{1}{2} \left(\psi \sum_{i=1}^{n} q_{i,l}^2 + 2\gamma \sum_{i \neq j} q_{i,l} q_{j,l} \right) \right]$$

where $q_{i,l}$ is the quantity of product i in the same market (or product category) l, $\mathbf{q}$ is the matrix of all quantities for all $n \times m$ products, $\mu > 0$ represents overall product quality, $\psi > 0$ measures the concavity of the utility function, and γ represents the degree of substitutability between

[4]Section B.1 shows that our results also hold for differentiated Cournot competition (i.e., strategic substitutes).
[5]In Appendix B.4 we discuss different assumptions about the timing of actions and the observability of contracts.

differentiated products i and j in market l. $\psi > \gamma > 0$ ensures that all products in the same market are (imperfect) substitutes. The higher the value of γ, the more alike the products are. For simplicity, we assume that the demand for any products in different markets is independent (i.e., cross-market substitution is 0). The consumer maximization problem yields linear demand for each product i, such that the firms face symmetric demand functions in market l given by

$$q_{i,l}(\vec{p_l}) = A - bp_{i,l} + a\sum_{j\neq i} p_{j,l} \tag{1}$$

where $\vec{p} = (p_{1,l}, ..., p_{n,l})$ is the row vector of all prices in market l and

$$A = \frac{\mu}{\psi + (n-1)\gamma}, \quad b = \frac{\psi + (n-2)\gamma}{[\psi + (n-1)\gamma](\psi - \gamma)}, \quad a = \frac{\gamma}{[\psi + (n-1)\gamma](\psi - \gamma)}.$$

By assuming $\psi > \gamma > 0$ we have $b > (n-1)a > 0$. Thus, a firm's price choice has a greater impact on the demand for its own product than its competitive rivals' actions in that particular market.

Each firm i has a marginal cost given by

$$c_i = \bar{c} - e_i \tag{2}$$

where $\bar{c} < \mu$ is a constant and e_i is the effort exerted by firm i's manager.[6]

The profits of firm i are then given by

$$\pi_i = \sum_{l=1}^{m} \left\{ [p_{i,l} - (\bar{c} - e_i)] \left(A - bp_{i,l} + a\sum_{j\neq i} p_{j,l} \right) \right\} + \varepsilon_i. \tag{3}$$

Importantly, an increase in the price $p_{j,l}$ of firm j in market l has a positive effect on the profit of firm i: firms benefit from softer competition by rivals. We assume that each firm i's profit π_i contains a profit shock ε_i that is normally distributed with zero mean and variance σ^2 and that is independent of other firms' profit shocks.

[6]By allowing managerial effort to improve firm productivity in this way, we follow similar setups used in Raith (2003) and in canonical models of corporate (process) innovation under strategic competition (D'Aspremont and Jacquemin, 1988; Kamien et al., 1992). Our specification means that the marginal benefit of managerial effort rises with firm size, as in Baker and Hall (2004), who also verify this assumption empirically.

2.2 Top Managers

All managers simultaneously choose productivity-improving effort levels in stage 2 in accordance with the incentives given by their contracts. The manager of firm i who has an outside option equal to $\bar{u}$ is offered the following total compensation in the form of a linear contract:

$$w_i = s_i + \alpha_i \pi_i \tag{4}$$

where s_i is a fixed salary and α_i is the incentive slope on firm i's profits π_i. This compensation contract mirrors real-world compensation practices, as top managers' compensation is usually tied to their firm's equity value, which reflects the discounted value of firm profits. Furthermore, this compensation contract which does not condition on competitor profits π_j, is the optimal linear contract even when owners can contract on π_j.[7] The manager's base salary s_i is used to satisfy the individual rationality constraint, which is pinned down by the manager's outside option $\bar{u}$. Each manager's expected utility $u_i(w_i, e_i)$ is given by $\mathrm{E}[-\exp(-r(w_i - \frac{\chi}{2}e_i^2 q_i))]$, where r is the degree of risk aversion. $\frac{\chi}{2}e_i^2 q_i$ is his disutility of exerting effort and $q_i = \sum_{l=1}^{m} q_{i,l}$ is the total quantity produced by firm i across all m product categories.

The functional form of our cost-of-effort function implies that lowering marginal cost c_i is relatively harder for the manager when the firm is large.[8] This ensures that for a given incentive slope α_i the manager's incentive to exert effort does not vary with the firm's output because both the manager's marginal impact on the firm's profit (through the marginal cost c_i) and the manager's marginal effort cost grow as the size of the firm grows. In other words, for a given incentive slope α_i the manager's effort is size invariant.

Given the normal distribution of ε_i, maximizing utility is equivalent to maximizing the certainty equivalent

$$\max_{e_i} CE_i = s_i + \alpha_i \mathrm{E}[\pi_i] - \frac{r}{2}\alpha_i^2 \sigma^2 - \frac{\chi}{2} e_i^2 q_i. \tag{5}$$

[7] Put differently, in our model, common ownership does not affect the use of relative performance evaluation (RPE) and therefore does not provide a rationale for its limited use in practice. In Appendix B.2.3 we further show that all of our results still hold when profit shocks are correlated and owners use RPE for managerial wage risk reduction reasons. Antón et al. (2016) empirically study RPE under common ownership.

[8] Our results about equilibrium managerial incentives remain unchanged if instead of lowering cost c_i the top manager can improve firm-wide product quality μ_i.

Thus, each manager i chooses effort e_i to maximize his expected compensation, net of risk and effort costs.

Our model assumes that the top manager only makes high-level decisions that influence firm-wide productivity, but that he does not control more detailed low-level decisions such as product market pricing. Product market prices are instead set by product specialists.

2.3 Pricing Specialists

Each firm i has m middle managers, which we label "pricing specialists" to avoid confusion with top-level managers. These can be thought of as divisional managers for a product category or regional managers for a geographic market. In stage 2, each pricing specialist of firm i in product category l chooses price $p_{i,l}$ to maximize the product market profits $\pi_{i,l}$ of firm i in product category l taking firm productivity (i.e., marginal cost c_i), which is simultaneously determined by the top manager's effort e_i, as given.

This delegation of pricing decisions to middle managers matches realistic features of organizations (Bloom et al., 2012b; Lo et al., 2016) and occurs for reasons not modeled in our theory, such as superior local or product-specific knowledge, middle manager empowerment, decentralization of business units, or negligible cross-elasticity of substitution between divisional units (Alonso et al., 2008; Rantakari, 2008; Alonso et al., 2015). In Section 4.1 we explore how centralization changes the predictions concerning product prices, markups, and top management incentives.

The optimal pricing decision is given by

$$\max_{p_{i,l}} \pi_{i,l} = [p_{i,l} - (\bar{c} - e_i)](A - bp_{i,l} + a \sum_{j \neq i} p_{j,l}). \tag{6}$$

The pricing specialists choose prices to maximize the individual firm profit in their product market category without taking common ownership motives into account.

2.4 Owners

There are n owners. Each owner i owns a (majority) stake in firm i as well as shares in other firms $j \neq i$. Ownership is taken to be exogenous.[9] Owner i's objective function can be restated

[9]We do not consider how and why the various ownership arrangements of firms arise in the first place. Piccolo and Schneemeier (2020) theoretically analyze endogenous common ownership and its interplay with product market

in the following way

$$\phi_i = \pi_i - w_i + \sum_{j \neq i} \kappa_{ij}(\pi_j - w_j) \tag{7}$$

where $0 \leq \kappa_{ij} \leq 1$ can be interpreted as the value to owner i of a dollar of net profits $(\pi_j - w_j)$ in firm j compared to a dollar of profits in firm i. Its exact value depends on the type of ownership and corresponds to what Edgeworth (1881) termed the "coefficient of effective sympathy among firms."[10]

In stage 1, each majority owner i publicly proposes an incentive contract (s_i, α_i) for her manager i, such that the product market behavior in stage 2, as induced by the incentive contract designed in stage 1, maximizes her profit shares in all the firms. The optimal incentive contract for manager i therefore internalizes the effect on profits of other firms in the industry to the extent that the majority owner of firm i also owns cash flow rights of (but does not have influence or control over) those other firms.

The assumption that the majority owner sets the terms of the incentive contract is made for expositional simplicity.[11] The maximization problem for the majority owner of each firm i in stage 1 is subject to the IR and IC constraints of the manager of firm i and the managerial efforts and prices at all firms constituting a Nash equilibrium given each owner i's choice of s_i and α_i. Her maximization problem is given by:

$$\max_{s_i, \alpha_i} \phi_i = (\pi_i - s_i - \alpha_i \pi_i) + \sum_{j \neq i} \kappa_{ij}(\pi_j - s_j - \alpha_j \pi_j) \tag{8}$$

$$\text{s.t.} \quad u_i \geq \bar{u} \quad \text{and} \quad e_i^* \in \arg\max_{e_i} \mathrm{E}[-\exp(-r(s_i + \alpha_i \pi_i - \chi q_i e_i^2/2))] \quad \text{and} \quad p_{i,l}^* \in \arg\max_{p_{i,l}} \pi_i.$$

To ensure that each owner's problem has an interior solution and all firms produce positive quan-

competition.

[10]There is a long tradition in economics of weighting shareholder interests in the objective function of the firm, including Drèze (1974), Grossman and Hart (1979), and Rotemberg (1984). Recent research further suggests institutional investors internalize broader goals of social responsibility (Hart and Zingales, 2017; Oehmke and Opp, 2019; Broccardo et al., 2020; Coffee, 2020), including climate change and race issues (Krueger et al., 2020; Condon, 2020; Shekita, 2021). We make the more limited assumption that investors partially internalize the product market externalities that their portfolio firms impose on other firms in their portfolio.

[11]This assumption can be understood as a metaphor for an explicit or implicit coalition of shareholders that jointly hold an effective majority of the stock being voted. Explicit coalitions are discussed by Olson and Cook (2017) and Shekita (2021). Moskalev (2020) shows conditions under which shareholders with similar portfolios optimally vote identically and therefore will be regarded as an implicit coalition or a single block by managers. In settings without a majority owner, the largest investor usually has the greatest chance of being pivotal.

Number	Equation	Description
(1)	$q_{i,l} = A - bp_{i,l} + a\sum_{j\neq i} p_{j,l}$	Product Demand for Firm i in Market l
(2)	$c_i = \bar{c} - e_i$	Productivity Improvement
(3)	$\pi_i = \sum_{l=1}^{m} \{[p_{i,l} - (\bar{c} - e_i)]q_{i,l}\} + \varepsilon_i$	Total Firm Profits
(4)	$w_i = s_i + \alpha_i \pi_i$	Top Manager Compensation
(5)	$\max_{e_i} CE_i = s_i + \alpha_i \mathrm{E}[\pi_i] - \frac{r}{2}\alpha_i^2\sigma^2 - \frac{\chi}{2} q_i e_i^2$	Top Manager Utility
(6)	$\max_{p_{i,l}} \pi_{i,l} = [p_{i,l} - (\bar{c} - e_i)]q_{i,l} + \varepsilon_i$	Middle Manager Objective Function
(7)	$\max_{s_i,\alpha_i} \phi_i = \pi_i - w_i + \sum_{j\neq i} \kappa_{ij}(\pi_j - w_j)$	Owner Objective Function

Table 1. Summary of the Model Setup

tities, we assume that the cost scaling parameter χ is sufficiently large relative to $\bar{c}$. Table 1 provides a summary of the model setup.

3 Theoretical Analysis

We begin our analysis of the theoretical framework by investigating the effect of common ownership on managerial incentives in an industry with symmetric firms. We then consider an extension with firm-level differences in ownership across multiple markets to illustrate the differential effects of common ownership on managerial incentives, costs, prices, quantities, and product market structure.

3.1 Symmetric Owners

To simplify the exposition, we assume that the owners are symmetric as in López and Vives (2019) such that owner i owns a majority stake in firm i and a residual symmetric share in all other firms. Therefore, we have $\kappa_{ij} = \kappa$.

In stage 2 of the game, the managers simultaneously choose effort and pricing specialists choose prices given the set of incentive contracts. For a given contract (s_i, α_i), manager i's first order condition with respect to productivity-improving effort e_i, along with all the m pricing specialist's first order condition with respect to price $p_{i,l}$, can be rearranged to yield the following best-response functions:

$$e_i = \frac{\alpha_i}{\chi} \tag{9}$$

$$p_{i,l} = \frac{A + b(\bar{c} - e_i) + a \sum_{j \neq i} p_{j,l}}{2b}. \tag{10}$$

First, the stronger the incentives α_i given to the manager, the larger the efficiency improvements e_i he will undertake, as can be seen by the effect of α_i in equation (9). This is because a larger share of the firm's profits rewards the manager for his costly private effort to improve efficiency and profits. This result illustrates that α, in addition to representing an explicit incentive slope, can also serve as a reduced-form mechanism for any governance intervention that improves firm efficiency. In line with this interpretation and with our model assumptions, Giroud and Mueller (2011) document that weak governance firms, particularly those in less competitive industries, have lower labor productivity and higher input costs.

Second, stronger managerial incentives also lead to lower prices because the efficiency improvements induced by stronger incentives increase the firm's per-unit profit margin, thereby encouraging the manager to produce a higher quantity and set a lower price. This is apparent by looking at the effect of e_i in equation (10). Stronger managerial incentives lead to more competitive product market behavior in the form of lower prices (and higher output). This feature also means that in our model managerial productivity has a multiplicative effect on firm profits (as in Gabaix and Landier (2008)) because it improves the firm's profit margin and increases the size of the firm.

The first order conditions (9) and (10) yield a system of $(1 + m) \times n$ linear equations which we solve for the equilibrium efforts $e_i^*(\vec{\alpha})$, equilibrium prices $p_{i,l}^*(\vec{\alpha})$, and equilibrium profits $\pi_i^*(\vec{\alpha})$ of the n firms as a function of the vector of incentive slopes $\vec{\alpha} = (\alpha_1, ..., \alpha_n)$. As we will show, these incentive slopes in turn depend on the level of common ownership κ.

Recall that the objective function of the majority owner of firm i, given in equation (7), captures the profit shares in her primary firm i and all other firms $j \neq i$. In stage 1, each majority owner has two instruments at her disposal. First, she uses the salary s_i to satisfy the manager's individual rationality constraint. Second, taking into account the effects of the incentive slope α_i on the stage 2 equilibrium efforts and prices, she uses the incentive slope α_i to maximize her objective function ϕ_i. The derivative of the owner's objective function with respect to α_i is given by

$$\frac{\partial \phi_i}{\partial \alpha_i} = \frac{\partial \pi_i^*}{\partial \alpha_i} - r\sigma^2\alpha_i^2 - \frac{q_i^*\alpha_i}{\chi} - \frac{\alpha_i^2}{2\chi}\frac{\partial q_i^*}{\partial \alpha_i} + \kappa \sum_{j\neq i}\left(\frac{\partial \pi_j^*}{\partial \alpha_i} - \frac{\alpha_j^2}{2\chi}\frac{\partial q_j^*}{\partial \alpha_i}\right).$$

The last term that includes κ captures the impact of changing α_i on the net profits of all the firms other than the investor's primary firm i. Because stronger incentives for the manager of firm i hurt the profits of all other firms $j \neq i$, and because the majority owner of firm i cares about these profits with intensity κ, this leads to our central theoretical result.

Proposition 1. *The symmetric equilibrium incentives $\alpha_i = \alpha^*(\kappa) < 1$ given to managers decrease and the firms' marginal costs c_i increase with common ownership κ.*

As common ownership measured by κ increases, the (majority) owner of firm i cares relatively more about the net profits of firm j in the industry (see equation (7)). Thus, each owner now prefers competition to be softer between the firms that she partially owns. In other words, each owner i would now like to induce higher prices $p_{i,l}$ because that benefits the profits π_j of firm j. While the majority owner of firm i does not directly control the product market price $p_{i,l}$, she can induce less aggressive product market behavior (and thus a higher price $p_{i,l}$) by setting a lower incentive slope α_i in stage 1. As can be seen from the best-response functions (9) and (10), this leads to less cost-cutting effort e_i by the manager (and hence higher marginal cost c_i) and a higher price $p_{i,l}$ set by the pricing specialist of market l in stage 2. This, in turn, benefits the net profits of firm j which become a relatively more important part of owner i's portfolio profits ϕ_i as common ownership κ increases.

By forgoing the provision of high-powered incentive contracts, common owners are "excessively deferential" toward managers (Bebchuk et al., 2017; Bebchuk and Hirst, 2019), both relative to undiversified owners ($\kappa = 0$) and also relative to the level of intervention that would obtain if firms did not interact strategically in the product market ($a = 0$), as in Holmstrom (1982). Because managers of more commonly-owned firms have less performance-sensitive incentives they also exert lower effort, resulting in lower firm productivity. This is in line with the interpretation that managers of these firms with endogenously weak corporate governance are allowed to "enjoy the quiet life" (Hicks, 1935; Bertrand and Mullainathan, 2003) at the expense of firm productivity.

In our model, common ownership has anticompetitive effects in the sense of higher prices. However, these higher prices are *not* caused by higher markups. Instead they are the result of a "productive inefficiency" or "cost inefficiency" (in the sense of higher marginal cost c_i than when there is no common ownership) caused by reduced managerial incentives and the resulting underinvestment in productivity improvements. The principal-agent problem and delegation within the firm are the fundamental sources of this productive inefficiency. As we discuss in Section 4.1, if a common owner could directly control pricing, she would instead use higher markups and set managerial incentives that are undistorted by common ownership. But without direct control of prices a common owner optimally underincentivizes the manager of her firm which in turn raises costs and increases prices while leaving price-cost markups essentially unchanged (except for cost passthrough reasons).

As predicted by our model, Aslan (2019) finds that in the consumer goods industry, the positive relationship between common ownership and prices is channeled largely through marginal cost variation while markups are unaffected by common ownership. Yet, even despite this productive inefficiency, not only are portfolio profits ϕ_i higher in equilibrium, but net profits $\pi_i - w_i$ are also higher when common ownership is higher, in line with the findings of Boller and Scott Morton (2020).

Corollary 1. *Firm net profits $\pi_i - w_i$ increase with common ownership κ.*

This net profit increase occurs because increases in κ lead to a greater weight on industry rather than individual profits in the objective function. Industry net profits (and, because of symmetry, individual firm net profits) are larger when all the firms partially internalize their firms' actions on other competitors' profits. The resulting reduction in equilibrium managerial incentives α^* allows firms to economize on productivity investment costs (for which the managers have to be compensated through w_i) and this outweighs the losses from the concurrent increase in the marginal production costs c_i.

3.2 Asymmetric Owners

We now show how asymmetries in firm-level common ownership can differentially affect firms' product market strategies across multiple markets. Firm-level variation in common ownership leads to firm-level variation in managerial incentives and generates firm- and market-level variation in prices, quantities, and concentration, as well as cross-market variation in competitive behavior, even within the same firm.

Consider an industry with three separate product categories or geographically separate markets ($l = \mathrm{I}, \mathrm{II}, \mathrm{III}$) and three firms ($i = 1, 2, 3$) owned by three investors. Each firm produces a differentiated product in two of the three markets such that there are two firms' products offered in each market. Specifically, firm 1 produces in markets I and II, firm 2 produces in markets II and III, and firm 3 produces in markets III and I. There are three investors such that each firm is controlled by one majority owner and two minority owners hold the remaining cash flow rights. As a result, owner i's objective function is given by

$$\phi_i = \pi_i - w_i + \kappa_{ij}(\pi_j - w_j) + \kappa_{ik}(\pi_k - w_k).$$

Although our analysis focuses on the case with three firms, three markets, and three investors, the results we present in this section straightforwardly generalize to any number of n firms that are owned by n investors and that each produce $n-1$ products across n distinct markets.

The combined profits of firm i, which competes in markets l and h with prices $p_{i,l}$ for market l and $p_{i,h}$ for market h set by its respective pricing specialists, are given by

$$\pi_i = (p_{i,l} - c_i)(A - bp_{i,l} + ap_{k,l}) + (p_{i,h} - c_i)(A - bp_{i,h} + ap_{j,h}) + \varepsilon_i.$$

For firm i, this results in the following familiar best-response functions from the top manager's effort decision and the pricing specialists' optimal price choices:

$$\begin{aligned} e_i &= \frac{\alpha_i}{\chi} \\ p_{i,l} &= \frac{A + b(\bar{c} - e_i) + ap_{k,l}}{2b} \\ p_{i,h} &= \frac{A + b(\bar{c} - e_i) + ap_{j,h}}{2b}. \end{aligned}$$

These feature the same positive and negative relationships, respectively, between managerial incentives for effort and prices as with symmetric owners.

The majority owner of firm i solves:

$$\max_{s_i, \alpha_i} \phi_i = \pi_i - s_i - \alpha_i \pi_i + \kappa_{ij}(\pi_j - s_j + \alpha_j \pi_j) + \kappa_{ik}(\pi_k - s_k + \alpha_k \pi_k)$$

$$\text{s.t.} \quad u_i \geq \bar{u} \quad \text{and} \quad e_i^* \in \arg\max_{e_i} \mathrm{E}[-\exp(-r(s_i + \alpha_i \pi_i - \chi q_i e_i^2/2))] \quad \text{and} \quad p_{i,l}^* \in \arg\max_{p_{i,l}} \pi_{i,l}$$

where κ_{ij} and κ_{ik} capture the impact of the minority ownership shares that the majority owner of firm i holds in firms j and k.

We assume that there is one undiversified "maverick" owner who owns 100% of firm 1 (which we call the "maverick" firm) while the remaining two owners of firms 2 and 3 each own δ of their majority firm and hold a minority stake of $1-\delta$ in the other firm, where $1/2 \leq \delta < 1$. This results in the following set of common ownership coefficients: $\kappa_{1,2} = \kappa_{1,3} = \kappa_{2,1} = \kappa_{3,1} = 0$ and $\kappa_{2,3} = \kappa_{3,2} = (1-\delta)/\delta \equiv \kappa$. In the markets I and II, the maverick firm is present. Thus, there is no overlap in ownership between the market competitors. In contrast, in the common ownership market III there is common ownership between the two firms, with its impact increasing in κ which is monotonically related to δ. Figure 2 summarizes the model setup.

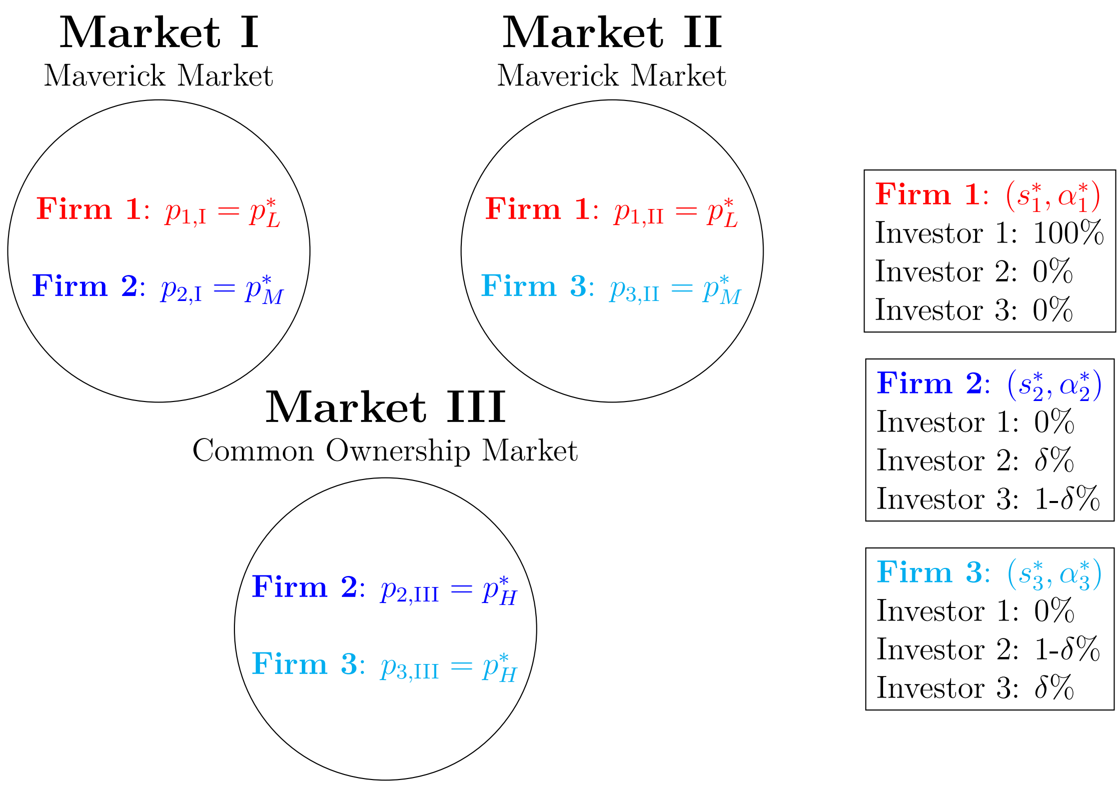

Figure 2. Model Setup and Equilibrium Incentives and Prices for Multimarket Firm-level Variation in Common Ownership: Firm 1 is the "maverick" firm whereas firms 2 and 3 are the commonly-owned firms where $50\% \leq \delta < 100\%$ and $\kappa \equiv (1-\delta)/\delta$. In equilibrium, $\alpha_1^* > \alpha_2^* = \alpha_3^*$ (Proposition 2) and $p_H^* > p_M^* > p_L^*$ (Corollary 2).

Before we derive the implications of these assumptions, we provide a real-world example that illustrates the importance of recognizing asymmetries in common ownership in multimarket settings. Consider the U.S. airline market, which has different geographic markets and routes and substantial firm-level variation in common ownership. Prior to its merger with and subsequent integration into Alaska Airlines in 2017, Virgin America had a radically different ownership structure compared to other large, publicly listed U.S. airlines such as Delta, American, United, and JetBlue. Table 2 Panel A shows that Virgin America was predominantly owned by two of its founders: the entrepreneur Richard Branson, who held the largest share ownership of 30.77% (as well as another 15.34% through Virgin Group Holdings Limited), and the activist private equity group Cyrus Capital Partners (headed by Stephen Freidheim), which held 23.52%. Neither of these two owners held large stakes in industry competitors. In contrast, Table 2 Panel B shows that almost all other U.S. airlines had the same overlapping owners as their largest shareholders. Given these stark differences in ownership arrangements, it is perhaps not too surprising that Virgin America won an unprecedented nine straight awards for "Top Domestic Airline" from *Travel+Leisure* because of its high quality and aggressive pricing. Airline industry experts described it as "the epitome of a market disruptor" (Taggart, 2016).[12]

[Insert TABLE 2 Here.]

3.2.1 Managerial Incentives

Under such common ownership with a maverick owner, the objective functions of the owners of firms 2 and 3 are identical, in that they maximize the weighted sum of profits of those two firms, while the maverick owner of firm 1 solely maximizes the profits of firm 1. The resulting equilibrium incentive slopes are α_1^* and $\alpha_2^* = \alpha_3^*$, and the equilibrium prices are $p_L^* \equiv p_{1,\text{I}}^* = p_{1,\text{II}}^*$ for the prices set by the maverick firm 1 in markets I and II, $p_M^* \equiv p_{2,\text{II}}^* = p_{3,\text{I}}^*$ for the prices set by the commonly-owned firms 2 and 3 in markets I and II where these firms compete against the maverick firm 1, and finally $p_H^* \equiv p_{2,\text{III}}^* = p_{3,\text{III}}^*$ for the prices set by the commonly-owned firms 2 and 3 in market III where these firms compete with each other.

Proposition 2. *The equilibrium incentives $\alpha_2^* = \alpha_3^*$ given to managers of the commonly-owned firms 2 and 3 are strictly lower than those given to the manager of the maverick firm 1, α_1^*. Therefore, $c_2 = c_3 > c_1$. The difference in the managerial incentive slopes and in the costs increases with common ownership κ between the commonly-owned firms 2 and 3.*

[12] One interesting exception in Panel B is the ultra-low cost airline Allegiant, in which the CEO held the largest ownership stake (20.30%). Tellingly, Allegiant has also been called an "industry disruptor" and a "maverick" by industry experts.

As before, the fact that the stage 2 equilibrium profit $\pi^*_{j,l}(\alpha_i, \alpha_j)$ of firm j in market l is decreasing in α_i immediately establishes the proposition. The intuition is also exactly the same as in the model with symmetric owners. Whereas the undiversified maverick owner only cares about the profits of firm 1, the two common owners of firms 2 and 3 also care about the impact of their respective managers' decisions on the other firm they own and with which they interact in market III. As a result, to induce less aggressive pricing choices (and thus less business stealing), these common owners set lower managerial incentive contracts than the maverick owner does. When common ownership κ increases, the common owners of firms 2 and 3 care more about the impact of their choice of α_2 and α_3 on the profit of the other commonly-owned firm and thus reduce these incentive slopes by a greater amount. In our analysis in Section 6, we investigate whether the empirical evidence is consistent with this link between managerial incentives and common ownership.

3.2.2 Product Market Effects

Beyond establishing a negative relationship between the strength of managerial incentives and common ownership, we can also analyze the impact that our proposed mechanism has on product market outcomes, including prices, quantities, and market structure. We show that even when managers only undertake firm-wide (not market-specific) productivity improvements in response to the managerial incentive contracts given to them and have no knowledge of the underlying ownership structures of their firm, firm-level variation in managerial incentives can generate market-level variation in competitive outcomes within the same industry. This is in accordance with prior empirical findings in the common ownership literature. We begin by studying the effect on product market prices.

Corollary 2. *The equilibrium price* $p^*_{2,\text{III}} = p^*_{3,\text{III}} = p^*_H$ *set by the two commonly-owned firms* 2 *and* 3 *in market* III *is higher than the price* $p^*_{2,\text{I}} = p^*_{3,\text{II}} = p^*_M$ *set by the commonly-owned firms* 2 *and* 3 *in the maverick markets* I *and* II*, which in turn is higher than the price* $p^*_{1,\text{I}} = p^*_{1,\text{II}} = p^*_L$ *set by the maverick firm in the maverick markets* I *and* II*. The difference in prices between the common ownership market* III *and the maverick markets* I *and* II *is increasing in common ownership* κ*.*

This corollary is a direct result of the differential effort choices induced by the difference in incentive contracts. Because the manager of the maverick firm 1 faces more high-powered incentives, he exerts greater effort which leads to lower marginal costs c_1 than those of the commonly-owned firms 2 and 3, $c_2 = c_3$. As a result, the maverick firm is endogenously a low-cost firm, and the price p_L^* set by the maverick firm in markets I and II is always lower than those of the commonly-owned firms. This is true both in markets I and II, where they face the low-cost maverick firm and they therefore set p_M^*, as well as in market III where these high-cost firms face each other and therefore set p_H^*. Hence, $p_H^* > p_M^* > p_L^*$. Finally, because the difference in effort incentives increases with common ownership κ, so does the difference in prices between the common-ownership market III and the maverick markets I and II.

Because in our model common owners cannot directly set higher prices but can only indirectly raise prices by lowering managerial incentives and increasing costs, common ownership does not have a direct impact on price-cost markups $\frac{p_{i,l}}{c_i}$. As a result, the effect of common ownership on markups is very small, ambiguous in sign, and entirely driven by cost passthrough. For example, with our linear demand specification the commonly-owned firms have a lower average markup across firms than the maverick firm, but they charge higher markups in the common ownership market than in the maverick market. In line with our prediction, in the reduced-form empirical studies of Aslan (2019) and Koch et al. (2020), price-cost markups are not consistently positively correlated with measures of common ownership. Similarly, the structural analysis of Backus et al. (2021a) in which the profit weights κ_{ij} are not included in the marginal cost specification but directly influence price setting, also rejects that common ownership has large or even modest effects on markups. However, an important takeaway of our analysis is that even when common ownership has no impact on markups, it can still have an anticompetitive effect on prices simply through higher marginal costs resulting from common ownership-induced productive inefficiency.

Corollary 2 provides an explanation for the positive empirical relationship between market-level common ownership and prices, which has been documented for airlines using reduced-form (Azar et al., 2018) and structural methods (Park and Seo, 2019), banking (Azar et al., 2021), agricultural seeds (Torshizi and Clapp, 2019), and consumer goods (Aslan, 2019). Ruiz-Pérez (2019) also provides evidence consistent with a positive relationship between common ownership and prices in airlines, but shows that it comes mostly from the effect of common ownership on entry decisions and their effect on the ensuing market structure. Our theoretical framework assumes that owners (who care about their profit shares in other firms, as in equation (7)) can only influence the managers' productivity improvements, but that market specialists set prices solely to maximize their own firms' profits (see equation (6)). Indeed, Ruiz-Pérez (2019) finds that a hybrid model, in which airlines act exactly according to the common owner profit shares for entry decisions but choose prices to maximize just their own firms' profits, fits the data the best.

The high prices charged in market III are not the result of directly anticompetitive or even explicitly collusive behavior by the two commonly-owned firms operating in this market. Rather, they are merely the result of less productive firms (due to weakly-incentivized top managers) competing against each other in the same market. This indirect channel is entirely distinct from theories in which common owners directly intervene in firm strategy and pricing. Although effects of common ownership may also operate through more direct channels, our theoretical model illustrates that anticompetitive product market effects can exist without the use of such direct channels.

Another straightforward corollary of Proposition 2 is that the quantities produced by the firms, product market concentration, and common ownership are endogenously related. Whereas in the common-ownership market the firms charge equal prices (p_H^*) and have equal market shares, the maverick firm charges lower prices (p_L^*) than the commonly-owned firms in the maverick markets (p_M^*). As a result, the produced quantities correlate negatively with common ownership, as documented by Azar et al. (2018) for the U.S. airline industry. Moreover, in the maverick markets, the maverick has a larger market share than the commonly-owned firm, whereas in the common ownership market, the market shares are symmetric. This leads to greater market concentration than in the common ownership market. As a result, market concentration is negatively correlated with common ownership at the market level. This prediction corresponds to an empirical fact documented in the airline (Azar et al., 2018) and the banking industry (Azar et al., 2021), but which until now does not have a theoretical explanation.

Corollary 3. *The total equilibrium output Q_l and product market concentration HHI_l are lower in the common-ownership market than in the maverick markets, $Q_{\mathrm{III}} < Q_{\mathrm{I}} = Q_{\mathrm{II}}$ and $HHI_{\mathrm{III}} < HHI_{\mathrm{I}} = HHI_{\mathrm{II}}$. The output and product market concentration difference between the common-ownership and maverick markets increases with common ownership κ.*

These results constitute a unified theoretical framework that can rationalize relationships between common ownership and a host of firm-, market-, and industry-level outcomes including prices, quantities, product market concentration, costs, markups, and profits while also explicitly recognizing agency conflicts between shareholders and managers. As such, it provides the first for-

Theory	Prediction	Level	Empirical Evidence
Prop. 1 & 2	Incentives (−)	Firm	Section 6
	Costs (+)	Firm	Aslan (2019)
	Markups (±)	Firm & Market	Aslan (2019), Koch et al. (2020), Backus et al. (2021a)
Coro. 1	Profits (+)	Firm	Boller and Scott Morton (2020)
Coro. 2	Prices (+)	Firm & Market	Azar et al. (2018), Park and Seo (2019), Aslan (2019), Azar et al. (2021), Torshizi and Clapp (2019)
Coro. 3	Output (−)	Market	Azar et al. (2018)
	Concentration (−)	Market	Azar et al. (2018), Azar et al. (2021)
Prop. 5	Governance (−)	Firm	Bubb and Catan (2018), Heath et al. (2020)
	Entry (−)	Firm & Market	Newham et al. (2019), Ruiz-Pérez (2019), Xie and Gerakos (2020)
	Investment (−)	Industry	Gutiérrez and Philippon (2018)

Table 3. Theoretical Predictions and Empirical Evidence: −, +, and ± respectively denote negative, positive, and ambiguous relationships between common ownership and the relevant variable.

mal mechanism (or "theory of harm") that applies to the common ownership debate as it currently stands. Table 3 summarizes our theoretical results and their relation to the empirical evidence.

In our model, managerial effort causes cost reductions and lower prices which affect the profitability of competitors. Other managerial decisions such as entry or investment choices influence the profits of competitors in similar ways. Therefore, our theoretical framework also relates, albeit more loosely, to another set of empirical results. Newham et al. (2019), Xie and Gerakos (2020), and Ruiz-Pérez (2019) find evidence that common ownership leads to less aggressive entry decisions in pharmaceuticals and airlines. Gutiérrez and Philippon (2018) document that quasi-indexer ownership reduces investment.[13] Finally, a variation of our model in which managerial effort leads to firm-specific product quality improvements rather than marginal cost reductions similarly predicts a negative relationship between common ownership and managerial incentives, but does not necessarily predict a positive relationship between common ownership and prices.

In summary, our theoretical analysis offers a plausible channel—namely simple and commonly

[13]This latter prediction can be reversed in a model of investment in innovation because the impact on other firms' profits can be positive due to technological spillovers (López and Vives, 2019; Antón et al., 2018).

used profit-based managerial incentive contracts—through which increases in common ownership can lead to less competitive product market behavior. Importantly, our model does not require any communication or even cooperation between the different owners themselves or their managers, or between product market competitors, nor does it require that top managers or pricing specialists know anything about the identities or motives of their owners. They merely need to know and respond to their own incentives.

4 Model Variations and Extensions

We discuss a number of model extensions and variations and their implications for interpreting existing evidence on common ownership from the industrial organization, finance, and governance literatures. Section B provides additional discussion of the form of strategic competition, relative performance evaluation, welfare implications, timing and observability assumptions, vertical relationships, endogenous market shares, product market differentiation, and concentration.

4.1 Agency Problems and Delegation in Organizational Hierarchies

Our theoretical framework highlights the importance of recognizing agency problems and organizational hierarchies in studies of common ownership. The organizational hierarchy that assigns high-level firm-wide decisions to top managers, but delegates product-specific pricing to middle managers, is the reason why in our model common ownership increases prices, but does not affect markups (except for cost passthrough). This theoretical prediction is consistent with the reduced-form empirical evidence in Aslan (2019) and Koch et al. (2020) and the structural model estimates in Backus et al. (2021a).

Backus et al. (2021a) study markup effects of common ownership and use detailed store-level scanner pricing data from the ready-to-eat cereal industry. They show that an exact version of the common ownership hypothesis without agency conflicts, in which owners (rather than top managers or pricing specialists) directly choose product prices according to the profit weights κ_{ij}, yields implied marginal costs that would be much too low (or even negative) and markups that would be much too high. However, their empirical evidence is at odds with such a simplified model, and they find little empirical support for markup effects of common ownership. Large, positive markup effects of common ownership would also obtain in our model if investors could either (i) directly choose prices themselves, (ii) optimally design the incentives of pricing specialists (i.e., $w_{i,l} = s_{i,l} + \alpha_{i,l}\pi_{i,l} + \sum_{j\neq i}\omega_{ij,l}\pi_{j,l}$) and thereby align them with their own, or (iii) centralize all multiproduct pricing decisions in the hands of the top manager and reward him based on competitors' profits (i.e., $w_i = s_i + \alpha_i\pi_i + \sum_{j\neq i}\omega_{ij}\pi_j$). All of these assumptions would require mechanisms in which common owners play a much more active role in shaping firm strategies and designing incentives within the organization than in our baseline model.

In Appendix B.2.1 we formally show that either assumption (i) or (ii) allows owners to set the managerial incentives α_i^* equal to direct-control incentives α_i^{DC} given by

$$\alpha_i^{DC} = \frac{1}{1 + \frac{\chi r \sigma^2}{q_i}}.$$

Owners can avoid distorting managerial incentives (and thereby avoid incurring productive inefficiency) due to common ownership, which would otherwise be required to indirectly soften competition. Under both of these two assumptions the incentives of top managers decrease due to common ownership (because common ownership raises prices $p_{i,l}$ and therefore lowers total firm quantity q_i), but only due to its indirect effect through agency problems (i.e., $r\sigma^2 > 0$).[14]

Proposition 3. *If owners directly control prices $p_{i,l}$ or can optimally design incentives for pricing specialists, the equilibrium managerial incentives are equal to the direct-control incentives $\alpha_i^* = \alpha_i^{DC}$ and decrease with common ownership as defined in Proposition 1 and 2. Prices $p_{i,l}^*$ and price-cost markups $\frac{p_{i,l}}{c_i}$ increase with common ownership.*

In Appendix B.2.2 we present a model variation with assumption (iii). In this model variation, there is no delegation of pricing decisions to middle managers; all pricing decisions are instead centralized in the hands of the top manager. Each top manager chooses effort e_i and also all of the firm's m product prices $p_{i,l}$. If managerial incentive contracts are not allowed to condition on rival profits π_j, our previous results in Section 3 are entirely unchanged. Under more general contracting assumptions, we show that common ownership leads to optimal managerial incentives that include positive weights ω_{ij} on rival profits π_j. These ω_{ij} weights increase with κ_{ij} to align

[14] Appendix B.3 illustrates that the total surplus loss due to common ownership can be larger or smaller under direct or indirect control of prices by investors. Instead of welfare being lost because of higher markups as under direct control, under indirect control surplus is lost because of higher prices due to lower firm productivity. When managerial effort is relatively inexpensive (i.e., the cost scaling parameter χ is small) and therefore plays an important role in determining productivity and prices, the (indirect) investment distortion can dominate the (direct) price distortion and total welfare can be lower under indirect control than under direct control.

managerial pricing decisions with owners' portfolio interests. Holding managerial effort e_i fixed, common ownership leads to higher price-cost markups because managers internalize the effect of their pricing decisions on other firms' profits in accordance with the κ_{ij} portfolio interests of their owners. However, these positive ω_{ij} weights impose additional wage risk on the top manager equal to $\frac{r}{2}\omega_{ij}^2\sigma^2$ for which the top manager has be compensated. The owner therefore will distort the top manager's incentive slope α_i downward, which leads to lower firm productivity and higher marginal costs c_i.

Proposition 4. *If all pricing decisions are centralized with the top manager, the equilibrium managerial incentives α_i^* decrease while prices $p_{i,l}^*$ increase with common ownership as defined in Proposition 1 and 2. Price-cost markups $\frac{p_{i,l}}{c_i}$ increase with common ownership if $r\sigma^2$ is sufficiently small.*

Thus, even in such a less realistic full centralization model in which top managers set multi-product prices that are more directly aligned with common owners' interests, the central prediction of our model that greater common ownership leads to less performance-sensitive managerial incentives still holds. However, in addition to ignoring key findings of the organizational delegation and decentralization literature, these model variations based on either (i), (ii), or (iii) above generate large markup effects of common ownership that are inconsistent with the existing empirical evidence. Thus, they provide an explanation for why existing empirical estimates deviate from industrial organization models that incorporate common ownership but assume away agency problems and organizational hierarchies.

The more realistic version of our model in which pricing decisions are delegated to middle managers who maximize only their own firm profit π_i rather than investor portfolio profits ϕ_i, is consistent with structural estimates of the U.S. airline industry. Ruiz-Pérez (2019) finds that a model of common ownership, in which airlines make both entry *and* pricing decisions exactly according to the profit weights of their (horizontally diversified) shareholders, matches the data as poorly as a model of completely separate ownership. However, a hybrid model in which airlines act according to shareholder portfolio profit weights (i.e., $\max \phi_i$ as in equation (7)) for entry decisions and then choose prices to maximize just their own firm profits (i.e., $\max_{p_{i,l}} \pi_{i,l}$ as in equation (6)) fits the observed data patterns much better. In other words, common ownership leads to less entry, but conditional on entry decisions, common ownership does not affect prices. This is akin to our model in which common ownership does not affect prices conditional on its effect on costs.

4.2 Shareholder Passivity

Our theoretical model employs a canonical principal-agent setup in which the principal (the majority shareholder) sets incentives for the agent (the manager). This same setup has been used as the workhorse model for much of the executive compensation literature and is often referred to as the *contracting view*.

However, such a managerial incentive design problem may convey the idea that lower managerial incentives (and hence anticompetitive product market outcomes) are deliberately and purposefully chosen by common owners. One of the strengths of our model is that it does not require common owners to take the initiative when designing incentives. It is sufficient for common owners to remain passive and thus not push for performance-sensitive compensation to the extent that an undiversified owner (or a diversified owner with holdings in other industries) would. In other words, our model does not distinguish between the absence of an undiversified shareholder pushing for performance-sensitive compensation (e.g., Richard Branson and Stephen Freidheim at Virgin America) and the presence of a large common owner who does not actively push for any particular compensation plan at all. Common owners merely let executives get away with high and performance-insensitive pay by not voting against the compensation plan proposed by management. This is consistent with the *skimming view* of executive compensation (Bertrand and Mullainathan, 2000, 2001).[15]

To formalize the idea that common owners have weak incentives to undertake active governance decisions because being passive is sufficient, consider the following variant of our model. In order to design a managerial incentive contract, a firm's (majority) owner must pay a corporate governance cost $g > 0$. If the owner does not pay g, the manager is given a "default" incentive contract $\underline{w}_i = \underline{s}_i + \underline{\alpha}\pi_i$ where $\underline{\alpha} \in [0, \alpha^{SB})$ and $\underline{s}_i$ is set to satisfy the top manager's IR constraint. α^{SB} is defined as the equilibrium level of incentives that obtains when there is no common ownership (i.e., $\kappa_{ij} = 0$ for all ij). From Proposition 1 and 2 we know that this "second-best" incentive slope α^{SB} is higher than any with common ownership ($\kappa_{ij} > 0$). It is the second-best solution from the owners' perspective in the sense that managerial incentives are only distorted downwards because

[15] As we show in Appendix B.2.4 using a shareholder "outrage constraint" (Bebchuk and Fried, 2006), the contracting and the skimming view differ with respect to whether managers capture economic rents, but they both lead to high, performance-insensitive pay and greater managerial slack under weak governance.

of risk aversion and noisy profits (i.e., $r\sigma^2 \geq 0$) but not because of common ownership.

The default incentive contract $\underline{w}_i$ results in managerial effort $\underline{e}_i < e^{SB}$ that is strictly lower than the second-best effort. This assumption is consistent with the evidence that in firms with weak corporate governance, managers have lower incentives, exert lower effort, and are allowed to "enjoy the quiet life" (Hicks, 1935; Bertrand and Mullainathan, 2003).

Proposition 5. *For any default incentive contract $\underline{\alpha} < \alpha^{SB}$ there exists a threshold $\underline{\kappa}$ such that if $\kappa < \underline{\kappa}$, the majority owner pays the governance cost g to design executive compensation, resulting in the equilibrium incentives given in Propositions 1 and 2. If $\kappa \geq \underline{\kappa}$, she does not pay the governance cost g, resulting in lower managerial incentives, lower managerial effort, higher costs, and higher prices.*

Common owners (high κ) endogenously choose to be passive and do not engage in the design of managerial incentives, whereas undiversified owners or diversified owners with holdings in other industries (low κ) do engage. This governance passivity of common owners offers an explanation for why the machine learning analysis of shareholder votes of Bubb and Catan (2018) categorizes the largest five common owners (BlackRock, Vanguard, State Street, Fidelity, and T. Rowe Price) as belonging to the "traditional governance party" of mutual funds. This party is distinctly deferential to management and is generally supportive of management on compensation proposals of all stripes, including say-on-pay proposals specifically. Proposition 5 is also consistent with the empirical results of Heath et al. (2020) and Schmidt and Fahlenbrach (2017). Heath et al. (2020) document that index funds are ineffective monitors who are less likely to vote against firm management on contentious governance issues and do not act to improve corporate governance through their vote or engagement. Schmidt and Fahlenbrach (2017) find a worsening of governance due to increases in passive ownership.[16]

4.3 Corporate Governance and Product Market Competition

Our theoretical results are in contrast to implicit assumptions the corporate finance, law & economics, and corporate law literatures have made about how common ownership can affect product market competition. For example, a series of papers starting with Bebchuk et al. (2017)

[16] Relatedly, Matvos and Ostrovsky (2008) also document differences in shareholders' voting behavior in mergers & acquisitions as a function of whether shareholders own stakes in both the bidder and the target.

have argued that because common owners such as index fund managers have "incentives, which would lead them to limit intervention with their portfolio companies [...] it is implausible to expect that index fund managers would seek to facilitate significant anticompetitive behavior." Our theoretical framework explains why common owners limit governance interventions with their portfolio companies. However, this passivity does not make the anticompetitive effects of common ownership implausible—quite the opposite. In our model, it is precisely the lack of intervention when setting high-powered incentives for top managers (or "excessively deferential treatment of managers," as Bebchuk and Hirst (2019) call it) that leads to less competitive product market behavior. In other words, there is no paradox between favoring more effective engagement by institutional investors and being concerned about the anticompetitive effects of common ownership. Weak governance and weak competition are jointly optimal for common owners. This insight is important because it calls into question policy prescriptions that aim to reduce common owners' governance efforts. Such an intervention would weaken both governance and competition at the same time.

Our model also produces new insights for analyzing corporate governance decisions. When firms interact strategically in the product market, from the perspective of portfolio value optimization, it may be optimal for a common owner to act like a "lazy owner," a behavior that is often associated with bad corporate governance. In other words, good governance—in the sense of measures that promote efficiency and shareholder returns from the perspective of an individual firm—imposes a negative (pecuniary) externality on product market rivals. Therefore, common owners of product market rivals may optimally reduce governance interventions, even though this leads to lower productivity, higher costs, and reduced operating performance of any individual firm, as documented by Giroud and Mueller (2010) and Giroud and Mueller (2011).

5 Data

Our theoretical framework yields testable implications for the relationship between common ownership and explicit top management incentive slopes. To test the prediction that common ownership is negatively related to the sensitivity of top management economic incentives against the null hypothesis that common ownership does not affect compensation structure, we require data on wealth-performance sensitivity and on ownership, and also a robust definition of what constitutes product market competitors. In what follows, we first detail the data sources used to construct our variables and then describe how we measure common ownership. Unless otherwise stated, our sample covers the time period between 1992 and 2019 and focuses on the universe of U.S. publicly-listed firms.[17]

5.1 Data Description

5.1.1 Executive Compensation

The empirical literature has used three leading measures of wealth-performance sensitivity. Baker and Hall (2004) and Edmans et al. (2009) provide theoretical guidance on when each measure is appropriate. They show that the relevant measure depends on whether CEO productivity is additive, linear, or multiplicative for firm profits.

First, Edmans et al. (2009) measure incentives as the dollar change in CEO wealth for a 100 percentage point change in firm value divided by annual pay. We denote this measure as WPS EGL (B^I in Edmans et al. (2009)). This measure is appropriate if CEO productivity has a multiplicative effect on firm profits (and, in turn, compensation), as it does in our model where managerial productivity improvements lead to both a margin improvement (see equation (2)) and expansion in firm output due to lower prices (see equations (1) and (10)). For this reason and because of the empirical validations in Edmans et al. (2009) demonstrating its superiority, WPS EGL is our primary measure of managerial incentives. Second, Jensen and Murphy (1990) measure managerial incentives by the change in CEO wealth for a \$1,000 increase in firm value (i.e., a dollar-dollar measure), and we denote this measure as WPS JM (B^{II} in Edmans et al. (2009)). If managerial productivity were constant in dollar terms regardless of firm size (e.g., if managerial effort were just an additive term in the firm profits in equation (3)), WPS JM would be the appropriate measure of managerial incentives. Third, Hall and Liebman (1998) measure incentives as the dollar change in CEO wealth for a percentage change in firm value. This measure is the executives' effective dollar ownership (i.e., their "equity-at-stake") and we denote it as WPS HL (B^{III} in Edmans et al. (2009)). If managerial productivity were linear in firm size (e.g., if managerial effort only improved the profit margin in equation (3) but had no impact on prices and hence output), WPS HL would be the correct measure. We use these additional two measures as

[17]This restriction is due to a lack of comprehensive data sources for managerial incentives, ownership, and industry classifications for foreign and domestic private firms.

robustness checks of the WPS EGL measure since they have been widely used in the incentives literature.[18] Summary statistics about the mean, standard deviation, and distribution of the three leading wealth-performance sensitivity measures, and CEO tenure are given in Table 4.

[Insert TABLE 4 Here.]

Our empirical analysis constructs the outcome variable using the ExecuComp database which contains over 3,462 companies, both active and inactive. The universe of firms covers the S&P 1500, plus companies that were once part of the S&P 1500, plus companies removed from the index that are still trading. Accounting and financial data for our controls such as volatility, leverage, and market equity come from Compustat.

5.1.2 Ownership

To construct the ownership variables, we use two sources of data: Thomson Reuters (institutional ownership in 13F) and Schwartz-Ziv and Volkova (2021) (blockholdings in 13D and 13G). The Thomson Reuters 13Fs are taken from SEC regulatory filings by institutions with at least $100 million total assets under management. We augment this data by scraping SEC 13F filings following Ben-David et al. (2020) which resolves the issues of stale and omitted institutional reports, excluded securities, and missing holdings from 2000 onwards.

We complement these institutional ownership data with blockholdings data from Schwartz-Ziv and Volkova (2021) because there are large, influential blockholders in many publicly-listed U.S. firms. The presence of such blockholders might be correlated with ownership by 13F institutional investors in a systematic way, and also correlate with our outcome measures. For example, some 13F institutions might have a preference for or against firms with family blockholders, which may systematically differ in their approach to governance. Thus, incorporating both institutional and non-institutional blockholders is important for the measurement of common ownership.

We describe the precise construction of the common ownership variables from these data in the following section.

[18]One issue with the EGL measure is that because CEO wealth is unobservable, EGL is scaled by annual CEO income. This is consistent with our theoretical model in which CEO income and wealth are proportional. However, in reality this may not be the case because of the volatility of CEO income. The two other WPS measures are not subject to this criticism.

5.1.3 Industry Definitions

Following the existing corporate finance literature, our baseline specifications define industries by four-digit SIC codes from CRSP. We also investigate whether our results are robust to using Compustat SIC-4 industry definitions and the 10K-text-based industry classifications of Hoberg and Phillips (2010, 2016) (henceforth HP). Finally, for additional robustness checks, we use coarser three-digit SIC codes. The advantage of broader industry definitions is that they may be more appropriate for multi-segment firms. Two significant disadvantages are that the market definition necessarily becomes less detailed and thus less accurate for focused firms, and that the variation used decreases.

Despite our efforts to use robust industry definitions, we acknowledge that no single one of them is perfect. In general, the assumption that an industry corresponds to a market in a way that precisely maps to theory will deviate from reality, no matter whether SIC or HP classifications are used. Moreover, using Compustat to extract sales and compute market shares means that we miss private firms in our sample. Studies that focus on one industry alone and benefit from specialized data sets for that purpose can avoid or mitigate these shortcomings. However, for firm-level studies involving multiple industries, the imperfection implied by coarser industry definitions is unavoidable. Our baseline assumption is that this deviation from the model, and from reality, leads to measurement error. We have no good reason to assume that these limitations should lead to false positives (or negatives) rather than attenuation bias. Nonetheless, it is advisable to keep these limitations in mind when deriving a quantitative interpretation of the results.

5.2 Measuring Common Ownership

To identify how common ownership is related to managerial incentives, we require a measure of common ownership. The existing literature provides several candidate measures of common ownership, the first of which is closely linked to the theoretical literature on common ownership, including our own model.

From equation (7), recall that the objective function of firm i is given by

$$\phi_i = \pi_i - w_i + \sum_{j \neq i} \kappa_{ij}(\pi_j - w_j)$$

where κ_{ij} is the weight that firm i places on its industry competitors j's net profits, $\pi_j - w_j$.

Specifically,

$$\kappa_{ij} = \frac{\sum_o \gamma_{io}\beta_{jo}}{\sum_o \gamma_{io}\beta_{io}}$$

where β_{io} is the ownership share of firm i accruing to shareholder o and γ_{io} is the control share of firm i exercised by shareholder o. We calculate the ownership share of investor o in firm i, β_{io}, as the percentage of all shares of firm i held by shareholder o. Following previous literature, and specifically Backus et al. (2021b), we assume proportional control, i.e., $\gamma_{io} = \beta_{io}$ as a baseline.[19]

The discussion on proportional control is important in the aggregation of shareholder preferences at the firm-pair level. However, we need a measure of kappas at the firm level, $\overline{\kappa}_i$. Thus, the weighted sum of these profit weights κ_{ij} across all the industry competitors of firm i is our main measure of common ownership. We aggregate κ_{ij} by taking an equal- or value-weighted average of the weights on the profits of the $n-1$ industry competitors of firm i as $\overline{\kappa}_i$ (or simply "kappa") defined as

$$\overline{\kappa}_i = \frac{1}{n-1}\sum_{j\neq i}\kappa_{ij} \quad \text{or} \quad \overline{\kappa}_i = \frac{1}{\sum_{j\neq i} v_j}\sum_{j\neq i}\kappa_{ij}v_j \tag{11}$$

where the weighting v_j is the stock market value of firm j that competes in the same industry as firm i.[20]

Although the average profit weight $\overline{\kappa}_i$ is the leading measure for measuring common ownership and directly maps to the profit weights used in our theoretical analysis, it is certainly not a perfect or "correct" measure of common ownership. It is therefore important to verify that our empirical results are robust to using alternative measures of the extent to which a firm's most powerful shareholders care about competitor profits.

Following the framework of Backus et al. (2021b) who show that under proportional control ("one share, one vote") each profit weight κ_{ij} can further be decomposed into

$$\kappa_{ij} = \underbrace{\cos(\beta_i, \beta_j)}_{\text{overlapping ownership}} \times \underbrace{\sqrt{\frac{IHHI_j}{IHHI_i}}}_{\text{relative IHHI}}. \tag{12}$$

The first term is the cosine of the angle between the vector β_i of ownership positions β_{io} that

[19] We can relax this assumption to test whether our results are robust to other reasonable specifications. Like Backus et al. (2021b) we use a power function such that $\gamma_{io} = \beta_{io}^{\lambda}$. As we increase the value of λ, we increase the convexity of the control weights and place more weight on the largest investors. Table C2 shows that our results are robust to different values of λ.

[20] Throughout our empirical analysis we use value-weighted measures of common ownership because these most closely match our theoretical analysis. The results are similar for equal-weighted measures of common ownership.

owners o hold in firm i and the corresponding vector β_j for firm j. The second term is the ratio of the "investor Herfindahl–Hirschman indices" $IHHI_i = \sum_o \beta_{io}^2$ and $IHHI_j = \sum_o \beta_{jo}^2$ for the owners of firm i and j.

The cosine similarity captures the overlap in ownership and is the origin of the incentive to internalize the profits of another firm. Abstracting from the possibility of large short positions, ownership shares in (i, j) are non-negative, and therefore this similarity metric $\cos(\beta_i, \beta_j)$ is restricted to the $[0, 1]$ interval. A cosine similarity of zero corresponds to no common ownership while a cosine similarity of 1 corresponds to identical shareholding structures. Since this is an L_2 similarity measure, the metric puts more weight on large owners than small owners. The second source of variation in common ownership profit weights comes from the ratio of the IHHI indices. Firms with relatively more concentrated investors place more weight on their own profits and less weight on competitor profits.

Ownership similarity is the symmetric component of the profit weight; if it increases, it will increase the objective functions of both firms in the industry. On the other hand, the relative shareholder concentration term is inherently asymmetric. To the extent that the asymmetric incentives of the profit-weight model are limited by legal restrictions or managerial behavior, empirically we may see the first-order effects of common ownership propagate through cosine similarity, as suggested by Boller and Scott Morton (2020). We therefore also use the weighted averages of the cosine similarity across all the $n - 1$ competitors (indexed by j) of firm i as a firm-specific measure for common ownership, which are given by

$$\overline{\cos}_i = \frac{1}{n-1} \sum_{j \neq i} \cos(\beta_i, \beta_j) \quad \text{or} \quad \overline{\cos}_i = \frac{1}{\sum_{j \neq i} v_j} \sum_{j \neq i} \cos(\beta_i, \beta_j) v_j. \tag{13}$$

An alternative measure we employ is the average fraction of competitor shares held by the firm's top five shareholders, which we call the Top 5 shareholder measure. This is a model-free measure. In particular, this firm-specific measure for firm i is defined as

$$\overline{Top5}_i = \frac{1}{n-1} \sum_{o}^{5} \sum_{i \neq j} \beta_{jo} \quad \text{or} \quad \overline{Top5}_i = \frac{1}{\sum_{j \neq i} v_j} \sum_{o}^{5} \sum_{i \neq j} \beta_{jo} v_j \tag{14}$$

where β_{jo} is again the ownership share of firm j accruing to shareholder o who is one of the 5 largest owners of firm i, and j indexes all of firm i's competitors (of which there are $n - 1$ for a given industry).

Another established and popular measure of connectivity and ownership overlap between firms comes from Antón and Polk (2014). It constructs a measure of common ownership that is the total value of stock held by all the common shareholders o of two industry competitors i and j, scaled by the total market capitalization of the two stocks i and j. Specifically, this pair-level measure is

$$AP_{ij} = \frac{\sum_o (S_i^o P_i + S_j^o P_j)}{S_i P_i + S_j P_j}$$

where S_i^o is the number of shares held by owner o of firm i trading at price P_i with a total of S_i shares outstanding, and similarly for the stock of firm j. We use the weighted average across all $n-1$ industry competitors of firm i and refer to it as the Anton-Polk (or AP) measure of common ownership:

$$\overline{AP}_i = \frac{1}{n-1}\sum_{j\neq i} AP_{ij} \quad \text{or} \quad \overline{AP}_i = \frac{1}{\sum_{j\neq i} v_j}\sum_{j\neq i} AP_{ij} v_j. \tag{15}$$

We also use the modified cross-holdings measure from Harford et al. (2011) (henceforth the HJL measure), which accounts for the incentives of common investors during the merger of two firms. In their setting, the shareholders of a bidding firm are more likely to internalize the effect of paying a lower takeover premium on the target firm if they also own shares of the target. To capture this externality of common ownership, they estimate each investor's relative ownership stake in the target to that of the acquirer in the following way: $HJL_{bt} = \frac{\beta_{to}}{\beta_{bo}+\beta_{to}}$. We build this measure for each investor, and aggregate these relative weights across investors for each pair of firms (instead of bidder b and target t, we follow our consistency labeling the firms focal i and competitor j). The weight that each investor has in this measure is her ownership in the focal firm, β_{io}. Specifically, this pair-level measure is given by $HJL_{ij} = \sum_o \beta_{io}\frac{\beta_{jo}}{\beta_{io}+\beta_{jo}}$. We use the weighted averages of this measure across all industry competitors of firm i, given by

$$\overline{HJL}_i = \frac{1}{n-1}\sum_{j\neq i} HJL_{ij} \quad \text{or} \quad \overline{HJL}_i = \frac{1}{\sum_{j\neq i} v_j}\sum_{j\neq i} HJL_{ij} v_j. \tag{16}$$

Finally, we use the "modified Herfindahl-Hirschman index Δ" (henceforth MHHID) as another measure of common ownership. This measure, originally developed by Bresnahan and Salop (1986) and O'Brien and Salop (2000), is used by regulators worldwide to assess competitive risks from the holdings of a firm's stock by direct competitors, and has been used by a number of previous empirical contributions to the literature on common ownership. Specifically, it is derived from the total market concentration (MHHI), which is composed of two parts: product market concentration as measured by HHI ($\sum_i s_i^2$) and common ownership concentration as measured by MHHID. HHI captures the number and relative size of competitors and MHHID captures to what extent these competitors are connected by common ownership. Formally,

$$\underbrace{\sum_i \sum_j s_i s_j \frac{\sum_o \gamma_{io}\beta_{jo}}{\sum_o \gamma_{io}\beta_{io}}}_{\text{MHHI}} = \underbrace{\sum_i s_i^2}_{\text{HHI}} + \underbrace{\sum_i \sum_{j \neq i} s_i s_j \frac{\sum_o \gamma_{io}\beta_{jo}}{\sum_o \gamma_{io}\beta_{io}}}_{\text{MHHID}}. \tag{17}$$

As before, we assume proportional control, $\gamma_{io} = \beta_{io}$. An attractive feature of MHHID is that it can be micro-founded with a voting model (Azar, 2016; Brito et al., 2018). The disadvantage of this measure relative to firm-level measures of common ownership (e.g., $\overline{\kappa}_i$, $\overline{\cos}_i$, $\overline{Top5}_i$, $\overline{AP}_i$, $\overline{HJL}_i$)[21] is that MHHID may absorb relevant cross-sectional variation (of shareholder overlap between the different companies) across firms within the same industry. By looking at firm-level measures of the "effective sympathy" that one firm's shareholders should have towards connected firms based on their portfolios, we capture more precisely the intensity of the influence of potentially asymmetric common ownership links between firms. For example, one firm in an industry of five competitors may be controlled by a single investor without stakes in competitors, whereas the other four firms are commonly owned.[22] Table 4 reports summary statistics for the different common ownership measures.

6 Empirical Analysis

6.1 Empirical Design

The main contribution of our theoretical analysis is to provide a mechanism, namely managerial incentive contracts, through which common ownership can affect product market structure and

[21] An omission from this list of firm-level measures of common ownership is the measure proposed by Gilje et al. (2020). This is because in their model "the measure cannot be interpreted as a profit weight" (Backus et al., 2020) and, by assumption, it "does not allow for strategic interactions" between either managers or firms (Gilje et al., 2020). It is therefore unsuitable in our context, which explicitly links managerial incentives to investor profit weights and focuses on strategic interactions between firms.

[22] To address the potential endogeneity of market shares that are an input to MHHID, we also use an equal-weighted (rather than market share-weighted) measure of MHHID, denoted by MHHID 1/N.

outcomes. We thereby provide an explanation for various previously documented (but unmodeled) results in the literature. However, the central prediction of our proposed mechanism, which has not been tested thus far, is that the strength of top management incentives varies across firms by the level of common ownership of the firms they manage. We now empirically test this prediction using various measures of wealth-performance sensitivity (WPS) and several common ownership measures.[23]

Our baseline panel analysis uses the following specification:

$$WPS_{ijzt} = \theta \cdot CO_{it} + \xi \cdot X_{ijz_4t} + \eta_{z_2t} + \upsilon_i + \varepsilon_{ijzt}, \tag{18}$$

where i indexes firms, j indexes managers, z_4 denotes industries at the four-digit level and z_2 at the two-digit level, X is a vector of controls, η_{z_2t} and υ_i are industry-year and firm fixed effects, respectively, and CO_{it} is our principal variable of interest, a measure of common ownership. Because our theoretical framework does not yield an explicit solution for the optimal managerial incentive slope, we remain agnostic as to the specific functional form in which common ownership influences managerial wealth-performance sensitivity. We use rank-transformed measures of common ownership, including equal- or value-weighted averages of profit weights, average cosine similarity, the top 5 shareholder, the AP, and the HJL measure, as well as industry-level MHHID, to allow for straightforward comparisons. All these common ownership measures are at the firm level except MHHID, which is measured at the four-digit industry level.

In our panel regressions, we use fixed effects to difference out potentially confounding variation. For example, there could be industry-level trends in common ownership that are correlated for unmeasured reasons with trends in managerial incentive slopes. Including industry-year fixed effects ensures that the common ownership coefficient is not estimated from such correlated trends. The remaining source of identifying variation is, mainly, differences across firms in changes over time in common ownership and incentive slopes.[24] The firm fixed effects ensure that the results are not driven by unobserved omitted firm characteristics that happen to be correlated both with

[23] An empirical analysis of the effect of managerial incentives on productivity and product market outcomes would require measuring or estimating managerial effort and firms' marginal costs which we do not undertake in this paper.

[24] There is also remaining variation across four-digit industries within two-digit industry-years. In regressions that use MHHID as the measure of common ownership, the *only* remaining variation is across four-digit industries within two-digit industry-years. All our coefficient estimates for firm-level measures of common ownership persist if we use four-digit industry-year fixed effects instead.

common ownership and incentive slope levels.

To make sure that our results are not driven by outliers, we winsorize our measures of compensation, sales, book-to-market, and institutional ownership at the 1% level. All standard errors are clustered two ways, at the firm and year level (Petersen, 2009).

6.2 Panel Regressions

Table 5 presents results from our baseline panel regressions. Column (1) regresses the natural logarithm of wealth-performance sensitivity (WPS) on our principal measure of interest, the year-by-year rank-transformed, equal-weighted average $\overline{\kappa}_{it}$, while controlling for size, book-to-market, volatility, leverage, executive's tenure with the firm, and institutional ownership,[25] as well as using (time-invariant) firm fixed effects and (time-varying) industry-year fixed effects.[26] The coefficient on the equal-weighted $\overline{\kappa}_{it}$ is negative, -0.239, and statistically significant. That is to say, wealth-performance sensitivities tend to be significantly lower for CEOs of firms that are more commonly owned. Column (2) uses the same specification as column (1) but instead uses the more appropriate value-weighted average $\overline{\kappa}_{it}$ as a measure of common ownership, to account for relative firm size among competitors. The paper's theoretical analysis suggests that relative firm sizes should matter for the preferences of common owners (e.g., equation (7)). The coefficient estimate for $\overline{\kappa}_{it}$ is very similar in magnitude (-0.222) and also statistically significant at the 1% level. Our coefficient estimates are also almost identical when we use higher-order polynomials or quintile dummies of the firm size measure, thus assuaging concerns that the common ownership variable might be picking up a non-linear effect of firm size. Our baseline results are based on $\overline{\kappa}_{it}$ computed assuming proportional control. Relaxing this assumption yields similar results, as shown in Table C2, where we vary the values of λ, in a similar way as Backus et al. (2021b) do.

[Insert TABLE 5 Here.]

All specifications use firm fixed effects to remove firm-invariant characteristics and industry-time fixed effects to account for trends in WPS that are industry-specific and may change over

[25] In Table C1 we explore the relationship between common ownership and institutional ownership in different specifications, as computed in Hartzell and Starks (2003). Our results are robust to the exclusion of institutional ownership, as well as the inclusion of different institutional ownership related variables.

[26] In order to achieve a close match between the multiplicative structure of managerial effort in our model and the empirical tests, this specification follows the analysis of CEO incentives in Table 2 of Edmans et al. (2009). The key differences are the additional fixed effects, industry controls, and the common ownership measure.

time. For example, important events such as the tech bubble in the early 2000s or the 2008 financial crisis may have affected industry compensation practices differently across time. The inclusion of these fixed effects ensures that we avoid spurious inferences from industry-wide trends or time-invariant firm compensation policies, instead basing our inferences only on within-firm and within-year variation.[27]

Importantly, because our regressions include firm (and industry-year) fixed effects, the results should be interpreted as driven by within-firm (and within-industry-year) variation in ownership and compensation structure over time. Firms change the wealth-performance sensitivity of their CEOs' compensation based on changes in how much shareholders place on the profits of industry competitors.

In order to conservatively estimate whether there is a significant panel correlation between common ownership and WPS, we present fully saturated regressions with a large number of fixed effects that might absorb more variation than desirable to arrive at the most meaningful quantitative estimates. That said, the estimated coefficient is similar in magnitude to other first-order determinants of WPS in the literature. Shifting a firm's average profit weight from the 25th percentile to the 75th percentile of the distribution of value-weighted average kappa would be associated with a 10.5% decrease ($= e^{-0.222\times(0.75-0.25)} - 1$) in CEO wealth-performance sensitivity.

This reduction in WPS can have a meaningful effect on a CEO's wealth. Recall that WPS is the dollar change in CEO wealth for a 100 percentage point change in firm value divided by annual flow compensation. For the average CEO in our data, WPS is around 20, and average flow compensation for a CEO in the S&P 500 was \$14.8 million in 2019. For a CEO at the 75th percentile of common ownership, a 50% increase in firm value would thus increase his wealth by \$148 million. This number is almost \$17 million (or almost three quarters of the CEO's annual compensation) smaller if the firm ranks 50 percentiles lower in terms of its common ownership weights (10.5% $\times$ \$148 million = \$15.54 million).

6.2.1 Alternative Industry Definitions

Our empirical analysis assumes that firms belonging to the same industry definitions compete in at least some product markets. Four-digit definitions could either be too narrow (if firms

[27] Table C3 shows that our results are robust to alternative fixed effects specifications (including the absence of fixed effects).

compete in multiple product markets labeled by different industry definitions) or too broad (if firms only compete in some product markets but not others, all of which belong to the same industry designation). Alternative industry definitions of a given granularity could also vary with respect to the extent to which they capture product market interactions. We now investigate to what extent our results are sensitive to alternative industry definitions.

Specifications (3) to (6) of Table 5 present evidence of the robustness of the results shown in the previous two columns to the data source used to compute industries. Columns (1) and (2), presented above, use CRSP definitions of SIC-4 codes, whereas columns (3) and (4) use Compustat, and columns (5) and (6) use the Hoberg-Phillips four-digit industry definitions. The coefficient estimates for common ownership remain similar in magnitude and statistically significant in all specifications. We conclude that our baseline results are robust to what is considered a competitor for any given firm and to how industries are defined.

6.2.2 Alternative Measures of Common Ownership

Our baseline results may suffer from a concern about the particular measure of common ownership we use, namely the weighted average of the profit weights that a firm i attaches to the profits of other firms. Although this particular measure has several attractive properties and is closely related to our theoretical analysis, there is no generally accepted theory to inform corporate objectives when firms are not price takers and shareholders have interests outside the firm. Therefore, we examine how the results change as we employ several alternatives that capture to what extent firms should display "effective sympathy" to their industry competitors. First, following Backus et al. (2021b), we decompose the profit weights into their sub-components and compute a firm's average of the cosine similarity with its industry competitors. Second, we calculate to what extent the top five shareholders in a firm own competitor stocks as well. Third, we use the Anton-Polk measure of common ownership. Fourth, we use the Harford et al. (2011) cross-holdings measure. Fifth, following the extant literature on common ownership, we use the MHHID and MHHID 1/N measures, which only vary at the industry level.

We present the results in Table 6. All measures of common ownership are significantly negatively related to CEO wealth-performance sensitivity with comparable magnitudes to our baseline estimates. An interquartile range move in the various alternative common ownership measures corresponds to a decrease of 6.6% ($= e^{-0.136\times(0.75-0.25)} - 1$) to 11.1% ($= e^{-0.237\times(0.75-0.25)} - 1$) in

CEO wealth-performance sensitivity.

[Insert TABLE 6 Here.]

In Appendix Table C4, we further show that this pattern also holds when using alternative industry definitions. We obtain very similar coefficient estimates that are statistically significant across almost all measures of common ownership and all industry definitions.

We also investigate which of the two components of the weighted average of the profit weight κ is principally responsible for the negative impact on wealth-performance sensitivity. In Appendix Table C6, we show that both the cosine similarity and IHHI ratio are negatively associated with wealth-performance sensitivity.

6.2.3 Alternative Measures of Wealth-performance Sensitivity

Another important question regarding the evidence we have presented so far is to what extent our insights are robust to the way managerial wealth-performance sensitivities are calculated. To investigate this question, Table 7 presents the same specifications as in Table 5 but with various alternative outcome variables, providing different measures of the sensitivity of CEO wealth to firm performance.

[Insert TABLE 7 Here.]

In Appendix Table C5, we show that this pattern also holds for alternative industry definitions and alternative measures of common ownership, thus illustrating that across all dimensions (i.e., wealth-performance sensitivities, common ownership measures, and industry definitions) of the full matrix of robustness checks, our results remain consistently negative, with similar economic magnitudes and statistical significance levels. Columns (1) through (3) use Jensen and Murphy's (1990) WPS measure, and columns (4) through (6) use Hall and Liebman's (1998) version of WPS. The results are qualitatively similar in magnitude to those presented in Table 5 and Table 6 and are statistically significant throughout. An interquartile reduction in value-weighted κ corresponds to a -8.0% reduction in WPS JM and a -5.3% reduction in WPS HL, both of which are comparable to the -10.5% reduction in the benchmark WPS EGL measure.

6.2.4 Other Robustness Tests

Table 8 shows that when common ownership is higher the wealth-performance sensitivity of top management compensation is lower, not just for CEOs but also for all top executives. The negative association between common ownership and wealth-performance sensitivity remains significant for almost all measures of common ownership, but the effect is weaker than for CEOs. One interpretation of this result is that CEOs are principally responsible for firm strategy and thus their decisions have a much greater impact on the profits of competitors than those of other top managers. Therefore, we would expect the incentive-reducing effect of common ownership to be most pronounced for CEOs.

[Insert TABLE 8 Here.]

To check robustness with respect to the relative timing of changes in common ownership and changes in WPS, in Appendix Table C7 we present the coefficient estimates of the same specification as in our baseline regressions but with one-year lags in the common ownership variables. Across all industry definitions and common ownership measures, the coefficient estimates and standard errors are very similar to our baseline regressions, and are even slightly larger in magnitude for the Hoberg-Phillips industry definitions.

Finally, in Appendix Table C8, we consider coarser industry definitions at the three-digit level. We find again that the relationship between wealth-performance sensitivity and common ownership is negative and statistically significant throughout. However, the magnitude of the estimated coefficients is somewhat smaller than for our baseline regressions. We hypothesize that this is due to attenuation bias because three-digit industry definitions less precisely capture the extent to which members of the defined set of competitors interact in the product market.

In sum, the baseline panel results are neither driven by the industry definition, nor by the measure of common ownership, nor by the measure of wealth-performance sensitivity we use. However, one might be concerned that sorting of executives with particular characteristics and preferences could be driving the results. For example, less aggressive CEOs might sort into firms that are held by common owners who, for unexplained reasons (i.e., other than their economic interests) also systematically offer "flatter" compensation packages. Our interpretation is not challenged by this plausible explanation: the purpose of the paper is to show that in firms whose largest owners are widely diversified, top managers receive less performance-sensitive compensation. Given that this sorting hypothesis is part of the narrative we propose, we do not intend to challenge this interpretation.

6.3 Difference-in-differences Design Using S&P 500 Additions

There is a key difference between our panel regression analysis and our theoretical analysis. In the model, ownership is assumed to be exogenous, but in the data, ownership could be endogenous. The panel regression coefficients may therefore not have the interpretation that common ownership leads to lower managerial wealth-performance sensitivities. For example, it could be the case that unobserved expected changes in firms' product market strategies drive both changes in common ownership and changes in the structure of executive compensation. To investigate to what extent the correlations reported so far have a causal interpretation, we employ a strategy that is based on shocks to common ownership due to index additions of competing firms. Specifically, we examine whether the negative correlation between common ownership and managerial wealth-performance sensitivity persists when we use only variation in common ownership that is caused by index additions of industry competitors.[28]

S&P 500 additions have been extensively used as a shock to ownership in the empirical literature over the past two decades (Afego, 2017). There are two fundamental criticisms of using index inclusion as a shock to a particular firm's (common) ownership. First, firms are selected from a committee to be added to the S&P 500, and hence the decision can be somewhat affected by the recent performance of the company. Second, once the firm is added to the S&P 500, there are many confounding effects observed: the company becomes more visible and receives more attention from analysts and the media, in addition to experiencing a change in ownership. Lewellen and Lowry (2020) further note that common ownership of firms newly added to the S&P 500 increases, but so does institutional ownership, while block ownership decreases. The change in common ownership weights of newly added firms is therefore not a suitable strategy for identifying common ownership effects.

To avoid these concerns, we employ a different identification strategy, pioneered by Boller and Scott Morton (2020). We use the addition of a stock j in the S&P 500 as a treatment shock

[28] Lewellen and Lowry (2020) and Egen (2019) criticize various instruments that the previous literature uses to identify firm-level effects of common ownership, in particular the addition of a firm to the S&P 500 as a treatment, the use of the BlackRock-BGI merger for identification of firm-level effects, institutional mergers, and Russell index reconstitutions. We do not use any of the identification techniques they scrutinize.

to the common ownership weights of *its industry competitors i that are already in the S&P 500.* The addition does not cause a change in ownership of these index incumbent competitors; their institutional ownership and block ownership is unaffected. However, as Boller and Scott Morton (2020) show (and as we confirm in our own analysis), the common ownership weights κ_{ij} the investors of these competitors i put on their newly added rival j do change, simply as a result of their investors adding the index entrant to their portfolios. We investigate to what extent the structure of the treated firms' executive pay packages changes when compared to control firms that are unaffected by the same index inclusion because they are not in the same industry as the newly included firm.[29]

For illustration, consider an industry with three firms (A, B, and C), two of which (A and B) are already in the S&P 500. When C is added to the index, index funds that already own shares in A and B will be forced to buy shares in C as well. As a result, both A and B will experience an increase in common ownership weights, whereas control firms outside the industry do not experience a change in common ownership weights. C is excluded from the analysis. Given the dearth of theoretical guidance, our empirical implementation is agnostic about the particular functional form by which shareholders' economic interests in the newly added competitor change. We limit ourselves to testing if there is an effect of a treatment with regards to whether common ownership increases.

In the period 1994-2019 we identify 379 additions to the S&P 500. Boller and Scott Morton (2020) show that the effect on peers is more pronounced when there is a true addition (the company added was not previously in the S&P400 or the S&P600) rather than a promotion (the added company was previously in the S&P400 or the S&P600). We therefore focus exclusively on 289 true index additions. We use a difference-in-differences approach and investigate the impact of the additions on WPS during an event window of five years before and after the addition. For each index addition, we identify as treated firms those that are in the same SIC-4 industry as the added firm and that are already members of the S&P 500. The control firms are those firms that are in the S&P 500 but not in the same SIC-4 industry as the added firm and that do not experience an inclusion in their industry in the same year of the inclusion event. This leaves us

[29] Index additions of competitors could change short-term hedging demand for an incumbent firm's stock. However, we are not aware of evidence that competitor index additions have longer-term effects on index incumbents that would be relevant in our setting. Furthermore, such effects would confound our strategy only if these factors were also correlated with changes in wealth-performance sensitivity.

with 163, 179, and 151 true index additions with a sufficient number of pre- and post-inclusion years for the CRSP, Compustat, and Hoberg-Phillips industry definitions, respectively.

[Insert FIGURE 3 Here.]

Figure 3 shows that the index inclusion of a direct industry competitor shifts the distribution of the average kappa (left panels) and cosine similarity (right panels) of treated firms (i.e., those in the same industry that were already in the index) to the right, for all industry definitions. The average kappa and cosine similarity of the index incumbent firms are lower before (solid blue line) than after (dashed red line) the index inclusion of a direct industry competitor.

These figures, which corroborate earlier findings by Boller and Scott Morton (2020), indicate that treated companies experience an increase in common ownership when they are treated. However, we are also interested in whether treated firms experience an abnormally strong increase in common ownership when they are treated. Appendix Table C10 reports the output from regressions of the change in common ownership, as measured by cosine similarity, on a treatment dummy, as well as on firm and year fixed effects. The estimate is identified from variation within each firm in the change of common ownership. The results indicate that treated firms experience an abnormally strong increase of common ownership when they are treated, compared to other firms in the same year and compared to their usual change in common ownership in other years.

We compare the WPS of treatment versus control firms before and after the inclusion event using the following specification:

$$WPS_{ijzt} = \zeta \cdot Treat_{ijz_4} + \theta \cdot Treat_{ijz_4} \cdot Post_{xt} + \xi \cdot X_{ijzPre} + \nu \cdot X_{ijzPre} \cdot Post_{xt} + \upsilon_i + \eta_t + \iota_x + \varepsilon_{ijzt}, \quad (19)$$

where i indexes firms, j indexes managers (CEOs), z_4 denotes industries at the four-digit level, t indexes years, x indexes index inclusion events, X_{ijzPre} is a vector of controls measured in the year of the addition (to avoid using potentially endogenous post-treatment variation in controls), and υ_i, η_t, and ι_x are the firm, year, and inclusion fixed effects, respectively. The estimation is run on a sample with five pre- and five post-years of the event treatment year. $Post_{xt}$ is, for any given inclusion event x, a dummy variable equal to 1 for the year of the inclusion event and all years after, and 0 for the years before. $Treat_{ijz_4}$ is a dummy variable equal to 1, for all sample years, if firm i, which is already in the index, experiences the index inclusion of a product market competitor (i.e., a firm with the same four-digit industry z_4 as firm i) during the sample period, and 0 otherwise. The firm being added to the index is excluded from the sample and is neither "treatment" nor "control" for the particular inclusion event.

A further explanation is in order to understand the remaining identifying variation. The key is to view every addition as a separate event. Recall the above example industry featuring firms A, B, and C. When C is added to the index, the treatment dummy takes the value of 1 for firms A and B, whereas it is 0 for all other sample firms—for all years of the sample. If in another industry (featuring firms X, Y, and Z), Z is added to the index in the same year when C is added, the treatment dummy is 1 for X and Y, but 0 for all other firms—except A, B, and C, which are removed as controls because their industry experienced an inclusion in the same year. If the inclusion of Z occurs in a different year than the inclusion of C, then A, B, and C each serve as controls. As a result, there is within-firm, across-event variation in whether the firm is treated, or whether it belongs to a control. Because inclusions happen in multiple years, there is also within-firm variation over time in whether it is treated or not. Therefore, firm and year fixed effects (υ_i and η_t) are not absorbed in the above design. $Post_{xt}$ is a dummy that is specific to an inclusion event and therefore does not get absorbed by year fixed effects either. In contrast, any given inclusion event assigns all firms to either the treatment or control group. Therefore, the treatment dummy is absorbed by firm fixed effects. Lastly, some specifications include inclusion fixed effects, ι_x. This serves the purpose of taking out potentially omitted variation across firms and over time that correlates with both WPS and the incidence of additions that may be heterogeneous across firms. The remaining variation is differences across firms in within-firm variation of common ownership over time that is due to the index inclusion of industry competitors.

Table 9 shows that following the index inclusion of a direct competitor that was previously not in the index, the WPS of CEO compensation at index incumbent firms operating in the same industry declines by 16.4% ($= e^{-0.179} - 1$). This result is estimated using the same set of controls as our panel regressions, as well as firm and year fixed effects. Columns (2), (4), and (6) report results with inclusion fixed effects, which lead to only small changes in the coefficient estimates. Columns (3) to (6) further show that these results are also very similar for alternative four-digit industry definitions based on Compustat and Hoberg-Phillips. As in our baseline estimations, the incentive-reducing effect is smallest in magnitude for the Hoberg-Phillips industry definitions, for which the decline in WPS is equal to 10.1% ($= e^{-0.107} - 1$).

[Insert TABLE 9 Here.]

Figure 4 plots the estimated effect of the index inclusion of an industry competitor on WPS over time. First, it shows that the negative effect of the index inclusion of a competitor on CEO WPS is not present before the inclusion of the competitor into the index. The pre-inclusion coefficient estimates are consistently insignificant. Second, it shows that the negative effect on CEO WPS is gradual. It increases in magnitude over time following the competitor's index inclusion and is consistently statistically significant for the post-competitor-inclusion years.[30]

[Insert FIGURE 4 Here.]

Finally, the incentive-reducing effect of a competitor index addition is only measurable for true additions to the index, but not for promotions from a similar index. Boller and Scott Morton (2020) show that such promotions are not followed by a similarly large increase in common ownership as true additions, and they do not find significant stock return reactions for these promoted companies' stock returns either. Similarly, in untabulated results we find that there is no statistically significant increase in common ownership due to promotions and that wealth-performance sensitivity does not decrease significantly for the index incumbents following the promotion of an industry competitor to the index. We view these results as an informative placebo exercise because they show that the reduction in WPS is not a mechanical consequence of the index addition of a competitor. As predicted by our theory, an associated ownership change appears to be necessary to obtain our result.

We therefore conclude that the index inclusion of a direct industry competitor increases common ownership and thereby decreases the WPS of CEO compensation. This result allays the empirical concern that endogenous ownership confounds the interpretation of the negative correlation between common ownership and managerial incentives reported in our panel regressions.

The strategy also allays the concern that other features of ownership, such as block ownership, institutional ownership, or passive ownership could be the true drivers of our results. The ownership structure of the treated firm does not change as a result of a competitor being added to the

[30] Although data limitations, industry definitions, and the complexity of multidimensional contracts make it difficult to test systematically for changes in the actual structure of compensation contracts conditional on the addition of a rival firm into the S&P 500, there is anecdotal evidence. For example, United Airlines was added to the S&P 500 in late 2015. In 2016, American Airlines, which was already in the S&P 500, changed its executive compensation contract to reward profit margins (which typically decrease with quantity produced) from its earlier focus on market share and consumer satisfaction metrics. In our data, this also coincides with a reduction (starting in 2016 and continuing strongly in subsequent years) in the wealth-performance sensitivity measure.

index—only the other portfolio components of the treated firms' owners change. Therefore, these difference-in-difference results are unlikely to be driven by omitted features of firm ownership.

Another challenge to a causal interpretation is the possibility of either a strategic response or "behavioral" reasons for why "treated" firms respond with reduced WPS to a rival being added to the index. Suppose for example that a newly added rival's WPS decreases as a result of its addition to the index. This may occur because of greater media attention, investor following, or brand recognition, which might substitute for performance-sensitive pay. Index inclusion may also change the index entrant's own ownership and therefore its incentive structure. If the firms that are "treated" with a newly added industry rival merely respond to the newly included firm's reduced WPS, our strategy might identify a "false positive" (negative) effect of common ownership on WPS. However, we find that the WPS of the newly added firms themselves does not in fact significantly change following additions to the S&P 500 (Figure C1). Therefore, strategic or behavioral responses of the index incumbents to changes of WPS of the newly-included firms cannot explain our results.

7 Conclusion

In this paper, we examine how shareholder portfolio interests affect optimal managerial incentive contracts under strategic product market competition. Our theoretical framework is built on standard assumptions in organizational economics and industrial organization. It provides a unified explanation for a large set of empirical facts, including that the sensitivity of top managers' wealth to their firm's performance is weaker when the firm's largest shareholders are also large shareholders of the firm's competitors. Using panel regressions and a difference-in-differences based on competitor index inclusions we find consistent and robust empirical support for this prediction. Firm-level common ownership has a large negative effect on the performance-sensitivity of managerial incentives. We also explain why firms set different prices across different product markets in the same industry, in ways that are consistent with prior empirical evidence on common ownership.

Some of these predictions depend on the assumption that shareholders can only affect the performance-sensitivity of top management incentives and that category-specific pricing decisions are delegated to middle managers. If, by contrast, investors (i) directly choose prices themselves,

(ii) perfectly align the incentives of pricing specialists with their own, or (iii) centralize all multi-product pricing decisions in the hands of the top manager and reward him based on competitors' profits, the model generates alternative predictions that do not capture all of the empirical facts. Therefore, our theoretical framework and empirical evidence can restrict the kinds of governance channels that are important for common ownership to have effects on firm behavior and product market outcomes, including firm efficiency, prices, and markups.

Our analysis shows that unilateral incentives arising from managerial compensation can be a mechanism through which common ownership influences product market competition. However, real-world competition between firms is more complex than our model assumes and than what we investigate in our empirical analysis. For example, common ownership may also affect (and be affected by) competition in input and labor markets and competition by foreign and private firms. Measuring such effects will refine our understanding of the interplay of common ownership and competition.

Finally, our results challenge the validity of a ubiquitous and fundamental assumption in industrial organization, organizational economics, and corporate finance that has rarely been examined. The fact that firms' ownership structures and shareholders' competitive preferences affect the structure of managerial incentives suggests that a firm's behavior and objectives depend on who owns the firm. Our model assumes an alternative objective function that is useful in organizing a set of empirical facts. It also provides an answer to the question of how the interests of owners trickle down through complex hierarchical organizations and "affect those making pricing decisions throughout the organization." Our findings may motivate future studies that test hypotheses derived from alternative firm objective functions and that recognize the organizational structures of competitors.

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Figures

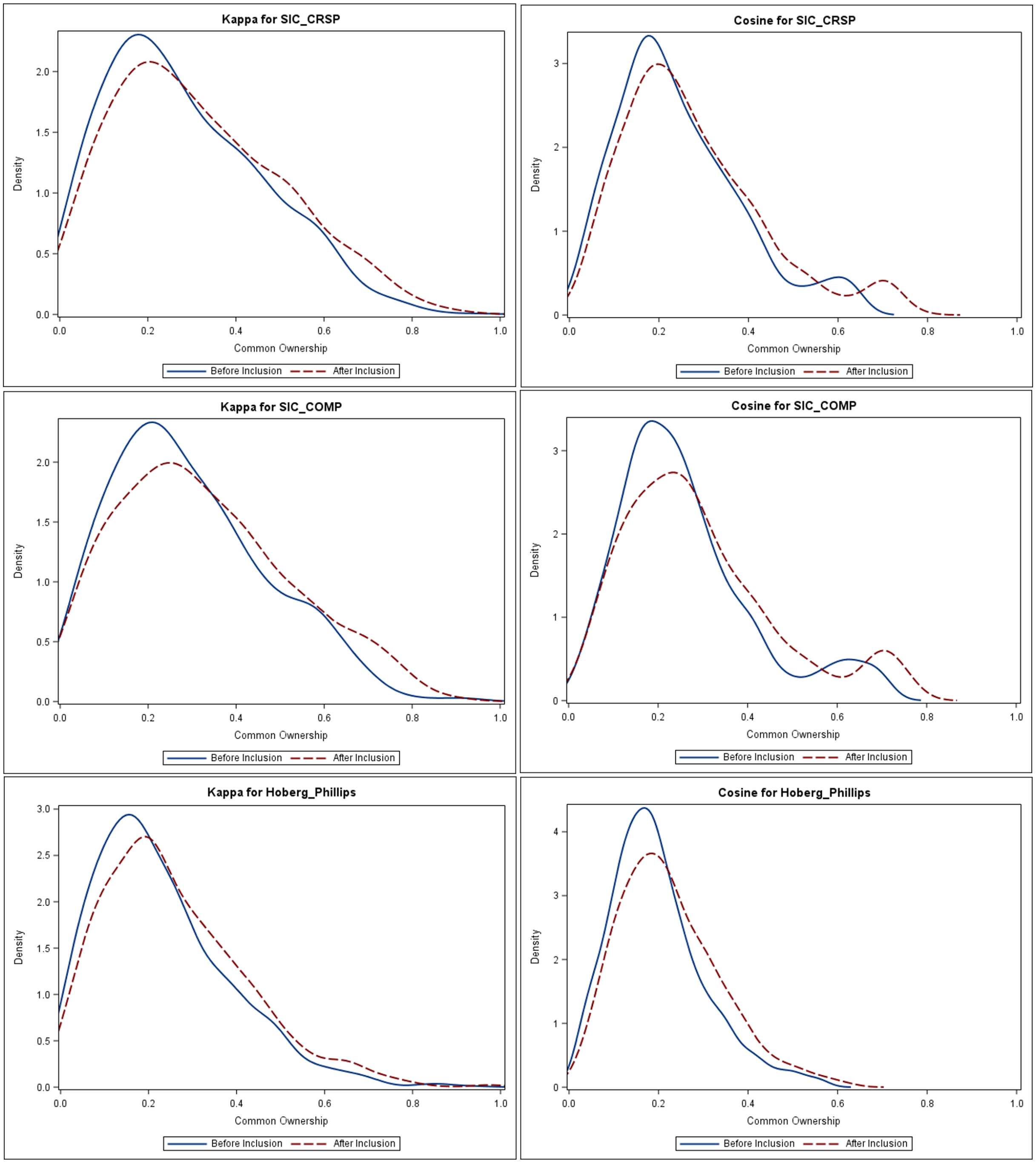

Figure 3. Distributions of kappa and cosine similarity before and after index inclusion of a competitor This figure plots the distributions of kappa (left panels) and cosine similarity (right panels) before (solid blue line) and after (dashed red line) index inclusion of a competitor for four-digit CRSP (1st row), Compustat (2nd row), and Hoberg-Phillips (3rd row) industry definitions.

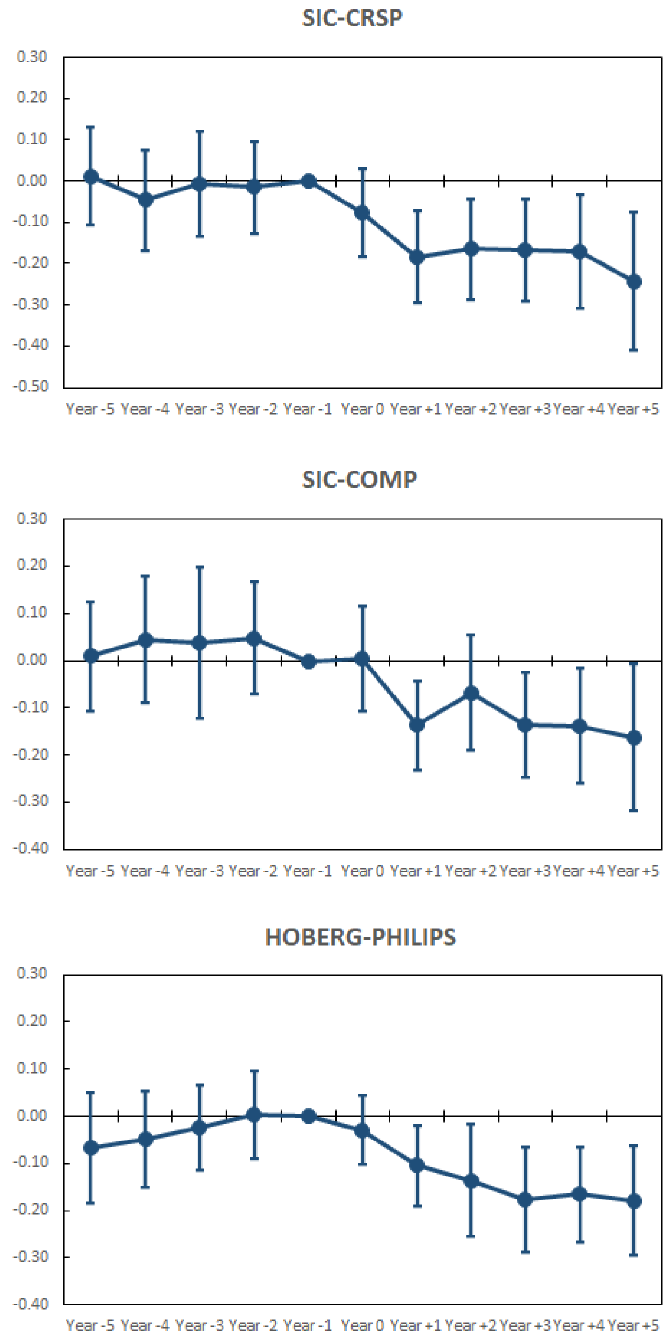

Figure 4. Estimated coefficients of S&P500 inclusion treatment indicator interacted with year fixed effects on WPS.
The graph plots the estimated coefficient on interactions of the treatment indicator variable with year fixed effects. We drop the interaction for the end of the year previous to the inclusion, and thus the effect is normalized to zero for that year. We control for volatility, natural log of market equity, leverage, HHI, and natural log of tenure, each evaluated in the year previous to the inclusion, and interacted with year fixed effects. We also include firm and year fixed effects, and double-cluster standard errors at the firm and year levels.

Tables

Table 2. Panel A: Virgin America's largest shareholders.
The data are from S&P Capital IQ (Q2 2016) and reflect the shareholder structure before the merger with Alaska Airlines.

Virgin America	[%]
Richard Branson	30.77
Cyrus Capital Partners	23.52
Virgin Group Holdings Ltd.	15.34
Vanguard	2.89
BlackRock	2.25
Alpine Associates Advisors	2.11
Hutchin Hill Capital	2.09
Societe Generale	1.84
Apex Capital	1.74
Morgan Stanley	1.70

Table 2. Panel B: Major US airlines' largest shareholders.
The data are from S&P Capital IQ (Q2 2016). The table is taken from Azar et al. (2018).

Delta Air Lines	[%]	**Southwest Airlines Co.**	[%]	**American Airlines**	[%]
Berkshire Hathaway	8.25	PRIMECAP	11.78	T. Rowe Price	13.99
BlackRock	6.84	Berkshire Hathaway	7.02	PRIMECAP	8.97
Vanguard	6.31	Vanguard	6.21	Berkshire Hathaway	7.75
State Street Global Advisors	4.28	BlackRock	5.96	Vanguard	6.02
J.P. Morgan Asset Mgt.	3.79	Fidelity	5.53	BlackRock	5.82
Lansdowne Partners Limited	3.60	State Street Global Advisors	3.76	State Street Global Advisors	3.71
PRIMECAP	2.85	J.P. Morgan Asset Mgt.	1.31	Fidelity	3.30
AllianceBernstein L.P.	1.67	T. Rowe Price	1.26	Putnam	1.18
Fidelity	1.54	BNY Mellon Asset Mgt.	1.22	Morgan Stanley	1.17
PAR Capital Mgt.	1.52	Egerton Capital (UK) LLP	1.10	Northern Trust Global Inv	1.02
United Continental Holdings	[%]	**Alaska Air**	[%]	**JetBlue Airways**	[%]
Berkshire Hathaway	9.20	T. Rowe Price	10.14	Vanguard	7.96
BlackRock	7.11	Vanguard	9.73	Fidelity	7.58
Vanguard	6.88	BlackRock	5.60	BlackRock	7.33
PRIMECAP	6.27	PRIMECAP	4.95	PRIMECAP	5.91
PAR Capital Mgt.	5.18	PAR Capital Mgt.	3.65	Goldman Sachs Asset Mgt.	2.94
State Street Global Advisors	3.45	State Street Global Advisors	3.52	Dimensional Fund Advisors	2.42
J.P. Morgan Asset Mgt.	3.35	Franklin Resources	2.59	State Street Global Advisors	2.40
Altimeter Capital Mgt.	3.26	BNY Mellon Asset Mgt.	2.34	Wellington	2.07
T. Rowe Price	2.25	Citadel	1.98	Donald Smith Co.	1.80
AQR Capital Management	2.15	Renaissance Techn.	1.93	BarrowHanley	1.52
Spirit Airlines	[%]	**Allegiant Travel Company**	[%]	**Hawaiian**	[%]
Fidelity	10.70	Gallagher Jr., M. J. (Chairman, CEO)	20.30	BlackRock	11.20
Vanguard	7.41	BlackRock	8.61	Vanguard	10.97
Wellington	5.44	Renaissance Techn.	7.28	Aronson, Johnson, Ortiz, LP	5.99
Wasatch Advisors Inc.	4.33	Vanguard	6.65	Renaissance Techn.	4.67
BlackRock	3.77	Fidelity	5.25	Dimensional Fund Advisors	3.17
Jennison Associates	3.49	Franklin Resources	4.52	State Street Global Advisors	2.43
Wells Capital Mgt.	3.33	Wasatch Advisors Inc.	4.39	PanAgora Asset Mgt.	2.22
Franklin Resources	2.79	T. Rowe Price	4.23	LSV Asset Management	2.22
OppenheimerFunds	2.67	TimesSquare Capital Mgt.	3.91	BNY Mellon Asset Mgt.	1.84
Capital Research and Mgt.	2.64	Neuberger Berman	3.07	Numeric Investors	1.79

Table 4. Summary statistics for key variables.

This table reports summary statistics for the variables at the CEO level (wealth-performance sensitivities and tenure), at the firm level (performance, market equity, volatility, kappa, cosine similarity, IHHI ratio, top 5 shareholder overlap, Anton-Polk, Harford-Jenter-Li), and at the industry level (HHI and MHHID). The wealth-performance sensitivities are WPS EGL (Edmans et al., 2009), WPS JM (Jensen and Murphy, 1990), and WPS HL (Hall and Liebman, 1998).

Variables	N	Mean	Median	Std	10%	90%
CEO variables						
WPS EGL	47,994	20.42	5.77	44.85	1.04	44.27
WPS JM	47,994	16.86	5.62	28.16	0.51	47.32
WPS HL	47,994	51.84	18.07	85.31	2.12	142.57
Tenure (in years)	48,651	7.39	6.00	4.73	1.00	15.00
Firm and industry variables						
ln(Market Equity)	47,563	7.684	7.572	1.599	5.741	9.840
Volatility	47,514	0.102	0.089	0.052	0.049	0.172
Leverage	47,373	0.242	0.219	0.213	0.000	0.497
HHI (at industry SIC-4 level)	10,670	0.581	0.522	0.314	0.175	1.000
Common ownership measures (SIC-4 CRSP)						
Kappa	44,239	0.337	0.263	0.689	0.041	0.637
Cosine Similarity (1st component of Kappa)	44,239	0.307	0.278	0.203	0.060	0.608
Ratio of IHHIs (2nd component of Kappa)	44,239	1.268	0.990	2.742	0.549	1.833
Top 5 Shareholder Overlap	45,996	0.092	0.079	0.066	0.015	0.189
Anton-Polk FCAP measure	46,761	0.0006	0.0005	0.0005	0.0002	0.0013
Harford-Jenter-Li measure	46,761	0.0002	0.0002	0.0002	0.0001	0.0005
MHHID (at industry SIC-4 level)	10,670	0.145	0.101	0.155	0.006	0.334

Table 5. Wealth-performance sensitivity as a function of common ownership.

This table presents the coefficients from regressions of the Edmans et al. (2009) measure of wealth-performance sensitivity (EGL) on common ownership (equal- and value-weighted $\overline{\kappa}$) while controlling for firm fixed effects and industry × year fixed effects. The universe covers all CEOs from 1992 to 2019 present in ExecuComp. We use industry definitions based on four-digit SIC codes from CRSP and Compustat as well as the Hoberg-Phillips 400 definition. Note that the Hoberg-Phillips industry definitions are available starting in 1996. Significance levels are denoted by: *** p<0.01, ** p<0.05, * p<0.1.

Dependent Variable	ln(Wealth-performance Sensitivity EGL)					
Industry Definition	SIC CRSP		SIC COMP		HOBERG-PHILIPS	
	(1)	(2)	(3)	(4)	(5)	(6)
Common Ownership (Kappa EW)	-0.239***		-0.257***		-0.220***	
	(0.051)		(0.045)		(0.053)	
Common Ownership (Kappa VW)		-0.222***		-0.238***		-0.197***
		(0.048)		(0.047)		(0.056)
Volatility	1.133***	1.149***	0.822***	0.826***	0.883***	0.898***
	(0.274)	(0.275)	(0.287)	(0.287)	(0.273)	(0.274)
ln(Market Equity)	0.370***	0.372***	0.370***	0.373***	0.392***	0.394***
	(0.020)	(0.020)	(0.020)	(0.020)	(0.024)	(0.025)
Leverage	0.0242	0.0257	-0.0109	-0.00731	0.0120	0.0147
	(0.064)	(0.064)	(0.061)	(0.061)	(0.072)	(0.073)
HHI	-0.120	-0.124	-0.0350	-0.0353	0.00747	0.0104
	(0.073)	(0.073)	(0.089)	(0.089)	(0.058)	(0.059)
ln(Tenure)	0.492***	0.492***	0.487***	0.486***	0.496***	0.496***
	(0.029)	(0.029)	(0.028)	(0.028)	(0.035)	(0.035)
Institutional Ownership	-0.398***	-0.385***	-0.430***	-0.415***	-0.319***	-0.305***
	(0.075)	(0.074)	(0.077)	(0.075)	(0.070)	(0.069)
Observations	42,492	42,492	45,369	45,369	33,905	33,905
R-squared	0.684	0.684	0.690	0.689	0.699	0.699
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry SIC-3 × Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 6. Wealth-performance sensitivity as a function of common ownership: alternative common ownership measures.

This table presents regressions similar to those in Table 5, but in addition to $\overline{\kappa}$ uses several alternative common ownership measures described in Section 5.2. We use industry definitions based on four-digit SIC codes from CRSP. Table C4 in the appendix repeats the analysis for Compustat and Hoberg-Phillips industry definitions. Significance levels are denoted by: *** p<0.01, ** p<0.05, * p<0.1.

Dependent Variable	ln(Wealth-performance Sensitivity EGL)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CO (Kappa)	-0.222***						
	(0.048)						
CO (Cosine Similarity)		-0.227***					
		(0.052)					
CO (Top 5 Overlap)			-0.136***				
			(0.037)				
CO (Anton and Polk)				-0.200**			
				(0.087)			
CO (Harford, Jenter and Li)					-0.237***		
					(0.084)		
CO (MHHID)						-0.231***	
						(0.054)	
CO (MHHID 1/N)							-0.142***
							(0.047)
Volatility	1.149***	1.160***	1.144***	1.186***	1.185***	1.165***	1.179***
	(0.275)	(0.276)	(0.276)	(0.278)	(0.277)	(0.277)	(0.278)
ln(Market Equity)	0.372***	0.369***	0.362***	0.374***	0.376***	0.360***	0.360***
	(0.020)	(0.020)	(0.020)	(0.021)	(0.021)	(0.021)	(0.021)
Leverage	0.0257	0.0268	0.0353	0.0296	0.0288	0.0301	0.0300
	(0.064)	(0.064)	(0.066)	(0.065)	(0.065)	(0.065)	(0.065)
HHI	-0.124	-0.125*	-0.148**	-0.137*	-0.144*	-0.216***	-0.115
	(0.073)	(0.073)	(0.070)	(0.074)	(0.074)	(0.074)	(0.073)
ln(Tenure)	0.492***	0.492***	0.498***	0.489***	0.490***	0.488***	0.488***
	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)
Institutional Ownership	-0.385***	-0.309***	-0.344***	-0.294**	-0.274***	-0.364***	-0.363***
	(0.074)	(0.076)	(0.078)	(0.079)	(0.080)	(0.076)	(0.076)
Observations	42,492	42,492	41,178	42,492	42,492	42,498	42,498
R-squared	0.684	0.684	0.683	0.683	0.683	0.683	0.683
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry (SIC-3) × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 7. Wealth-performance sensitivities as a function of common ownership: alternative WPS measures.
This table presents regressions similar to those in Table 5 and Table 6, but uses several alternative alternative measures of wealth-performance sensitivity. In columns (1) to (3) the dependent variable is the Jensen and Murphy (1990) measure while columns (4) to (6) use the Hall and Liebman (1998) measure (both in natural logs). We use industry definitions based on four-digit SIC codes from CRSP. Table C5 in the appendix repeats the analysis for Compustat and Hoberg-Phillips industry definitions. Significance levels are denoted by: *** p<0.01, ** p<0.05, * p<0.1.

Dependent Variable	ln(WPS JM)			ln(WPS HL)		
	(1)	(2)	(3)	(4)	(5)	(6)
CO (Kappa)	-0.167***			-0.109***		
	(0.045)			(0.046)		
CO (Cosine Similarity)		-0.190***			-0.123***	
		(0.049)			(0.048)	
CO (Top 5 Overlap)			-0.150***			-0.076***
			(0.035)			(0.034)
Volatility	1.427***	1.434***	1.456***	1.616***	1.620***	1.635***
	(0.268)	(0.268)	(0.268)	(0.291)	(0.292)	(0.290)
Size	0.0799***	0.0781***	0.0733***	0.695***	0.694***	0.690***
	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)	(0.023)
Leverage	-0.553***	-0.553***	-0.550***	0.0648	0.0651	0.0608
	(0.062)	(0.062)	(0.063)	(0.062)	(0.062)	(0.065)
HHI	-0.122*	-0.126*	-0.149**	-0.0930	-0.0950	-0.119*
	(0.065)	(0.064)	(0.063)	(0.069)	(0.069)	(0.068)
ln(Tenure)	0.395***	0.395***	0.402***	0.572***	0.573***	0.582***
	(0.025)	(0.025)	(0.026)	(0.034)	(0.034)	(0.033)
Institutional Ownership	-0.0915	-0.0303	-0.0619	-0.142**	-0.103	-0.127*
	(0.057)	(0.057)	(0.057)	(0.061)	(0.062)	(0.062)
Observations	42,492	42,492	41,178	42,492	42,492	41,178
R-squared	0.792	0.792	0.793	0.792	0.792	0.794
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry (SIC-3) × Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 8. Wealth-performance sensitivity as a function of common ownership: all executives.

This table presents regressions similar to those in Table 6 with the sample now covering all top executives rather than just CEOs. We use industry definitions based on four-digit SIC codes from CRSP. Significance levels are denoted by: *** p<0.01, ** p<0.05, * p<0.1.

Dependent Variable	Log(Wealth-performance Sensitivity EGL)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CO (Kappa)	-0.0864***						
	(0.017)						
CO (Cosine Similarity)		-0.0894***					
		(0.018)					
CO (Top 5 Overlap)			-0.0586***				
			(0.015)				
CO (Anton and Polk)				-0.0195			
				(0.036)			
CO (Harford, Jenter and Li)					-0.0568*		
					(0.033)		
CO (MHHID)						-0.0849***	
						(0.019)	
CO (MHHID 1/N)							-0.0370**
							(0.016)
Volatility	-0.114	-0.111	-0.107	-0.104	-0.101	-0.110	-0.105
	(0.152)	(0.152)	(0.160)	(0.152)	(0.152)	(0.152)	(0.152)
ln(Market Equity)	0.381***	0.380***	0.378***	0.377***	0.380***	0.377***	0.376***
	(0.011)	(0.011)	(0.012)	(0.012)	(0.011)	(0.011)	(0.011)
Leverage	0.0840***	0.0847***	0.0936***	0.0868***	0.0864***	0.0865***	0.0864***
	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)
HHI	-0.0631**	-0.0640**	-0.0549**	-0.0561**	-0.0633**	-0.0958***	-0.0563**
	(0.024)	(0.023)	(0.025)	(0.022)	(0.022)	(0.027)	(0.024)
ln(Tenure)	0.300***	0.300***	0.305***	0.298***	0.299***	0.299***	0.299***
	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)
Institutional Ownership	-0.119***	-0.0879***	-0.101***	-0.0993***	-0.0839**	-0.109***	-0.108***
	(0.028)	(0.027)	(0.027)	(0.034)	(0.034)	(0.028)	(0.029)
Observations	230,142	230,142	221,872	230,142	230,142	230,167	230,167
R-squared	0.798	0.798	0.797	0.797	0.797	0.798	0.797
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry (SIC-3) × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 9. Wealth-performance sensitivity as a function of common ownership: difference-in-differences estimation. This table presents the difference in difference estimates using S&P500 inclusions of competitors. Firms that are already in the S&P500 index and are in an industry that experiences an addition of a competitor firm to the S&P500 index in a given year are the treatment group, and all other firms in different industries that did not experience an inclusion in the index are the control firms. The Post dummy takes value of 1 for the event year and for the five years after the inclusion, and takes value of 0 for the five years before. The controls (not shown) we use are volatility, the natural log of market equity, leverage, HHI, and the natural log of tenure and are taken as of the pre-event year. Firm and year fixed effects are included in all specifications. Standard errors are clustered two ways at the firm and year level. Significance levels are denoted by: *** p<0.01, ** p<0.05, * p<0.1.

Dependent Variable	ln(Wealth-performance Sensitivity EGL)					
Industry Definition	SIC CRSP		SIC COMP		HOBERG-PHILLIPS	
	(1)	(2)	(3)	(4)	(5)	(6)
Treat * Post	-0.179***	-0.179***	-0.152***	-0.153***	-0.107**	-0.107***
	(0.053)	(0.047)	(0.054)	(0.048)	(0.040)	(0.032)
Post	0.873***	0.888***	0.796***	0.818***	1.047***	1.060***
	(0.240)	(0.128)	(0.227)	(0.119)	(0.321)	(0.135)
True Inclusions of Competitors	163	163	179	179	151	151
Unique Treated Firms	335	335	351	351	417	417
Unique Control Firms	807	807	837	837	709	709
R-squared	0.523	0.523	0.528	0.528	0.545	0.546
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Inclusion FE	No	Yes	No	Yes	No	Yes

Online Appendix: Not for Publication

A Omitted Proofs

A.1 Symmetric Owners

In this section we present the proofs for Proposition 1 and Corollary 1. Because all the firms are symmetric and present in all of the m distinct product categories (or geographic markets), we can assume without loss of generality that that there is only a single product category (i.e., $m = 1$) and thus only a single pricing specialist for each firm. The first order conditions (9) and (10) yield a system of $2n$ linear equations which we solve for the equilibrium efforts $e_i^*(\vec{\alpha})$ and equilibrium prices $p_i^*(\vec{\alpha})$ of the n firms as a function of the vector of incentive slopes $\vec{\alpha}$. These are given by

$$e_i^*(\vec{\alpha}) = \frac{\alpha_i}{\chi} \tag{20}$$

$$p_i^*(\vec{\alpha}) = \frac{(A + b\bar{c})(2b + a) - \frac{b}{\chi}\{[2b - (n-2)a]\alpha_i + a\sum_{j\neq i}\alpha_j\}}{(2b + a)[2b - (n-1)a]} \tag{21}$$

and the resulting equilibrium profit $\pi_i^*(\vec{\alpha})$ is

$$\pi_i^*(\vec{\alpha}) = \frac{b}{(2b+a)^2[2b-(n-1)a]^2}\{A(2b+a) - \bar{c}[2b^2 - (n-1)a^2 - (2n-3)ab] + \frac{\alpha_i}{\chi}[2b^2 - (n-1)a^2 - (n-2)ab] - \sum_{j\neq i}\frac{\alpha_j}{\chi}ab\}^2. \tag{22}$$

In stage 1 the majority owner of firm i chooses α_i to maximize her objective function given by

$$\phi_i = \pi_i^*(\vec{\alpha}) - w_i^*(\vec{\alpha}) + \kappa\sum_{j\neq i}(\pi_j^*(\vec{\alpha}) - w_j^*(\vec{\alpha})).$$

Given that the individual rationality constraint of the manager is binding we have

$$s_i = -\alpha_i\pi_i^*(\vec{\alpha}) + \frac{r}{2}\sigma^2\alpha_i^2 + \frac{q_i^*(\vec{\alpha})\chi e_i^2}{2} + \bar{u}$$

and hence

$$w_i^*(\vec{\alpha}) = \frac{r}{2}\sigma^2\alpha_i^2 + \frac{q_i^*(\vec{\alpha})\chi e_i^2}{2} + \bar{u}.$$

From the manager's incentive compatibility we have $e_i = \frac{\alpha_i}{\chi}$. Therefore, by substituting the incentive compatibility and individual rationality constraints (and omitting the outside option $\bar{u}$) the objective function of the majority owner of firm i who chooses α_i can be rewritten as

$$\phi_i = \pi_i^*(\vec{\alpha}) - \frac{r}{2}\sigma^2\alpha_i^2 - \frac{q_i^*(\vec{\alpha})\alpha_i^2}{2\chi} + \kappa\sum_{j\neq i}\left(\pi_j^*(\vec{\alpha}) - \frac{r}{2}\sigma^2\alpha_j^2 - \frac{q_j^*(\vec{\alpha})\alpha_j^2}{2\chi}\right).$$

Taking the derivative of the owner's objective function with respect to α_i yields

$$\frac{\partial\phi_i}{\partial\alpha_i} = \frac{\partial\pi_i^*}{\partial\alpha_i} - r\sigma^2\alpha_i - \frac{q_i^*\alpha_i}{\chi} - \frac{\alpha_i^2}{2\chi}\frac{\partial q_i^*}{\partial\alpha_i} + \kappa\sum_{j\neq i}\left(\frac{\partial\pi_j^*}{\partial\alpha_i} - \frac{\alpha_j^2}{2\chi}\frac{\partial q_j^*}{\partial\alpha_i}\right).$$

To ensure that the produced quantities and profit are positive, we require that χ (or $\mu - \bar{c}$) is sufficiently large.

The resulting first order condition can then be rewritten in the following way

$$\kappa = \frac{-\frac{\partial\pi_i^*}{\partial\alpha_i} + \frac{\alpha_i^2}{2\chi}\frac{\partial q_i^*}{\partial\alpha_i} + r\sigma^2\alpha_i + \frac{q_i^*\alpha_i}{\chi}}{\sum_{j\neq i}\left(\frac{\partial\pi_j^*}{\partial\alpha_i} - \frac{\alpha_j^2}{2\chi}\frac{\partial q_j^*}{\partial\alpha_i}\right)}. \tag{23}$$

We now rewrite the expressions of the firms' equilibrium quantities and profits as $q_i^* = by_i$ and $\pi_i^* = by_i^2$, where

$$y_i = \frac{A(2b+a) - \bar{c}[2b^2 - (n-1)a^2 - (2n-3)ab] + \frac{\alpha_i}{\chi}[2b^2 - (n-1)a^2 - (n-2)ab] - \sum_{j\neq i}\frac{\alpha_j}{\chi}ab}{(2b+a)[2b-(n-1)a]}.$$

The derivatives of the firms' equilibrium profits with respect to α_i are given by

$$\frac{\partial\pi_i^*}{\partial\alpha_i} = \frac{2b[2b^2 - (n-1)a^2 - (n-2)ab]}{(2b+a)[2b-(n-1)a]}\frac{1}{\chi}y_i > 0$$
$$\frac{\partial\pi_j^*}{\partial\alpha_i} = -\frac{2b(ab)}{(2b+a)[2b-(n-1)a]}\frac{1}{\chi}y_j < 0, \forall j \neq i.$$

Similarly, the derivatives of the firms' quantity choices with respect to α_i are given by

$$\frac{\partial q_i^*}{\partial \alpha_i} = \frac{b[2b^2-(n-1)a^2-(n-2)ab]}{(2b+a)[2b-(n-1)a]}\frac{1}{\chi} > 0$$
$$\frac{\partial q_j^*}{\partial \alpha_i} = -\frac{b(ab)}{(2b+a)[2b-(n-1)a]}\frac{1}{\chi} < 0, \forall j \neq i.$$

Using the symmetry of the equilibrium such that $\alpha_i = \alpha^*, \forall i$ we obtain

$$y_i = y^* = \frac{A + (\frac{\alpha^*}{\chi} - \bar{c})[b-(n-1)a]}{2b-(n-1)a} \equiv k_1\alpha^* + k_2$$

where $k_1 = \frac{1}{\chi}\frac{b-(n-1)a}{2b-(n-1)a} \in (0, \frac{1}{2})$ and $k_2 = \frac{A-\bar{c}[b-(n-1)a]}{2b-(n-1)a}$ which is positive given that $\mu > \bar{c}$.

Substituting all the derivatives into the expression for κ in equation (23) and noting that $q_i^* = q^*$ and $\pi_i^* = \pi^*$ we obtain

$$\begin{aligned}\kappa &= \frac{2b^2-(n-1)a^2-(n-2)ab}{(n-1)ab} + \frac{r\sigma^2\alpha^* + by^*\alpha^*\frac{1}{\chi}}{\sum_{j\neq i}\left[-\frac{1}{\chi}\frac{2ab^2}{(2b+a)[2b-(n-1)a]}y^* + \frac{(\alpha^*)^2}{2\chi^2}\frac{ab^2}{(2b+a)[2b-(n-1)a]}\right]} \\ &= M_1 + M_2M_3(\alpha^*)\end{aligned}$$

where

$$M_3(\alpha^*) = \frac{bk_1(\alpha^*)^2 + (\chi r\sigma^2 + bk_2)\alpha^*}{\frac{1}{2\chi}(\alpha^*)^2 - 2\chi k_1\alpha^* - 2\chi k_2},$$

and

$$M_1 = \frac{2b^2-(n-1)a^2-(n-2)ab}{(n-1)ab}, \qquad M_2 = \frac{(2b+a)(2b-(n-1)a)}{(n-1)ab^2}.$$

Since $b > (n-1)a > 0$, it follows that $M_2 > 0$ and $M_1 > 1$. We now wish to show that $\frac{\partial\kappa}{\partial\alpha^*} < 0$, which is the same as showing that $M_3(\alpha^*)$ is decreasing in α^*. The sign of the derivative of $M_3(\alpha^*)$ is equal to the sign of the numerator of the derivative of $M_3(\alpha^*)$ which is given by

$$-\frac{1}{2}\left[r\sigma^2 + \frac{1}{\chi}bk_2 + 4bk_1^2\right]\alpha^{*2} - 4bk_1k_2\alpha^* - 2k_2(\chi r\sigma^2 + bk_2).$$

This is a quadratic function of α^*. The quadratic coefficient is $-\frac{1}{2}\left[r\sigma^2 + \frac{1}{\chi}bk_2 + 4bk_1^2\right]$. The discriminant Δ of this quadratic function is given by

$$\begin{aligned}\Delta =&16b^2k_1^2k_2^2 - 4k_2(\chi r\sigma^2 + bk_2)\left[r\sigma^2 + \frac{1}{\chi}bk_2 + 4bk_1^2\right]\\ =&-4\frac{k_2}{\chi}(\chi r\sigma^2 + bk_2)^2 - 16\chi bk_1^2k_2r\sigma^2\end{aligned}$$

Recall that $k_2 > 0$ because $\mu > \bar{c}$. As a result, the discriminant Δ is negative and the quadratic coefficient is also negative. Therefore, the whole quadratic function is always negative which ensures that the numerator of the derivative of $M_3(\alpha^*)$ is always negative and thus $M_3(\alpha^*)$ is decreasing in α^*.

Finally, even though we have established that $\frac{\partial\kappa}{\partial\alpha^*} < 0$, it is not immediately clear that $\frac{\partial\alpha^*}{\partial\kappa} < 0$, because there might be two meaningful solutions to the principal's maximization problem, which yields a quadratic equation in α^*. However, because $k_2 > 0$, there is only one positive root and one negative root. This guarantees that for each $\kappa \in [0, 1]$ there is a unique positive α^* such that equation (23) holds. This establishes Proposition 1. ■

We now present the proof for Corrollary 1. Since $\alpha(\kappa)$ is decreasing in κ and $\kappa \in [0, 1]$. Thus, $\alpha \in [\alpha(1), \alpha(0)]$. It is therefore equivalent to show that $\pi_i - w_i$ is decreasing in α over $[\alpha(1), \alpha(0)]$.

First, $\alpha(1)$ solves the function

$$M_1 + M_2M_3 = 1$$

which reduces to

$$\frac{3}{2}bk_1\alpha^2 + (\chi r\sigma^2 + bk_2 - 2bk_1^2)\alpha - 2\chi bk_1k_2 = 0$$

This quadratic function denoted by $g(\alpha)$ has a positive and a negative root. Thus, $\alpha(1)$ is the right (positive) root, and $g(\alpha) \geq 0$ if $\alpha \geq \alpha(1)$.

Second, we have

$$\pi_i - w_i = by_i^2 - \frac{1}{2}r\sigma^2\alpha^2 - \frac{by_i\alpha^2}{2\mu}$$

where $y_i = k_1\alpha + k_2$. Thus,

$$\begin{aligned}\frac{\partial(\pi_i - w_i)}{\partial\alpha} =& 2bk_1(k_1\alpha + k_2) - r\sigma^2\alpha - \frac{b(k_1\alpha + k_2)\alpha}{\mu} - \frac{bk_1\alpha^2}{2\mu} \\ =& -\frac{3}{2}bk_1\alpha^2 - (\mu r\sigma^2 + bk_2 - 2bk_1^2)\alpha + 2\mu bk_1k_2 \\ =& -g(\alpha)\end{aligned}$$

By the first step, $g(\alpha) \geq 0$ for $\alpha \geq \alpha(1)$. Therefore, the derivative $\frac{\partial(\pi_i - w_i)}{\partial\alpha} \leq 0$ for $\alpha \in [\alpha(1), \alpha(0)]$. This proves the corollary. ■

A.2 Multiproduct Firms and Asymmetric Owners

In this section we present the proofs for Proposition 2, Corollary 2, and Corollary 3. To simplify notation we set $\chi = 1$ which satisfies the second-order and interior solution conditions for sufficiently large $\mu - \bar{c}$. By similar algebra as in the symmetric case we obtain the following equations for quantities and firm profits,

$$\begin{aligned} q_1^* &= q_{1,I}^* + q_{1,II}^* = by_{1,I} + by_{1,II} \\ q_2^* &= q_{2,II}^* + q_{2,III}^* = by_{2,II} + by_{2,III} \\ q_3^* &= q_{3,III}^* + q_{3,I}^* = by_{3,III} + by_{3,I} \\ \pi_1^* &= \pi_{1,I}^* + \pi_{1,II}^* = by_{1,I}^2 + by_{1,II}^2 \\ \pi_2^* &= \pi_{2,II}^* + \pi_{2,III}^* = by_{2,II}^2 + by_{2,III}^2 \\ \pi_3^* &= \pi_{3,III}^* + \pi_{3,I}^* = by_{3,III}^2 + by_{3,I}^2, \end{aligned}$$

where

$$y_{i,l} = \frac{A(2b + a) - \bar{c}(2b^2 - a^2 - ab) + \alpha_i(2b^2 - a^2) - \alpha_{l\setminus i}ab}{4b^2 - a^2}$$

and $l\setminus i$ denotes the firm which is active in market l other than firm i.

Owner 1 solves

$$\max_{\alpha_1} \quad \pi_1^* - w_1^* = by_{1,I}^2 + by_{1,II}^2 - \frac{r}{2}\sigma^2\alpha_1^2 - \frac{by_{1,I} + by_{1,II}}{2}\alpha_1^2$$

The first order condition is given by

$$2b\left(y_{1,I}\frac{\partial y_{1,I}}{\partial \alpha_1}+y_{1,II}\frac{\partial y_{1,II}}{\partial \alpha_1}\right)-r\sigma^2\alpha_1-b(y_{1,I}+y_{1,II})\alpha_1-\frac{b}{2}\left(\frac{\partial y_{1,I}}{\partial \alpha_1}+\frac{\partial y_{1,II}}{\partial \alpha_1}\right)\alpha_1^2=0$$

Owner 2 solves

$$\begin{aligned}\max_{\alpha_2}\quad (\pi_2^*-w_2^*)+\kappa(\pi_3^*-w_3^*)=\max_{\alpha_2}\quad & by_{2,II}^2+by_{2,III}^2-\frac{r}{2}\sigma^2\alpha_2^2-\frac{by_{2,II}+by_{2,III}}{2}\alpha_2^2\\ &+\kappa\left(by_{3,III}^2+by_{3,I}^2-\frac{r}{2}\sigma^2\alpha_3^2-\frac{by_{3,III}+by_{3,I}}{2}\alpha_3^2\right).\end{aligned}$$

The first order condition is

$$\begin{aligned}&2b\left(y_{2,II}\frac{\partial y_{2,II}}{\partial \alpha_2}+y_{2,III}\frac{\partial y_{2,III}}{\partial \alpha_2}\right)-r\sigma^2\alpha_2-b(y_{2,II}+y_{2,III})\alpha_2\\ &\qquad-\frac{b}{2}\left(\frac{\partial y_{2,II}}{\partial \alpha_2}+\frac{\partial y_{2,III}}{\partial \alpha_2}\right)\alpha_2^2+\kappa\left(2by_{3,III}\frac{\partial y_{3,III}}{\partial \alpha_2}-\frac{b}{2}\frac{\partial y_{3,III}}{\partial \alpha_2}\alpha_3^2\right)=0.\end{aligned}$$

By symmetry, $\alpha_2=\alpha_3$ in equilibrium. Then

$$\begin{aligned}y_{1,I}=y_{1,II}&\equiv k_1\alpha_1+k_2\alpha_2+k_3\\ y_{2,II}=y_{3,I}&\equiv k_1\alpha_2+k_2\alpha_1+k_3\\ y_{2,III}=y_{3,III}&\equiv k_1\alpha_2+k_2\alpha_2+k_3\end{aligned}$$

where $k_1=\frac{2b^2-a^2}{4b^2-a^2}$, $k_2=\frac{-ab}{4b^2-a^2}$, $k_3=\frac{A-\bar{c}(b-a)}{2b-a}$. Then the above two FOC can be simplified to

$$\begin{aligned}\left[4(k_1\alpha_1+k_2\alpha_2+k_3)-\alpha_1^2\right]k_1&=\frac{r\sigma^2}{b}\alpha_1+2(k_1\alpha_1+k_2\alpha_2+k_3)\alpha_1\\ \left[2(k_1\alpha_2+k_2\alpha_1+k_3)+2(k_1\alpha_2+k_2\alpha_2+k_3)-\alpha_2^2\right]k_1&=\frac{r\sigma^2}{b}\alpha_2+(k_1\alpha_2+k_2\alpha_1+k_3)\alpha_2\\ &\quad+(k_1\alpha_2+k_2\alpha_2+k_3)\alpha_2-\kappa k_2\left(2k_1\alpha_2+2k_2\alpha_2+2k_3-\frac{\alpha_2^2}{2}\right)\end{aligned}$$

where the difference of the two equations gives:

$$\left[3k_1(\alpha_1+\alpha_2)+k_2\alpha_2+2k_3+\frac{r\sigma^2}{b}-(4k_1-2k_2)k_1\right](\alpha_2-\alpha_1)=$$
$$\kappa k_2\left(2k_1\alpha_2+2k_2\alpha_2+2k_3-\frac{\alpha_2^2}{2}\right).$$

Before proceeding with the analysis, it is useful to present several variants of the first order conditions that are useful in establishing the final result.

Variant 1:

$$k_1\alpha_1+k_2\alpha_2+k_3=\frac{k_1\alpha_1^2+\frac{r\sigma^2}{b}\alpha_1}{4k_1-2\alpha_1}$$
$$k_1\alpha_2+k_2\frac{\alpha_1+\alpha_2}{2}+k_3=\frac{(k_1+\frac{\kappa}{2}k_2)\alpha_2^2+\frac{r\sigma^2}{b}\alpha_2+\kappa k_2^2(\alpha_1-\alpha_2)}{4k_1-2\alpha_2+2\kappa k_2}$$

Variant 2:

$$3k_1\alpha_1^2+\left(\frac{r\sigma^2}{b}+2(k_2\alpha_2+k_3)-4k_1^2\right)\alpha_1-4k_1(k_2\alpha_2+k_3)=0$$
$$\left[3k_1+(1+\frac{\kappa}{2})k_2\right]\alpha_2^2+\left(\frac{r\sigma^2}{b}+2(\frac{k_2}{2}\alpha_1+k_3)-(4k_1+2\kappa k_2)(k_1+\frac{k_2}{2})-\kappa k_2^2\right)\alpha_2$$
$$+\kappa k_2^2\alpha_1-(4k_1+2\kappa k_2)(\frac{k_2}{2}\alpha_1+k_3)=0$$

Several observations follow from these two variants.

1. Since the LHS of both equations in Variant 1 are positive, it follows that $\alpha_1<2k_1$ and $\alpha_2<2k_1+\kappa k_2$.

2. In the first (second) equation of Variant 1, α_2 (α_1) can be explicitly written as a function of α_1 (α_2). So, we could represent the first equation by Curve 1 and the second equation by Curve 2.

3. According to Variant 2, both curves cross $\alpha_1=\alpha_2$ once in the northeast quadrant. Denote the first intersection as α^* and the second as α^{**}. Then the following relationship holds: $0<\alpha^{**}<\alpha^*<2k_1$.

Proof. The intersections satisfy

$$(3k_1 + 2k_2)\alpha^{*2} + \left(\frac{r\sigma^2}{b} + 2k_3 - 4k_1^2 - 4k_1k_2\right)\alpha^* - 4k_1k_3 = 0$$

$$\left[3k_1 + (2 + \frac{\kappa}{2})k_2\right]\alpha^{**2} + \left(\frac{r\sigma^2}{b} + 2k_3 - (4k_1 + 2\kappa k_2)(k_1 + k_2)\right)\alpha^{**} - (4k_1 + 2\kappa k_2)k_3 = 0$$

or equivalently

$$\begin{aligned}
(3k_1 + 2k_2)\alpha^{*2} &+ \left(\frac{r\sigma^2}{b} + 2k_3 - 4k_1^2 - 4k_1k_2\right)\alpha^* - 4k_1k_3 = 0 \\
(3k_1 + 2k_2)\alpha^{**2} &+ \left(\frac{r\sigma^2}{b} + 2k_3 - 4k_1^2 - 4k_1k_2\right)\alpha^{**} - 4k_1k_3 \\
&\qquad + \kappa k_2 \left(\frac{\alpha^{**2}}{2} - (2k_1 + 2k_2)\alpha^{**} - 2k_3\right) = 0
\end{aligned}$$

Both have a unique positive root. Equation (3) is equivalent to

$$(2k_1 + 2k_2)\alpha^{*2} + \left(\frac{r\sigma^2}{b} + 2k_3\right)\alpha^* + 2k_1\left(\frac{\alpha^{*2}}{2} - (2k_1 + 2k_2)\alpha^* - 2k_3\right) = 0$$

which means that the last term of the LHS of this equation is strictly negative. It further implies that the LHS of equation (3) would be strictly positive if it is evaluated at α^* instead of α^{**}. As the LHS of equation (3) is strictly negative if it is evaluated at 0 it then follows by the Intermediate Value Theorem that $0 < \alpha^{**} < \alpha^*$. In addition, if $\alpha^* \geq 2k_1$, we would have the LHS of equation (3) being positive, which yields a contradiction. Thus, $0 < \alpha^{**} < \alpha^* < 2k_1$.

Lemma 1. *If $k_3 > -2k_1k_2$, then the system has a solution such that $\alpha_1 > \alpha_2 > 0$. If in addition, $k_3 > 2k_1^2 - k_1k_2$, then the system has a unique solution such that $\alpha_1, \alpha_2 > 0$.*[31]

Proof. There are several new observations given by $k_3 > -2k_1k_2$.

1. Curve 1 crosses the α_2-axis at $(0, -\frac{k_3}{k_2})$ where $-\frac{k_3}{k_2} > 2k_1$.

2. On Curve 1, as α_1 approaches $2k_1$ from the left, $\alpha_2 \to -\infty$.

[31] Note that the second condition implies the first.

3. The function represented by Curve 1 either first increases and then decreases in α_1 over $(0, 2k_1)$, or it is always decreasing in α_1 over $(0, 2k_1)$. This can be shown by taking derivatives, and is omitted here.

4. Curve 2 crosses the α_1-axis at $(-\frac{k_3(4k_1+2\kappa k_2)}{2k_1k_2}, 0)$, where $-\frac{k_3(4k_1+2\kappa k_2)}{2k_1k_2} > 2k_1$.

(i) First, given $k_3 > -2k_1k_2$, we show the existence of a solution such that $\alpha_1 > \alpha_2 > 0$.

Proof. Recall that Curve 1 passes (α^*, α^*) where $0 < \alpha^* < 2k_1$. Then combined with the first three observations, it follows that the function represented by Curve 1 must be decreasing in α_1 over $(\alpha^*, 2k_1)$. Meanwhile, Curve 2 also passes $(\alpha^{**}, \alpha^{**})$ where $0 < \alpha^{**} < 2k_1$. Combined with the last observation and the fact that α_1 is uniquely pinned down by α_2, it follows that the function represented by Curve 2 must be decreasing in α_1 over $(\alpha^{**}, 2k_1)$. By the Intermediate Value Theorem, Curve 1 and 2 must intersect and the intersection satisfies $\alpha_1 > \alpha_2$. The result is the most clear if one draws out the curves in such a way that the $y-$axis is α_2.

(ii) Second, given $k_3 > 2k_1^2 - k_1k_2$, we show that all solutions such that $\alpha_1, \alpha_2 > 0$ must satisfy $\alpha_1 > \alpha_2$.

Proof. Consider equation (A.2). The RHS is negative because $k_2 < 0$ and

$$2k_1\alpha_2 + 2k_2\alpha_2 + 2k_3 - \frac{\alpha_2^2}{2} > 4k_1^2 - 2k_1k_2 - \frac{(2k_1)^2}{2} > 0$$

At the same time, the first term in the LHS is positive because

$$3k_1(\alpha_1 + \alpha_2) + k_2\alpha_2 + 2k_3 + \frac{r\sigma^2}{b} - (4k_1 - 2k_2)k_1 > 2k_3 - (4k_1 - 2k_2)k_1 > 0$$

To balance the equation, $\alpha_2 - \alpha_1$ has to be negative, that is, there is no solution such that $0 < \alpha_1 < \alpha_2$.

(iii) Lastly, we show that there cannot be two distinct solutions such that $\alpha_1 > \alpha_2 > 0$.

Proof. Suppose, to the contrary, there are two solutions satisfying $\alpha_1 > \alpha_2 > 0$. Let the first solution be $(\overline{\alpha}_1, \overline{\alpha}_2)$ and the second be $(\underline{\alpha}_1, \underline{\alpha}_2)$. Without loss of generality, $\overline{\alpha}_1 > \underline{\alpha}_1$. Since both of them need to satisfy equation (A.2), denote

$$F(\alpha_1,\alpha_2) = \left[3k_1(\alpha_1+\alpha_2) + k_2\alpha_2 + \underbrace{2k_3 + \frac{r\sigma^2}{b} - (4k_1-2k_2)k_1}_{\equiv C>0}\right](\alpha_2-\alpha_1) - \kappa k_2\left(2k_1\alpha_2 + 2k_2\alpha_2 + 2k_3 - \frac{\alpha_2^2}{2}\right).$$

In the region $\alpha_1 > \alpha_2 > 0$,

$$\frac{\partial F}{\partial \alpha_1} = -6k_1\alpha_1 - k_2\alpha_2 - C < 0$$
$$\frac{\partial F}{\partial \alpha_2} = (3k_1 + (1+\frac{\kappa}{2})k_2)\cdot 2\alpha_2 + C - k_2\alpha_1 - 2\kappa k_2(k_1+k_2) > 0$$

By the Implicit Function Theorem, we should have $\overline{\alpha}_2 > \underline{\alpha}_2$. But this is contradicting with the fact that both curves are decreasing in the region $\alpha_1 > \alpha_2 > 0$. Thus, the solution is unique.

Therefore, because $\alpha_1^* > \alpha_2^* = \alpha_3^*$ it follows that the equilibrium effort of the maverick manager e_1^* is higher than that of the managers of the commonly-held firms, $e_2^* = e_3^*$. As a result, the marginal cost of the maverick firm $c_1 \equiv c_L$ is lower than that of the commonly-held firms $c_2 = c_3 \equiv c_H$. Given these marginal costs the resulting equilibrium prices are given by

$$p_L^* \equiv p_{1,\mathrm{I}}^* = p_{1,\mathrm{II}} = \frac{A(2b+a) + 2b^2c_L + abc_H}{4b^2-a^2}$$
$$p_M^* \equiv p_{2,\mathrm{II}}^* = p_{3,\mathrm{I}} = \frac{A(2b+a) + 2b^2c_H + abc_L}{4b^2-a^2}$$
$$p_H^* \equiv p_{2,\mathrm{III}}^* = p_{3,\mathrm{III}} = \frac{A(2b+a) + 2b^2c_H + abc_H}{4b^2-a^2}.$$

Comparing these expressions establishes that $p_L^* < p_M^* < p_H^*$. Furthermore, note that the maverick firm does not have a common shareholder, so Curve 1 is independent of κ. At the same time, Curve 2 moves monotonically with κ. To see this, notice that the original first order condition of Owner 2 can be expressed as

$$\underbrace{k_2(2k_1-\alpha_2)}_{<0 \text{ as } \alpha_2<2k_1}\alpha_1 = G(\alpha_2) - \kappa\, \underbrace{k_2\left(2k_1\alpha_2 + 2k_2\alpha_2 + 2k_3 - \frac{\alpha_2^2}{2}\right)}_{<0 \text{ by assumption on } k_3}.$$

Therefore, if we fix α_2, as κ increase, α_1 must decrease in order to stay on Curve 2. In other words, in a graph where α_1 is the x-axis and α_2 is the y-axis, as κ increases, Curve 1 does not change, but Curve 2 moves downwards. Then it is clear that α_1^* (α_2^*) increases (decreases) in κ, and it follows that $\alpha_1^* - \alpha_2^*$ increases in κ. It follows that when κ increases the difference $c_H - c_L$ increases. Therefore, the differences in prices charged by maverick and commonly-held firms between the market with common ownership (III) and the markets without common ownership (I and II) given by $p_H^* - p_L^*$ and $p_H^* - p_M^*$ also increase when κ increases. ■

A.3 Strategic Substitutes

Consider the following change to our baseline model. Instead of competing in prices, firms compete in quantities. For each firm i a quantity specialist sets the optimal quantity q_i. Given the representative consumer's preferences the inverse demand function facing firm i is $p_i(q_i, q_j) = A - bq_i - a\sum_{j\neq i} q_j$ where the parameters are now defined as $A = \mu$, $b = \nu$, and $a = \gamma$.

The maximization problem for the majority owner of firm i in stage 1 is given by

$$\max_{s_i,\alpha_i} \pi_i - w_i + \sum_{j\neq i} \kappa(\pi_j - w_j)$$
$$\text{subject to} \quad u_i \geq \bar{u} \quad \text{and} \quad e_i^* \in \arg\max_{e_i} \mathbb{E}[-\exp(-r(w_i - \chi q_i e_i^2/2)] \quad \text{and} \qquad q_i^* \in \arg\max_{q_i} \pi_i.$$

Specifically, the maximization problem for the manager of firm i in stage 2 is given by

$$\max_{e_i} s_i + \alpha_i\pi_i - \frac{r}{2}\alpha_i^2\sigma^2 - \chi q_i e_i^2/2,$$

and that of the quantity specialist is given by

$$\max_{q_i} q_i(A - bq_i - a\sum_{j\neq i} q_j - c_i) + \varepsilon_i.$$

The resulting first order conditions from the maximization choices in stage 2 can be rearranged to yield the following best-response functions for the manager and the quantity specialist of firm i

$$
\begin{aligned}
e_i &= \frac{\alpha_i}{\chi} \\
q_i &= \frac{A - (\bar{c} - e_i) - a \sum_{j \neq i} q_j}{2b}.
\end{aligned}
$$

As before, these first order conditions yield a system of $2n$ linear equations which we solve for the equilibrium efforts $e_i^*(\vec{\alpha})$ as well as the equilibrium quantities $q_i^*(\vec{\alpha})$ of the n firms as a function of the vector of incentive slopes $\vec{\alpha}$. Substituting these equilibrium effort and quantity choices into the expression for each firm i's profit yields the equilibrium profits $\pi_i^*(\vec{\alpha})$ in stage 2 as a function of the vector of incentive slopes chosen in stage 1. In stage 1, the majority owner of firm i uses the salary s_i to satisfy the manager's individual rationality constraint and uses the incentive slope α_i to maximize her profit shares both in firm i and all other firms $j \neq i$ taking into account the effects of α_i on the equilibrium effort and price choices in stage 2.

The resulting equilibrium quantity $q_i^*(\vec{\alpha})$ and profit $\pi_i^*(\vec{\alpha})$ of firm i are given by

$$
\begin{aligned}
q_i^*(\vec{\alpha}) &= \frac{(2b-a)(A-\bar{c}) + \frac{\alpha_i}{\chi}[2b + (n-2)a] - a \sum_{j \neq i} \frac{\alpha_j}{\chi}}{(2b-a)[2b + (n-1)a]} \\
\pi_i^*(\vec{\alpha}) &= \frac{b\{(2b-a)(A-\bar{c}) + \frac{\alpha_i}{\chi}[2b + (n-2)a] - a \sum_{j \neq i} \frac{\alpha_j}{\chi}\}^2}{(2b-a)^2[2b + (n-1)a]^2}.
\end{aligned}
$$

Following the same steps as the proof of Proposition 1 establishes that $\frac{\partial \alpha^*}{\partial \kappa} < 0$.

The only quantitative change is that for any given κ, an owner's optimal choice of α_i is larger than with strategic complements because of the opposite strategic effect on firm profits under strategic substitutes. When the owner of firm i lowers α_i under differentiated Bertrand competition this leads to a higher price p_i which in turn results in higher p_j which benefits firm i. In contrast, lowering α_i under differentiated Cournot leads to a lower quantity q_i which in turn induces higher q_j which hurts firm j.

B Theoretical Extensions and Discussion

B.1 Form of Strategic Interaction

Although our model and its extension focus on product market competition and, more specifically, on cost-reducing productivity improvement as one particular channel through which firms' strategic interaction can affect the steepness of incentives, our conclusions about common ownership reducing the performance sensitivity of managerial incentives hold more generally. Any setting in which more performance-sensitive compensation (or, more generally, better corporate governance) encourages managers to make strategic choices that have negative repercussions for the profits of other firms owned by common owners will yield the same prediction. This is because any increase in common ownership will make common owners relatively more sensitive to the negative effects that firms' corporate actions have on their competitors, and will thus make them less willing to set performance-sensitive managerial compensation on the margin.

As we showed formally in Appendix A.3, our results for managerial incentives are qualitatively unchanged for the case in which firms compete in strategic substitutes rather than strategic complements (i.e., set quantities rather than prices). The reason is that when firms compete in quantities, stronger managerial incentives (and the resulting lower marginal costs) similarly induce firms to expand quantity, which in turn has a negative impact on the profits of competing firms. The only quantitative change is that for any given κ, an owner's optimal choice of α_i is larger than with strategic complements because of the opposite strategic effect on firm profits under strategic substitutes.

All of our other firm-, market-, and industry-level predictions for costs, prices, quantities, and concentration are also unchanged, with the exception of the prediction about firm-level (though not market-level) pricing. Under strategic substitutes, commonly-owned firms respond to the aggressive behavior of the maverick by producing lower quantities (and thus charging higher prices) in the maverick markets I and II than in the common ownership market III. However, in equilibrium the output of the maverick firm expands even more in the maverick markets I and II, such that the total market quantity produced is still higher and the average market price level is still lower in the maverick markets than in the common ownership market. Therefore, the market-level predictions about prices and quantities of Table 3 remain unchanged.

B.2 Alternative Organizational and Contracting Assumptions

We consider how the conclusions of our theoretical framework change when pricing decisions are no longer delegated to pricing specialists and when owners have access to more sophisticated contracts for top managers and pricing specialists. We further show that our model can accommodate rent extraction by top managers under weak governance.

B.2.1 Direct Investor Control of Prices

We first analyze the second-best equilibrium in which owners directly control prices. Formally, the maximization problem is now given by

$$\max_{p_{i,l},s_i,\alpha_i} \phi_i = (\pi_i - s_i - \alpha_i\pi_i) + \sum_{j\neq i} \kappa_{ij}(\pi_j - s_j - \alpha_j\pi_j)$$
$$\text{s.t.} \quad u_i \geq \bar{u} \quad \text{and} \quad e_i^* \in \arg\max_{e_i} \mathrm{E}[-\exp(-r(s_i + \alpha_i\pi_i - \chi q_i e_i^2/2))].$$

where the difference with respect to the maximization problem in (8) is that the owner now also controls the prices $p_{i,l}$.

Owners can also implement direct price control by designing an incentive contract for the pricing specialist of each market l of the form

$$w_{i,l} = s_{i,l} + \alpha_{i,l}\pi_{i,l} + \sum_{j\neq i} \omega_{ij,l}\pi_{j,l}. \tag{21}$$

Given that the pricing decision does not involve a private cost borne by the (risk-neutral) specialist, the owner optimally sets the pricing specialist's salary equal to the outside option $s_{i,l} = \bar{u}_{i,l}$ and sets the incentive slopes equal to $\alpha^*_{i,l} = \epsilon$ and $\omega_{ij,l} = \epsilon\kappa_{ij}$ where $\epsilon > 0$ can be a vanishingly small positive number. This ensures that each pricing specialist sets prices exactly in accordance with the majority owner's objective function at the minimum wage expense to the owner.

As before, the IC constraint of the top manager yields $e_i = \frac{\alpha_i}{\chi}$. Substituting the IR and IC constraints into the objective function we obtain

$$\phi_i = \sum_{l=1}^{m} \{[p_{i,l} - (\bar{c} - \alpha_i/\chi)]q_{i,l}\} - \frac{r}{2}\sigma^2\alpha_i^2 - \frac{q_i\alpha_i^2}{2\chi} + \kappa \sum_{j \neq i} \left(\sum_{l=1}^{m} \{[p_{j,l} - (\bar{c} - \alpha_j/\chi)]q_{j,l}\} - \frac{r}{2}\sigma^2\alpha_j^2 - \frac{q_j\alpha_j^2}{2\chi} \right).$$

where

$$q_i = \sum_{l=1}^{m} A - bp_{i,l} + a \sum_{j \neq i} p_{j,l}.$$

Partially differentiating ϕ_i with respect to α_i yields

$$\sum_{l=1}^{m} \left(\frac{q_{i,l}}{\chi} \right) - r\sigma^2\alpha_i - \frac{q_i\alpha_i}{\chi} = 0$$

which can be rewritten as

$$\alpha_i^{DC} = \frac{1}{1 + \frac{\chi r \sigma^2}{q_i}}.$$

The first order condition for the pricing specialist in market l yields the best response function

$$p_{i,l} = \frac{1}{2b} \left[A + bc_i + a \sum_{j \neq i} p_{j,l} + a \sum_{j \neq i} \kappa_{ij}(p_{j,l} - c_j) \right].$$

Holding effort e_i (and therefore costs c_i) fixed, prices and markups are higher when κ_{ij} is higher. Pricing specialists perfectly internalize the adverse effects of their low prices on owners' portfolio profits through $\omega_{ij,l} = \epsilon\kappa_{ij}$. These (perfectly aligned) incentives for pricing specialists ensure that the managerial effort decision is not distorted due to common ownership, as the following proposition (stated in the main text) shows.

Proposition 3. *If owners directly control prices $p_{i,l}$ or can optimally design incentives for pricing specialists, the equilibrium managerial incentives α_i^* are equal to α_i^{DC} and decrease with common ownership. Prices $p_{i,l}^*$ and price-cost markups $\frac{p_{i,l}}{c_i}$ increase with common ownership.*

The functional form of our cost-of-effort function (given by $\frac{\chi}{2}q_i e_i^2$) ensures that the manager's effort choice e_i is always equal to $\frac{\alpha_i}{\chi}$. Because the optimal incentives for the pricing specialists perfectly align the interests of pricing specialists and owners, there is no longer any need to inefficiently distort the managerial effort choice e_i downwards to indirectly raise prices $p_{i,l}$.

However, if $r\sigma^2 > 0$ this direct-control managerial incentive slope $\alpha_i^{DC} = \frac{1}{1+\chi r\sigma^2/q_i}$ decreases with common ownership. This is because common ownership raises prices $p_{i,l}$ and therefore lowers total firm quantity q_i.

Thus, prices $p_{i,l}$ increase, but optimal managerial incentive slopes α_i decrease (and hence marginal costs c_i increase) with common ownership. A priori, the impact on markups is not clear. However, the direct price effect is always larger than the indirect incentive effect. As a result, common ownership increases markups. Thus, the prediction on markups resulting from the second-best implementation presented here in which investors perfectly control prices, differs markedly from the delegated pricing model and the empirical evidence presented in the main text.

B.2.2 Centralized Pricing Decisions by Top Managers

We now assume that pricing decisions are no longer delegated to the various pricing managers, but that the top manager of firm i simultaneously chooses both effort e_i and prices $p_{i,l}$ for all the products of the firm.

If owners can only contract on own firm profits π_i, all of the results presented in the main text are entirely unchanged. This is because with an incentive contract that only rewards π_i the top manager has exactly the same incentives for setting prices as the pricing specialists do under delegated pricing. As a result, the top manager's pricing decisions are exactly the same as those of the pricing specialists and his effort decision is similarly unaffected.

We therefore allow the owners to write managerial incentive contracts of the form

$$w_i = s_i + \alpha_i \pi_i + \sum_{j \neq i} \omega_{ij} \pi_j$$

where ω_{ij} is the incentive slope for manager i on firm j's profits. The resulting certainty equivalent for the manager is given by

$$CE_i = s_i + \alpha_i \pi_i + \sum_{j \neq i} \omega_{ij} \pi_j - \frac{r}{2} \left(\alpha_i^2 \sigma^2 - \sum_{j \neq i} \omega_{ij}^2 \sigma^2 \right) - \frac{\chi}{2} e_i^2 q_i.$$

The manager's first order conditions with respect to e_i and $p_{i,l}$ yield the following best response functions

$$
\begin{aligned}
e_i &= \frac{\alpha_i}{\chi} \\
p_{i,l} &= \frac{1}{2b}\left[A + bc_i + a\sum_{j\neq i} p_{j,l} + a\sum_{j\neq i}\frac{\omega_{ij}}{\alpha_i}(p_{j,l} - c_j) + b\frac{\alpha_i}{2\chi}\right].
\end{aligned}
$$

First, because managerial effort only affects the costs of firm i, but does not affect the profits of firm j directly, the weights ω_{ij} do not feature in the best response function (B.2.2) for effort e_i. Second, from the best response function for prices $p_{j,l}$ in equation (B.2.2) it is immediately apparent that the ratio of $\frac{\omega_{ij}}{\alpha_i}$ determines how much weight the top manager puts on the profits of other firms when choosing prices. For a given level of managerial efforts, prices and markups increase with the weights ω_{ij} and decrease with α_i. If effort e_i were held fixed, it would be optimal for the owner to set $\omega_{ij} = \alpha_i\kappa_{ij}$ to ensure that the top manager sets product market prices $p_{i,l}$ exactly in accordance with the owner's objective function ϕ_i.

Proposition 4. *If all pricing decisions are centralized with the top manager, the equilibrium incentives α_i^* decrease while prices $p_{i,l}^*$ increase with common ownership. Price-cost markups $\frac{p_{i,l}}{c_i}$ increase with common ownership if $r\sigma^2$ is sufficiently small.*

When κ_{ij} increases, it is optimal for the owner to also increase ω_{ij}. Doing so does not affect manager's effort choice e_i and better aligns the manager's pricing decisions with those that the owner would make. However, as can be seen in equation (B.2.2), these higher ω_{ij} weights impose additional wage risk on the top manager. As a result (and as in any standard moral hazard problem with linear incentives), the owner increases the fixed salary s_i and lowers the incentive slope α_i. This lowers managerial effort e_i and results in higher costs c_i. Therefore, common ownership increases equilibrium prices $p_{i,l}^*$.

A priori it is not clear whether common ownership increases markups, because it has two effects that work in opposite directions. First, holding costs fixed greater common ownership leads to higher markups. Second, common ownership also reduces equilibrium incentives α_i^* and therefore increases costs. However, this second effect is entirely absent when the top managers are not risk-averse (i.e., $r = 0$) or the profits of other firms π_j do not have a random shock (i.e., $\sigma^2 = 0$). In those cases the owner can perfectly align the top manager's pricing incentives by setting $\omega_{ij} = \alpha_i\kappa_{ij}$ without imposing any risk cost on the manager. As a result, for sufficiently low risk aversion or low profit shock variance, the first effect is larger than the second and common ownership increases markups.

Therefore, in this less realistic model variation without delegated pricing decisions, our central prediction that managerial incentives decrease as common ownership increases continues to hold. However, as with direct investor control of prices, this model variation generates predictions on markups that are inconsistent with the existing empirical evidence.

B.2.3 Relative Performance Evaluation for Top Managers

We now return to the assumptions of our main model. We assume that pricing decisions are again delegated to pricing specialists who set prices $p_{i,l}$ to maximize $\pi_{i,l}$. However, we allow the majority owner of firm i to contract on the performance of other firms $j \neq i$ rather than just on the performance of firm i. Specifically, let the managerial incentive contract be of the form

$$w_i = s_i + \alpha_i \pi_i + \sum_{j \neq i} \omega_{ij} \pi_j \tag{21}$$

where ω_{ij} is the incentive slope for manager i on firm j's profits.

Because the managerial incentive scheme conditions on both π_i and π_j, it is important to specify the correlation between their respective noise terms ε_i and ε_j. Denote this correlation by $\text{corr}(\varepsilon_i, \varepsilon_j) = \rho_{ij}$. In a canonical incentive design problem without product market interactions (Holmstrom, 1982) the assumption $\rho_{ij} > 0$ generates the standard risk reduction reason for relative performance evaluation (i.e., $\omega_{ij} < 0$). To distinguish this channel from strategic considerations emphasized in the present paper, we assume in the main text that all profit shocks are independently distributed such that $\rho_{ij} = 0$.

The following proposition shows that, in contrast to informal conjectures in the literature, common ownership does not necessarily provide a new rationale for the absence of relative performance evaluation.

Proposition 6. *The equilibrium managerial incentive contracts set all $\omega^*_{ij} = 0$ for all ij firm pairs and are identical to the ones in Proposition 1 and 2.*

The proof (and intuition) for this result is a straightforward application of the informativeness principle (Holmstrom, 1979). First, because pricing specialists rather than top managers control product market prices $p_{i,l}$ in our model, a common owner can only indirectly affect $p_{i,l}$ through changing the manager's incentive slopes α_i and ω_{ij}. Second, the weights ω_{ij} do not affect the top manager's effort e_i which is equal to α_i because e_i only changes c_i, but does not directly affect π_j,[32] and the pricing specialists choose price simultaneously with the top manager. However, the weights ω_{ij} impose additional wage risk on the manager equal to $\frac{r}{2}\omega_{ij}^2\sigma^2$. Finally, except for the additive noise terms, the product market competition game between firms is deterministic. Therefore, despite the strategic interactions between firms, observing π_j in addition to π_i does not provide any additional information about managerial effort e_i to the principal. As a result, the optimal managerial incentive schemes set $\omega_{ij}^* = 0$ for all ij firm pairs and are therefore identical to those obtained in Proposition 1 and 2. Thus, our model shows that common ownership does not necessarily provide a rationale for the limited use of relative performance evaluation observed in practice (Oyer, 2004; Jenter and Kanaan, 2015).

If the firms' noise terms are correlated (i.e., $\rho_{ij} \neq 0$ for at least some ρ_{ij}), the optimal incentive weights ω_{ij}^* will be non-zero because π_j provides additional information not contained in π_i. This is the standard risk reduction reason for relative performance evaluation and allows the principal to set a higher incentive slope α_i and thereby induce higher effort e_i. In particular, for a given incentive slope α_i the principal sets the vector $\vec{\omega}_i$ containing $\omega_{ii} = \alpha_i$ and the remaining $n-1$ weights ω_{ij} to solve the following wage risk minimization problem

$$\min_{\vec{\omega}_i} \text{Var}[w_i] \text{ s.t. } \omega_{ii} = \alpha_i$$

where the variance of the wage is equal to

$$\text{Var}[w_i] = \text{Var}\left[\alpha_i \varepsilon_i + \sum_{j \neq i} \omega_{ij} \varepsilon_j\right]$$

The resulting $n-1$ linear first order conditions together with the condition $\omega_{ii} = \alpha_i$ pin down the vector of optimal incentive weights $\vec{\omega}_i$ given by the linear system

$$\hat{\boldsymbol{\rho}}_i \vec{\omega}_i = \vec{v}_i \alpha_i \tag{21}$$

where $\hat{\boldsymbol{\rho}}_i$ is the $n \times n$ correlation matrix of the noise terms ε_i and ε_j with all the correlation terms

[32] This is in contrast to the prices $p_{i,l}$ which are chosen at the same time as e_i but which do directly affect π_j.

ρ_{ij} set to zero in row i and $\vec{v}_i$ is an $n \times 1$ vector of zeros except for a value of 1 in row i

$$\hat{\boldsymbol{\rho}}_i = \begin{bmatrix} 1 & \rho_{12} & \cdots & \cdots & \cdots & \cdots & \cdots & \rho_{1n} \\ \rho_{21} & \ddots & & & & & & \rho_{2n} \\ \vdots & & \ddots & & & & & \vdots \\ \rho_{(i-1)1} & \rho_{(i-1)2} & \cdots & 1 & \cdots & \cdots & \cdots & \rho_{(i-1)n} \\ 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ \rho_{(i+1)1} & \rho_{(i-1)2} & \cdots & \cdots & \cdots & 1 & \cdots & \rho_{(i+1)n} \\ \vdots & & & & & & \ddots & \vdots \\ \rho_{n1} & \rho_{n2} & \cdots & \cdots & \cdots & \cdots & \cdots & 1 \end{bmatrix}, \quad \vec{v}_i = \begin{bmatrix} 0 \\ 0 \\ \vdots \\ 0 \\ 1 \\ 0 \\ \vdots \\ 0 \end{bmatrix}.$$

The optimal incentive weights ω^*_{ij} for firm i are therefore given by

$$\vec{\omega}_i = \hat{\boldsymbol{\rho}}_i^{-1} \vec{v}_i \alpha_i. \tag{21}$$

These incentive weights are just linear transformations of α_i and do not vary with common ownership except through the influence of common ownership on α_i. Therefore, our theoretical predictions about the relationship between common ownership and managerial wealth-performance sensitivity are unaffected by relative performance evaluation schemes for top managers. When two noise terms are perfectly positively or negatively correlated (i.e., $|\rho_{ij}| = 1$), the principal can eliminate all wage risk from the manager's contract by setting $\omega_{ij} = -\rho_{ij}\alpha_i$.

Finally, our theoretical framework considers how the first-order component of managerial incentives, the aggregate incentive slope, is affected by common ownership. Therefore, our empirical analysis of managerial incentives accounts for all links between firm performance and executive wealth aggregated into a single comprehensive incentive slope, as suggested by Edmans et al. (2017), rather than focusing only on changes in salary, bonuses, or any other specific feature of managerial compensation.

Antón et al. (2016) and Liang (2016) empirically document that a specific industry-level measure of common ownership, namely MHHID, is negatively related to the strength of managerial relative pay-for-performance sensitivity, whereas Kwon (2016) offers contradictory evidence. The approach of these papers is problematic for two reasons. First, they focus on pay-for-performance sensitivity, but Edmans et al. (2017) argue that "any empirical measure of executive incentives must take into account the incentives provided by changes in the value of the executive's equity holdings—i.e., measure wealth-performance sensitivities, rather than pay-performance sensitivities" and that "focusing only on changes in salary, bonuses, and new equity grants misses the majority of incentives." Second, Backus et al. (2021b) and Backus et al. (2021a) show theoretically and empirically that MHHID is a flawed industry-level measure of common ownership. Instead, they propose the use of firm-level profit weights ("kappas") which we employ as our primary measure of common ownership.

B.2.4 Managerial Rents under Weak Governance

In Section 4.2 we assumed that when the majority owner does not pay the governance cost g, the manager is given a default incentive contract $\underline{w}_i = \underline{s}_i + \underline{\alpha}\pi_i$ where $\underline{\alpha} \in [0, \alpha^{SB})$ and $\underline{s}_i$ is set to satisfy the top manager's binding individual rationality constraint.

However, a default fixed salary $\underline{s}_i$ that leaves the manager with no rents is a strong and arguably unrealistic assumption, particularly in the case of weak governance. We therefore replace the customary individual rationality constraint with a shareholder outrage constraint (Bebchuk and Fried, 2006) under which the top manager earns positive rents R whenever the majority owner does not pay the governance cost g. Formally, the constraints for the majority owner's maximization problem are now given by

$$\text{if } g \text{ paid:} \quad u_i \geq \bar{u} \quad \text{and} \quad e_i^* \in \arg\max_{e_i} u(w_i, e_i) \quad \text{and} \quad p_{i,l}^* \in \arg\max_{p_{i,l}} \pi_i$$
$$\text{if } g \text{ not paid:} \quad u_i \geq \bar{u} + R \quad \text{and} \quad \underline{e}_i \in \arg\max_{e_i} u(\underline{w}_i, e_i) \quad \text{and} \quad \underline{p}_{i,l} \in \arg\max_{p_{i,l}} \pi_i$$

Whenever the majority owner does not pay g she has to pay a large fixed salary $\underline{s}_i$ to satisfy the shareholder outrage constraint $u_i \geq \bar{u} + R$. By the familiar contracting argument, for a given default incentive slope $\underline{\alpha}_i$ it is optimal to set $\underline{s}_i$ to make the constraint binding. Weak governance now leads to productive inefficiency ($\underline{e}_i < e_i^*$) and managerial rent extraction ($u_i > \bar{u}$). As a result of this large fixed salary $\underline{s}_i$, the majority owner is now more willing to pay g compared to the case of optimal incentive contracting with a binding individual rationality constraint.

Nonetheless, a slightly modified version of Proposition 5 continues to hold. However, the common ownership threshold $\underline{\kappa}$ (above which the majority owner does not pay g) is higher than if the top manager is held to his outside option $\bar{u}$.

B.3 Welfare under Direct and Indirect Investor Control

We study the welfare consequences of common ownership under different assumptions about which firm decisions investors control.[33] To do so we consider a simplified version of our model with n single-product firms and symmetric common ownership κ in which (i) there is no top manager, but investors directly choose investment e_i with an investment cost function given by $\frac{\chi}{2}e_i^2$, (ii) investment e_i is set in stage 1 and is observable to firm i but not to other firms j, and (iii) price p_i is set in stage 2 either by investors who maximize ϕ_i (direct control) or by the pricing specialist of firm i who maximizes π_i (indirect control). We show that the surplus loss from common ownership can be larger or smaller if investors directly control p_i than if this decision is delegated to pricing specialists.

As a benchmark let us first consider the case of no common ownership, $\kappa = 0$. Both e_i and p_i are set to maximize π_i. The first order conditions are

$$\frac{\partial \pi_i}{\partial p_i} = A - 2bp_i + a\sum_{j\neq i} p_j + b(\bar{c} - e_i) = 0$$
$$\frac{d\pi_i}{de_i} = \frac{\partial \pi_i}{\partial e_i} = q_i - \chi e_i = 0$$

yielding the equilibrium outcomes

$$q^{\pi\pi} = \frac{b\tilde{A}}{2b - (n-1)a - \frac{b[b-(n-1)a]}{\chi}}$$
$$e^{\pi\pi} = \frac{1}{\chi}q^{\pi\pi}.$$

where

$$\tilde{A} = A - \bar{c}[b - (n-1)a].$$

[33] We are particularly grateful to Meg Meyer for detailed suggestions and comments on this section.

B.3.1 Direct Investor Control

Consider the direct control case (denoted by $\phi\phi$) where investors set both e_i and directly control p_i to maximize ϕ_i. The first order conditions are

$$\frac{\partial \phi_i}{\partial p_i} = \frac{\partial \pi_i}{\partial p_i} + \kappa \sum_{j \neq i} \frac{\partial \pi_j}{\partial p_i} = 0$$

$$\frac{d\phi_i}{de_i} = \frac{\partial \pi_i}{\partial e_i} + \frac{\partial \pi_i}{\partial p_i}\frac{\partial p_i}{\partial e_i} + \sum_{j \neq i} \frac{\partial \pi_i}{\partial p_j}\frac{\partial p_j}{\partial e_i} + \kappa \sum_{j \neq i} \frac{\partial \pi_j}{\partial e_i} + \kappa \sum_{j \neq i} \frac{\partial \pi_j}{\partial p_j}\frac{\partial p_j}{\partial e_i} + \kappa \sum_{j \neq i} \frac{\partial \pi_j}{\partial p_i}\frac{\partial p_i}{\partial e_i} = 0.$$

First, because e_i does not directly affect π_j we have $\frac{\partial \pi_j}{\partial e_i} = 0$. Therefore, the fourth term is zero. Second, because of the non-observability of e_i to firm j we have $\frac{\partial p_j}{\partial e_i} = 0$. Therefore, the third and the fifth term are zero. Third, the sum of the second and the sixth term is $\left(\frac{\partial \pi_i}{\partial p_i} + \kappa \sum_{j \neq i} \frac{\partial \pi_j}{\partial p_i}\right)\frac{\partial p_i}{\partial e_i}$ which is also equal to zero due to the first order condition for p_i. Thus, the only remaining term is the first term. The expressions are given by

$$\frac{\partial \phi_i}{\partial p_i} = A - 2bp_i + a\sum_{j \neq i} p_j + b(\bar{c} - e_i) + \kappa a \sum_{j \neq i}(p_j - \bar{c} + e_j)$$

$$\frac{d\phi_i}{de_i} = \frac{\partial \pi_i}{\partial e_i} = q_i - \chi e_i$$

and yield the equilibrium outcomes

$$q^{\phi\phi} = \frac{[b - \kappa(n-1)a]\tilde{A}}{2b - (n-1)a(1+\kappa) - \frac{[b-\kappa(n-1)a][b-(n-1)a]}{\chi}}$$

$$e^{\phi\phi} = \frac{1}{\chi} q^{\phi\phi}.$$

B.3.2 Indirect Investor Control

To mirror the decision structure of our model, assume now that investors set e_i to maximize ϕ_i, but the pricing specialists set p_i to maximize π_i. The first order conditions of this indirect control case (denoted by $\phi\pi$) are

$$\begin{aligned}
&\frac{\partial \pi_i}{\partial p_i} = 0\\
&\frac{d\phi_i}{de_i} = \frac{\partial \pi_i}{\partial e_i} + \frac{\partial \pi_i}{\partial p_i}\frac{\partial p_i}{\partial e_i} + \sum_{j\neq i}\frac{\partial \pi_i}{\partial p_j}\frac{\partial p_j}{\partial e_i} + \kappa\sum_{j\neq i}\frac{\partial \pi_j}{\partial e_i} + \kappa\sum_{j\neq i}\frac{\partial \pi_j}{\partial p_j}\frac{\partial p_j}{\partial e_i} + \kappa\sum_{j\neq i}\frac{\partial \pi_j}{\partial p_i}\frac{\partial p_i}{\partial e_i} = 0.
\end{aligned}$$

First, because e_i does not directly affect π_j we have $\frac{\partial \pi_j}{\partial e_i} = 0$. Therefore, the fourth term is zero. Second, because of the non-observability of e_i to firm j we again have $\frac{\partial p_j}{\partial e_i} = 0$. Therefore, the third and the fifth term are zero. Third, because of the first order condition for p_i the second (and also the fifth) term is zero. The remaining equation is

$$\frac{d\phi_i}{de_i} = \frac{\partial \pi_i}{\partial e_i} + \kappa\sum_{j\neq i}\frac{\partial \pi_j}{\partial p_i}\frac{\partial p_i}{\partial e_i} = 0.$$

Pricing specialist i's reaction function in the second stage is

$$p_i = \frac{A + b\bar{c} - be_i + a\sum_{j\neq i} p_j}{2b}.$$

Thus, we have

$$\begin{aligned}
\frac{\partial \pi_i}{\partial e_i} &= q_i - \chi e_i\\
\frac{\partial \pi_j}{\partial p_i} &= a(p_j - \bar{c} + e_j)\\
\frac{\partial p_i}{\partial e_i} &= -\frac{1}{2}
\end{aligned}$$

which yields

$$\frac{d\phi_i}{de_i} = q_i - \chi e_i - \kappa\sum_{j\neq i}\frac{a(p_j - \bar{c} + e_j)}{2} = 0.$$

Finally, we obtain

$$\begin{aligned}
q^{\phi\pi} &= \frac{b\tilde{A}}{2b - (n-1)a - \frac{2b[b-(n-1)a] + \kappa ab(n-1)}{2\chi + \kappa(n-1)a}}\left[1 - \frac{\kappa(n-1)a}{2\chi + \kappa(n-1)a}\right]\\
e^{\phi\pi} &= \frac{2(1+\kappa\upsilon)}{2\chi + \kappa(n-1)a}q^{\phi\pi} - \frac{\kappa\upsilon\tilde{A}}{2\chi + \kappa(n-1)a},
\end{aligned}$$

where

$$\upsilon = \frac{(n-1)a}{2[b-(n-1)a]}.$$

B.3.3 Comparison

First, $e^{\phi\phi} > e^{\phi\pi}$. This occurs because under indirect control ($\phi\pi$) investors cannot directly control p_i they have to distort investment e_i to reduce competition. Second, output is lower due to the presence of common ownership. Because of the price distortion effect of common ownership under direct control ($\phi\phi$) we have $q^{\pi\pi} > q^{\phi\phi}$. Because of the investment distortion effect under indirect control we have $q^{\pi\pi} > q^{\phi\pi}$. Third, for all parameter values that satisfy the second-order conditions we have $q^{\phi\phi} < q^{\phi\pi}$. Therefore, indirect control is always better for consumer welfare than direct control. Fourth, producer surplus is always higher under direct control than under indirect control.

However, the total welfare ranking between direct and indirect control is ambiguous and depends on whether χ is large or small. χ measures how costly it is to invest in marginal cost reduction e_i and thus determines the impact of investment in shaping production and pricing decisions. As $\chi \to \infty$, $q^{\phi\pi} \to q^{\pi\pi}$ because the investment distortion effect disappears, but $q^{\phi\phi} < q^{\pi\pi}$ because the price distortion effect is still present. However, if χ is sufficiently small the investment distortion effect on total welfare dominates the price distortion effect on total welfare and the welfare loss of common ownership is smaller under direct than under indirect control.

B.4 Timing and Observability

Our results are robust a number of separate assumptions about timing and observability.

B.4.1 Timing of Pricing Decisions

Assume that rather than setting prices concurrently with the effort choices of top managers in stage 2, pricing specialists set prices in stage 3 after observing the effort choice e_i of the manager of their firm. Because there is a deterministic relationship between effort e_i and marginal cost c_i this is also equivalent to observing the firm's marginal cost c_i. In this case each manager i's first order condition remains the same because each pricing specialist i is choosing p_i to maximize the profit of firm π_i. Thus, by the envelope theorem the new term in manager i's first order condition stemming from the impact of e_i on π_i via the change in p_i is 0.

Now assume that pricing specialists observe not just the effort choice e_i of their own manager but the entire vector of all managerial effort choices before choosing prices in stage 3. In that case top managers will play a pre-commitment game in productivity improvements in stage 2. Although this changes the magnitude of the incentive-reducing effect of common ownership, it does not change any of our qualitative conclusions.

However, under these changed timing assumptions and with public contracts it is important that the managerial contracts cannot be renegotiated.

B.4.2 Observability of Managerial Contracts

Our results also qualitatively hold for privately observable managerial incentive contracts under the assumption of simultaneous effort and pricing decisions by managers and pricing specialists. As discussed by Katz (1991) the assumption that the contract between an owner and the top manager of her firm is observable to other firms is central to the literature on strategic delegation (Vickers, 1985; Fershtman and Judd, 1987; Sklivas, 1987; Fershtman et al., 1991). In those papers, the owner's main consideration for managerial incentive design is to change the competitive behavior of other firms to increase profits at her own firm. Specifically, an owner i's net profits $\pi_i - w_i$ indirectly benefit from distorting incentives of manager i away from own firm profit maximization because this causes other firms $j \neq i$ to compete less aggressively in the product market. But to influence the competitive behavior of other firms it is important that incentive contracts are observable to them.

However, this strategic effect is not the main driving force in our setting. Instead, a common owner's portfolio profits $\phi_i = \pi_i - w_i + \sum_{j \neq i} \kappa_{ij}(\pi_j - w_j)$ directly benefit from reducing managerial incentives at firm i away from the level that would obtain under own firm profit maximization focused on $\pi_i - w_i$. This incentive reduction increases the net profits $\pi_j - w_j$ at other firms even without these other firms responding to the reduced managerial incentives at firm i. In other words, in our model even without publicly observable contracts managerial incentives have a direct effect in addition to the indirect strategic effect that exists when contracts are publicly observable.

B.5 Vertical Relationships

Our theoretical framework focuses on a single industry and does not feature vertical relationships. However, common ownership of vertically related firms could also play a role. Indeed, several papers have documented some effects of common ownership in vertical relationships (Geng et al., 2017; Kedia et al., 2017). Furthermore, product market effects of vertical common ownership may include pro-competitive effects such as the mitigation or outright elimination of double marginalization, much in the same way that vertical integration does in the outright ownership case. However, vertical integration can also have anticompetitive effects, including exclusionary conduct like foreclosure and raising rivals' costs. For example, Crawford et al. (2018) provide a comprehensive welfare analysis incorporating both positive and negative effects under partial vertical integration. A similar logic would also apply to quasi-vertical integration through common ownership.

However, even if quasi-vertical integration through common ownership only has the beneficial effect of eliminating double marginalization this will not completely offset the negative horizontal common ownership effect. This is because (consumer-facing) firms will still want to charge a markup to final consumers, even if markups were reduced to zero elsewhere in the vertical chain.

Finally, even if (i) vertical common ownership does not have any anticompetitive effects, (ii) perfectly eliminates double marginalization along the vertical chain, and (iii) consumers are also shareholders, horizontal common ownership will still have anticompetitive effects as in our model. This is because consumer interests as shareholders are only fully internalized if there is perfect homogeneity (in particular with regards to equity ownership) across consumer-shareholders as shown by Farrell (1985). Following this line of argument about consumer-shareholder heterogeneity, Azar and Barkai (2020) show that, despite being a large majority, households in favor of competition own only 20% of all wealth whereas the small minority of households who own the vast majority of resources in the economy, oppose increasing competition.

B.6 Endogenous Market Shares

The endogeneity of market shares is an important feature of our theoretical framework. As we will show, not only does it provide a causal interpretation for previous empirical findings, but it also identifies shortcomings in the interpretation of existing empirical work. In our model, the only cause of market-level variation in prices, output, market shares, and concentration is the firm-level variation in common ownership.

To illustrate, suppose that an econometrician ran a regression of market prices on a measure of common ownership concentration, market concentration, and controls, all of which could depend on market shares. First, in light of our model, the econometrician would be wrong to interpret (only) the common ownership coefficient as the price effect of common ownership, as many papers in the literature, including Azar et al. (2018) and Azar et al. (2021), do by assuming exogenous market shares. This interpretation is wrong in the context of our model because variation in market concentration is also driven by common ownership.[34] Second, the econometrician would also be wrong to interpret a price effect of variation in market shares without variation in ownership as evidence against the presence of anticompetitive effects of common ownership, as in Dennis et al. (2019).[35] This is because in our model the price effect is actually intermediated via an endogenous market structure caused by common ownership.

Although a different model may yield a different interpretation of the same evidence, at the very least our results emphasize the importance of a greater integration of empirical and theoretical research on common ownership in the future.

B.7 Product Market Differentiation

Our model emphasizes the role of strategic product market competition between firms. If the products within each product category were independent (i.e., $a = 0$) and thus each firm's pricing decisions had no impact on the demand and profits of other firms, common ownership κ between the firms would not have any impact on the equilibrium managerial incentives α^*.[36] More generally, in any setting (e.g., perfect competition) where a firm can treat its own product market behavior as having no impact on the behavior and profits of other firms, common ownership κ will

[34] Specifications in Azar et al. (2018) and Azar et al. (2021) that hold markets shares fixed and only use variation from ownership to affect their measure of common ownership concentration show that not the *entire* effect is driven by variation in market shares—but it does not reject that *some* of the effect is.

[35] Kennedy et al. (2017) show a positive panel correlation between ticket prices and common ownership profit weights ("incentive terms" in their paper), and thereby disprove the claim by Dennis et al. (2019) that the positive relationship between airline ticket prices and common ownership is due to endogenous market shares. Similarly, Park and Seo (2019) show a positive effect of common ownership on prices in a structural model, which also rules out a decisive role of endogenous market shares.

[36] This is because the driving force of our model is not diversification across unrelated firms as in Edmans et al. (2019), but rather diversification *within* the same industry.

not influence managerial incentives α^*. In particular, the negative effect of common ownership κ on equilibrium incentives α^* given to managers increases with the degree of product homogeneity a, that is $\frac{\partial^2 \alpha^*}{\partial \kappa \partial a} < 0$.

Recall that product differentiation influences how strongly the firms' production decisions influence each other. When product differentiation is low (a is high) the price choice of the other firm, p_j, has a relatively large impact on demand q_i. In other words, when product differentiation is low, price decreases will lead to more business stealing. Thus, any increase in the incentives given to the manager of firm i (and the resulting decrease in marginal cost and decrease in price of firm i) will reduce the profits of the other firm by more than if product differentiation were high. As a result, when common ownership increases in industries with relatively homogeneous products, owners are particularly hesitant to give strong profit incentives to their manager because this would lead the manager to compete too aggressively and steal business away from other firms also owned by the owner. This empirical prediction is potentially testable in multimarket industries in which one can measure the degree of product differentiation with confidence.

Finally, this finding further highlights the importance of focusing on the right settings to study the effects of common ownership. The existing literature (e.g., Azar et al. (2018) and Backus et al. (2021b)) has emphasized that anticompetitive effects of common ownership are only measurable in a subset of markets in any given industry, and that measuring such effects requires variation across markets in the level of common ownership for identification. However, Koch et al. (2020) argue that the product market effects of common ownership can be identified from regressing industry price markups and industry profitability on common ownership measures using industry-level specifications similar to Azar (2012). Unlike Azar (2012) they do not find evidence that common ownership improves profitability. In contrast, our theoretical work focuses on within-firm across-market effects and our empirical work examines firm-level effects. Our paper shows that, even if one took the empirical result at face value that there is no effect of common ownership on markups, this does not imply that there are no anticompetitive effects. The anticompetitive effects in our model come from a production cost inefficiency that is caused by the combination of common ownership and agency problems, rather than an allocative efficiency that results in higher markups.

B.8 Product Market Concentration

In our baseline model with n symmetric firms, one can show that the incentive-reducing and price-increasing effects of common ownership are particularly pronounced when product market concentration is high (i.e., when the number of firms n is small). This is because as the number of firms grows, each firm becomes small and its negative impact on other firms through charging lower prices diminishes. As a result, common owners are less concerned about the negative side effects (i.e., lower prices) on other firms of high-powered managerial incentives when designing incentive plans. This theoretical result can explain the empirical finding of Azar et al. (2018) that the price-increasing effect of common ownership is bigger in airline markets with higher product market concentration. To our knowledge, our model is the first in the literature that is able to explain this empirical pattern.

Moreover, this prediction is also consistent with the empirical results on the relationship between corporate governance and product market competition. In our model, common owners exert weak corporate governance and enable the "quiet life" of top managers by making managerial compensation less sensitive to firm performance and this incentive-reducing effect is particularly pronounced in less competitive industries where it results in lower productivity and higher costs. Giroud and Mueller (2010) and Giroud and Mueller (2011) provide empirical evidence for this prediction by showing that weak corporate governance firms have lower productivity and higher costs, but only in less competitive industries.

C Additional Empirical Results

Table C1. Wealth-performance sensitivity as a function of common ownership with a set of institutional ownership related controls.

This table presents the coefficients from regressions of the Edmans et al. (2009) measure of wealth-performance sensitivity (EGL) on common ownership (value-weighted $\overline{\kappa}$) while controlling for firm fixed effects and industry × year fixed effects. This table first excludes institutional ownership, and then includes it in different ways. Institutional Ownership is the ratio of ownership held by institutional investors, Top 5 Institutional Ownership is the Institutional Ownership held by Top 5 shareholders of the firm, Investor Concentration is the HHI of investor ownership, and Investor Concentration Quartile is a variable that takes values 0, 1, 2, and 3 for each increase quartile in IHHI.

Dependent Variable	ln(Wealth-performance Sensitivity EGL)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CO (Kappa)	-0.192***	-0.222***		-0.243***	-0.239***	-0.231***	-0.197***
	(0.047)	(0.048)		(0.052)	(0.053)	(0.050)	(0.052)
Volatility	1.288***	1.149***	1.175***	1.229***	1.248***	1.241***	1.153***
	(0.280)	(0.275)	(0.278)	(0.278)	(0.278)	(0.278)	(0.274)
ln(Market Equity)	0.355***	0.372***	0.359***	0.353***	0.354***	0.354***	0.375***
	(0.020)	(0.020)	(0.021)	(0.019)	(0.020)	(0.020)	(0.020)
Leverage	0.0330	0.0257	0.0319	0.0342	0.0358	0.0320	0.0229
	(0.065)	(0.064)	(0.065)	(0.065)	(0.065)	(0.065)	(0.064)
HHI	-0.125	-0.124	-0.0961	-0.130*	-0.129*	-0.128*	-0.121
	(0.074)	(0.073)	(0.073)	(0.074)	(0.074)	(0.074)	(0.073)
ln(Tenure)	0.489***	0.492***	0.487***	0.490***	0.489***	0.490***	0.492***
	(0.030)	(0.029)	(0.029)	(0.029)	(0.030)	(0.029)	(0.029)
Institutional Ownership		-0.385***	-0.363***				-0.443***
		(0.074)	(0.077)				(0.083)
Top 5 Institutional Ownership				-0.362***			
				(0.118)			
Investor Concentration (IHHI)					-1.549**		0.960
					(0.641)		(0.718)
Inv Concentration Quartile (IHQ)						-0.0367***	
						(0.012)	
Observations	42,492	42,492	42,498	42,492	42,492	42,492	42,492
R-squared	0.683	0.684	0.683	0.683	0.683	0.683	0.684
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry SIC-3 x Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table C2. Wealth-performance sensitivity as a function of common ownership: robustness to different corporate control assumptions.

This table presents regressions similar to those in Table 5 but uses different assumptions with respect to shareholder control. Specifically, we follow Backus et al. (2021b) and use a power function such that $\gamma_{io} = \beta_{io}^{\lambda}$. As we increase the value of λ, we increase the convexity of the control weights. We show results for $\lambda = 0.5$, $\lambda = 2$, and $\lambda = 3$. The outcome variable is the Edmans et al. (2009) measure of wealth-performance sensitivity (EGL).

Dependent Variable	ln(Wealth-performance Sensitivity EGL)								
Industry Definition	SIC CRSP			SIC COMP			HOBERG-PHILLIPS		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CO Kappa ($\gamma = \beta^{0.5}$)	-0.225***			-0.224***			-0.199***		
	(0.049)			(0.048)			(0.061)		
CO Kappa ($\gamma = \beta^{2}$)		-0.206***			-0.229***			-0.191***	
		(0.046)			(0.042)			(0.048)	
CO Kappa ($\gamma = \beta^{3}$)			-0.194***			-0.216***			-0.182***
			(0.044)			(0.039)			(0.043)
Volatility	1.157***	1.140***	1.137***	0.839***	0.814***	0.811***	0.903***	0.889***	0.885***
	(0.274)	(0.275)	(0.275)	(0.287)	(0.288)	(0.288)	(0.274)	(0.274)	(0.274)
ln(Market Equity)	0.373***	0.370***	0.368***	0.373***	0.370***	0.369***	0.395***	0.392***	0.390***
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.025)	(0.024)	(0.024)
Leverage	0.0267	0.0253	0.0253	-0.00615	-0.00812	-0.00852	0.0159	0.0135	0.0134
	(0.064)	(0.065)	(0.065)	(0.061)	(0.061)	(0.061)	(0.072)	(0.073)	(0.073)
HHI	-0.124	-0.123	-0.122	-0.0338	-0.0362	-0.0362	0.00818	0.0122	0.0126
	(0.073)	(0.074)	(0.073)	(0.090)	(0.089)	(0.089)	(0.059)	(0.059)	(0.059)
ln(Tenure)	0.491***	0.492***	0.491***	0.485***	0.486***	0.486***	0.496***	0.496***	0.496***
	(0.029)	(0.029)	(0.029)	(0.028)	(0.028)	(0.028)	(0.035)	(0.035)	(0.035)
Institutional Ownership	-0.409***	-0.364***	-0.355***	-0.437***	-0.391***	-0.381***	-0.329***	-0.285***	-0.278***
	(0.074)	(0.073)	(0.073)	(0.077)	(0.074)	(0.074)	(0.071)	(0.069)	(0.069)
Observations	42,492	42,492	42,492	45,369	45,369	45,369	33,905	33,905	33,905
R-squared	0.684	0.684	0.684	0.689	0.690	0.690	0.699	0.699	0.699
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry (SIC-3) x Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table C3. Wealth-performance sensitivity as a function of common ownership with different fixed effects.

This table presents the coefficients from regressions of the Edmans et al. (2009) measure of wealth-performance sensitivity (EGL) on common ownership (equal- and value-weighted $\overline{\kappa}$) with no fixed effects (columns 1 and 6), with only firm fixed effects (columns 2 and 7), with firm and year fixed effects (columns 3 and 8), with firm, year, and industry SIC-3 fixed effects (columns 4 and 9), and with all set of baseline fixed effects (firm, and industry SIC-3 × year, in columns 5 and 10).

Dependent Variable	ln(Wealth-performance Sensitivity EGL)									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
CO (Kappa EW)	-0.827***	-0.347***	-0.179***	-0.180***	-0.239***					
	(0.077)	(0.064)	(0.047)	(0.048)	(0.051)					
CO (Kappa VW)						-0.665***	-0.193***	-0.181***	-0.182***	-0.222***
						(0.081)	(0.064)	(0.047)	(0.048)	(0.048)
Volatility	1.713***	2.190***	1.224***	1.265***	1.133***	1.922***	2.230***	1.239***	1.281***	1.149***
	(0.503)	(0.589)	(0.314)	(0.309)	(0.274)	(0.519)	(0.595)	(0.315)	(0.310)	(0.275)
ln(Market Equity)	0.166***	0.349***	0.381***	0.384***	0.370***	0.170***	0.342***	0.383***	0.387***	0.372***
	(0.016)	(0.037)	(0.023)	(0.022)	(0.020)	(0.016)	(0.038)	(0.023)	(0.022)	(0.020)
Leverage	-0.745***	-0.527***	-0.0251	-0.0116	0.0242	-0.766***	-0.528***	-0.0239	-0.0105	0.0257
	(0.079)	(0.107)	(0.064)	(0.064)	(0.064)	(0.081)	(0.108)	(0.065)	(0.064)	(0.064)
HHI	0.0523	-0.0605	-0.0120	-0.00655	-0.120	0.0453	-0.0503	-0.0175	-0.0118	-0.124
	(0.056)	(0.058)	(0.049)	(0.055)	(0.073)	(0.057)	(0.058)	(0.050)	(0.056)	(0.073)
ln(Tenure)	0.311***	0.0935*	0.458***	0.461***	0.492***	0.288***	0.0806	0.458***	0.461***	0.492***
	(0.045)	(0.047)	(0.031)	(0.031)	(0.029)	(0.045)	(0.048)	(0.031)	(0.031)	(0.029)
Institutional Ownership	-0.782***	-1.182***	-0.404***	-0.399***	-0.398***	-0.771***	-1.172***	-0.397***	-0.393***	-0.385***
	(0.116)	(0.163)	(0.081)	(0.080)	(0.075)	(0.117)	(0.165)	(0.080)	(0.080)	(0.074)
Observations	43,977	43,816	43,816	43,805	42,492	43,977	43,816	43,816	43,805	42,492
R-squared	0.098	0.553	0.624	0.632	0.684	0.089	0.552	0.624	0.632	0.684
Firm FE	No	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Year FE	No	No	Yes	Yes	No	No	No	Yes	Yes	No
Industry SIC-3 FE	No	No	No	Yes	No	No	No	No	Yes	No
Industry SIC-3 × Year FE	No	No	No	No	Yes	No	No	No	No	Yes

Table C4. Panel A. Wealth-performance sensitivity as a function of different measures of common ownership (Compustat).

This table presents the association between different common ownership measures and the Edmans et al. (2009) measure of wealth performance sensitivity (EGL) using four-digit Compustat industry definitions.

Dependent Variable	ln(Wealth-performance Sensitivity EGL)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CO (Kappa)	-0.238***						
	(0.047)						
CO (Cosine Similarity)		-0.237***					
		(0.059)					
CO (Top 5 Overlap)			-0.194***				
			(0.041)				
CO (Anton and Polk)				-0.182*			
				(0.095)			
CO (Harford, Jenter and Li)					-0.274**		
					(0.104)		
CO (MHHID)						-0.0196	
						(0.076)	
CO (MHHID 1/N)							0.00257
							(0.060)
Volatility	0.826***	0.838***	0.876***	0.859***	0.856***	0.865***	0.863***
	(0.287)	(0.288)	(0.287)	(0.288)	(0.288)	(0.288)	(0.289)
ln(Market Equity)	0.373***	0.369***	0.368***	0.373***	0.379***	0.358***	0.358***
	(0.020)	(0.020)	(0.021)	(0.022)	(0.022)	(0.021)	(0.021)
Leverage	-0.00731	-0.00612	-0.0127	-0.00177	-0.00279	-0.00131	-0.00101
	(0.061)	(0.061)	(0.064)	(0.061)	(0.061)	(0.061)	(0.061)
HHI	-0.0353	-0.0285	-0.0122	-0.0463	-0.0598	-0.0241	-0.0175
	(0.089)	(0.089)	(0.091)	(0.090)	(0.090)	(0.098)	(0.090)
ln(Tenure)	0.486***	0.486***	0.488***	0.481***	0.483***	0.481***	0.480***
	(0.028)	(0.028)	(0.028)	(0.029)	(0.028)	(0.028)	(0.028)
Institutional Ownership	-0.415***	-0.332***	-0.356***	-0.324***	-0.282***	-0.387***	-0.387***
	(0.075)	(0.077)	(0.078)	(0.080)	(0.081)	(0.078)	(0.078)
Observations	45,369	45,369	44,676	45,369	45,369	45,375	45,375
R-squared	0.689	0.689	0.690	0.689	0.689	0.689	0.689
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry (SIC-3) × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table C4. Panel B. Wealth-performance sensitivity as a function of different measures of common ownership (Hoberg-Phillips).

This table presents the association between different common ownership measures and the Edmans et al. (2009) measure of wealth performance sensitivity (EGL) using four-digit Hoberg-Phillips industry definitions.

Dependent Variable	ln(Wealth-performance Sensitivity EGL)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CO (Kappa)	-0.197***						
	(0.056)						
CO (Cosine Similarity)		-0.184***					
		(0.061)					
CO (Top 5 Overlap)			-0.144***				
			(0.040)				
CO (Anton and Polk)				-0.153			
				(0.105)			
CO (Harford, Jenter and Li)					-0.210*		
					(0.113)		
CO (MHHID)						-0.102	
						(0.070)	
CO (MHHID 1/N)							-0.0567
							(0.053)
Volatility	0.898***	0.896***	0.862***	0.925***	0.919***	0.925***	0.924***
	(0.274)	(0.275)	(0.274)	(0.275)	(0.275)	(0.276)	(0.275)
ln(Market Equity)	0.394***	0.390***	0.384***	0.394***	0.397***	0.381***	0.381***
	(0.025)	(0.025)	(0.025)	(0.026)	(0.025)	(0.025)	(0.025)
Leverage	0.0147	0.0175	0.0123	0.0207	0.0188	0.0211	0.0212
	(0.073)	(0.073)	(0.073)	(0.072)	(0.072)	(0.072)	(0.072)
HHI	0.0104	0.0154	0.0242	-0.00289	-0.0106	-0.0221	0.0148
	(0.059)	(0.059)	(0.056)	(0.060)	(0.060)	(0.063)	(0.058)
ln(Tenure)	0.496***	0.496***	0.497***	0.493***	0.494***	0.493***	0.493***
	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)	(0.035)
Institutional Ownership	-0.305***	-0.244***	-0.267***	-0.231***	-0.203**	-0.291***	-0.290***
	(0.069)	(0.070)	(0.074)	(0.071)	(0.073)	(0.072)	(0.073)
Observations	33,905	33,905	33,374	33,905	33,905	33,916	33,916
R-squared	0.699	0.699	0.699	0.699	0.699	0.699	0.699
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry (SIC-3) × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table C5. Panel A. Wealth-performance sensitivities as a function of common ownership: alternative WPS measures (Compustat).

This table presents coefficient estimates from regressions of different measures of wealth-performance sensitivity on common ownership. The difference to Table 7 is that we use four-digit Compustat industry definitions. In columns (1) to (3) the dependent variable is the Jensen and Murphy (1990) measure (JM) while in columns (4) to (6) it is the Hall and Liebman (1998) measure (HL).

Dependent Variable	ln(WPS JM)			ln(WPS HL)		
	(1)	(2)	(3)	(4)	(5)	(6)
CO (Kappa)	-0.164***			-0.140***		
	(0.042)			(0.047)		
CO (Cosine Similarity)		-0.191***			-0.143**	
		(0.052)			(0.058)	
CO (Top 5 Overlap)			-0.184***			-0.129***
			(0.038)			(0.037)
Volatility	1.140***	1.146***	1.204***	1.363***	1.370***	1.420***
	(0.282)	(0.282)	(0.277)	(0.298)	(0.299)	(0.292)
ln(Market Equity)	0.0858***	0.0843***	0.0840***	0.703***	0.700***	0.700***
	(0.023)	(0.023)	(0.024)	(0.023)	(0.023)	(0.023)
Leverage	-0.571***	-0.571***	-0.574***	0.0530	0.0536	0.0477
	(0.059)	(0.059)	(0.060)	(0.061)	(0.061)	(0.062)
HHI	-0.0813	-0.0777	-0.0698	-0.0463	-0.0424	-0.0298
	(0.083)	(0.083)	(0.084)	(0.085)	(0.085)	(0.087)
ln(Tenure)	0.390***	0.391***	0.395***	0.565***	0.564***	0.569***
	(0.025)	(0.025)	(0.025)	(0.032)	(0.032)	(0.032)
Institutional Ownership	-0.135**	-0.0718	-0.0869	-0.184***	-0.134**	-0.143**
	(0.058)	(0.058)	(0.057)	(0.060)	(0.063)	(0.061)
Observations	45,369	45,369	44,676	45,369	45,369	44,676
R-squared	0.794	0.794	0.796	0.794	0.794	0.795
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry (SIC-3) × Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Table C5. Panel B. Wealth-performance sensitivities as a function of common ownership: alternative WPS measures (Hoberg-Phillips).

This table presents coefficient estimates from regressions of different measures of wealth-performance sensitivity on common ownership. The difference to Table 7 is that we use four-digit Hoberg-Phillips industry definitions. In columns (1) to (3) the dependent variable is the Jensen and Murphy (1990) measure (JM) while in columns (4) to (6) it is the Hall and Liebman (1998) measure (HL).

Dependent Variable	ln(WPS JM)			ln(WPS HL)		
	(1)	(2)	(3)	(4)	(5)	(6)
CO (Kappa)	-0.119**			-0.0784		
	(0.049)			(0.052)		
CO (Cosine Similarity)		-0.113**			-0.0431	
		(0.053)			(0.058)	
CO (Top 5 Overlap)			-0.134***			-0.0676*
			(0.032)			(0.036)
Volatility	1.367***	1.366***	1.371***	1.371***	1.376***	1.361***
	(0.280)	(0.281)	(0.277)	(0.276)	(0.277)	(0.276)
ln(Market Equity)	0.121***	0.119***	0.119***	0.738***	0.735***	0.733***
	(0.030)	(0.030)	(0.031)	(0.024)	(0.024)	(0.024)
Leverage	-0.565***	-0.563***	-0.565***	0.0831	0.0850	0.0821
	(0.062)	(0.062)	(0.062)	(0.062)	(0.062)	(0.061)
HHI	-0.0131	-0.0102	-0.0119	0.0183	0.0215	0.0223
	(0.061)	(0.061)	(0.060)	(0.054)	(0.054)	(0.052)
ln(Tenure)	0.396***	0.396***	0.398***	0.542***	0.542***	0.544***
	(0.028)	(0.028)	(0.028)	(0.030)	(0.030)	(0.030)
Institutional Ownership	-0.0535	-0.0162	-0.0252	-0.132**	-0.114*	-0.112*
	(0.058)	(0.058)	(0.057)	(0.059)	(0.061)	(0.060)
Observations	33,905	33,905	33,374	33,905	33,905	33,374
R-squared	0.803	0.803	0.804	0.815	0.815	0.815
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry (SIC-3) × Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Table C6. Wealth-performance sensitivity as a function of common ownership: horse race between kappa components (cosine similarity and IHHI ratio).

This table presents regressions similar to those in Table 5 and Table 6. The outcome variable is again the Edmans et al. (2009) measure of wealth performance sensitivity (EGL). Column (1) repeats the specification of column (1) of Table 5 using the rank-transformed measure of kappa. The remaining columns (2) to (5) take logs of each κ_{ij} to decompose it into its two subcomponents and then average it across all industry competitors.

Dependent Variable	ln(Wealth-performance Sensitivity EGL)				
	(1)	(2)	(3)	(4)	(5)
$\overline{\kappa}_i$	-0.222***				
	(0.048)				
$\overline{\log(\kappa_{ij})}$		-0.0423***			
		(0.009)			
$\overline{\log(\cos_{ij})}$			-0.0457***		-0.0364***
			(0.011)		(0.011)
$\overline{\log\sqrt{\frac{IHHI_j}{IHHI_i}}}$				-0.0635***	-0.0516***
				(0.015)	(0.015)
Volatility	1.149***	1.151***	1.176***	1.141***	1.146***
	(0.275)	(0.275)	(0.277)	(0.276)	(0.276)
ln(Market Equity)	0.372***	0.370***	0.366***	0.365***	0.370***
	(0.020)	(0.020)	(0.021)	(0.021)	(0.020)
Leverage	0.0257	0.0236	0.0269	0.0263	0.0234
	(0.064)	(0.064)	(0.065)	(0.064)	(0.064)
HHI	-0.124	-0.120	-0.116	-0.106	-0.119
	(0.073)	(0.073)	(0.072)	(0.073)	(0.073)
ln(Tenure)	0.492***	0.492***	0.491***	0.489***	0.492***
	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)
Institutional Ownership	-0.385***	-0.379***	-0.312***	-0.452***	-0.398***
	(0.074)	(0.070)	(0.075)	(0.073)	(0.072)
Observations	42,492	42,492	42,492	42,492	42,492
R-squared	0.684	0.684	0.684	0.684	0.684
Firm FE	Yes	Yes	Yes	Yes	Yes
Industry (SIC-3) × Year FE	Yes	Yes	Yes	Yes	Yes

Table C7. Wealth-performance sensitivity as a function of common ownership: robustness to using lagged common ownership measures.

This table presents coefficients from regressions of wealth-performance sensitivities on common ownership. The difference to Table 6 and Table C4 is that we use lagged common ownership measures instead of using contemporaneous measures.

Dependent Variable	ln(Wealth-performance Sensitivity EGL)								
Industry Definition	SIC CRSP			SIC COMP			HOBERG-PHILLIPS		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Lag of CO (Kappa)	-0.230***			-0.242***			-0.205***		
	(0.048)			(0.052)			(0.053)		
Lag of CO (Cosine Similarity)		-0.288***			-0.322***			-0.257***	
		(0.050)			(0.061)			(0.056)	
Lag of CO (Top 5 Overlap)			-0.199***			-0.241***			-0.177***
			(0.040)			(0.038)			(0.036)
Volatility	1.216***	1.206***	1.259***	0.842**	0.815**	0.904***	1.032***	0.993***	0.965***
	(0.304)	(0.306)	(0.309)	(0.318)	(0.319)	(0.307)	(0.310)	(0.311)	(0.313)
ln(Market Equity)	0.368***	0.367***	0.369***	0.369***	0.369***	0.367***	0.399***	0.398***	0.394***
	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.020)	(0.026)	(0.025)	(0.026)
Leverage	0.0464	0.0473	0.0526	0.00467	0.00464	0.00812	0.0478	0.0487	0.0469
	(0.068)	(0.069)	(0.070)	(0.064)	(0.063)	(0.065)	(0.077)	(0.077)	(0.077)
HHI	-0.119	-0.124	-0.145*	-0.0684	-0.0686	-0.0559	0.0444	0.0434	0.0332
	(0.075)	(0.074)	(0.074)	(0.087)	(0.088)	(0.088)	(0.057)	(0.057)	(0.058)
ln(Tenure)	0.552***	0.554***	0.554***	0.543***	0.546***	0.547***	0.556***	0.558***	0.552***
	(0.028)	(0.028)	(0.028)	(0.027)	(0.027)	(0.027)	(0.034)	(0.033)	(0.033)
Institutional Ownership	-0.304***	-0.257***	-0.279***	-0.311***	-0.257***	-0.276***	-0.228***	-0.193***	-0.205***
	(0.069)	(0.066)	(0.070)	(0.068)	(0.063)	(0.067)	(0.065)	(0.062)	(0.066)
Observations	38,124	38,124	36,985	41,128	41,128	40,448	29,896	29,896	29,416
R-squared	0.698	0.698	0.697	0.703	0.703	0.704	0.713	0.713	0.712
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry (SIC-3) × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table C8. Wealth-performance sensitivity as a function of common ownership: robustness to coarser industry definitions at the three-digit level.

This table presents regressions similar to those in Table 6 and Table C4 but uses coarser three-digit industry definitions. The outcome variable is the Edmans et al. (2009) measure of wealth-performance sensitivity (EGL).

Dependent Variable	ln(Wealth-performance Sensitivity EGL)								
Industry Definition	SIC CRSP			SIC COMP			HOBERG-PHILLIPS		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
CO (Kappa)	-0.200***			-0.203***			-0.180***		
	(0.048)			(0.046)			(0.048)		
CO (Cosine Similarity)		-0.222***			-0.228***			-0.139***	
		(0.053)			(0.052)			(0.047)	
CO (Top 5 Overlap)			-0.134***			-0.150***			-0.0941**
			(0.038)			(0.036)			(0.035)
Volatility	-0.0580	-0.0616	-0.0473	-0.0998	-0.106	-0.0989	-0.0236	-0.0174	-0.0290
	(0.054)	(0.054)	(0.053)	(0.087)	(0.087)	(0.086)	(0.047)	(0.047)	(0.047)
ln(Market Equity)	1.172***	1.174***	1.162***	1.077***	1.078***	1.042***	1.005***	1.014***	0.991***
	(0.255)	(0.256)	(0.254)	(0.266)	(0.267)	(0.266)	(0.274)	(0.275)	(0.267)
Leverage	0.372***	0.370***	0.365***	0.369***	0.367***	0.363***	0.406***	0.401***	0.398***
	(0.022)	(0.021)	(0.021)	(0.022)	(0.022)	(0.022)	(0.024)	(0.025)	(0.025)
HHI	0.00130	0.00343	0.00794	-0.0240	-0.0230	-0.0214	0.00324	0.00587	0.00537
	(0.059)	(0.059)	(0.060)	(0.060)	(0.061)	(0.063)	(0.068)	(0.068)	(0.067)
ln(Tenure)	0.485***	0.485***	0.485***	0.482***	0.483***	0.482***	0.492***	0.491***	0.494***
	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.029)	(0.034)	(0.034)	(0.034)
Institutional Ownership	-0.377***	-0.305***	-0.333***	-0.402***	-0.328***	-0.356***	-0.348***	-0.299***	-0.316***
	(0.081)	(0.082)	(0.083)	(0.082)	(0.081)	(0.084)	(0.072)	(0.074)	(0.076)
Observations	46,274	46,274	45,618	46,603	46,603	46,110	34,790	34,790	34,303
R-squared	0.650	0.650	0.650	0.650	0.650	0.650	0.674	0.674	0.675
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry (SIC-2) × Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table C9. Wealth-performance sensitivity as a function of common ownership: robustness of difference-in-differences estimation to alternative measures of WPS .

This table presents the difference in difference estimates using S&P500 inclusions of competitors. Dependent variables are ln(WPS JM) in Panel A and ln(WPS HL) in Panel B. Firms that are already in the S&P500 index and are in an industry that experiences an addition of a competitor firm to the S&P500 index in a given year are the treatment group, and all other firms in different industries that did not experience an inclusion in the index are the control firms. The Post dummy takes value of 1 for the event year and for the five years after the inclusion, and takes value of 0 for the five years before. The controls (not shown) we use are volatility, the natural log of market equity, leverage, HHI, and the natural log of tenure and are taken as of the pre-event year. Firm and year fixed effects are included in all specifications. Standard errors are clustered two ways at the firm and year level. Significance levels are denoted by: *** p<0.01, ** p<0.05, * p<0.1.

Panel A: Dependent Variable WPS JM	ln(Wealth-performance Sensitivity JM)					
Industry Definition	SIC CRSP		SIC COMP		HOBERG-PHILIPS	
	(1)	(2)	(3)	(4)	(5)	(6)
Treat * Post	-0.169***	-0.171***	-0.131***	-0.132***	-0.0864**	-0.0852***
	(0.043)	(0.039)	(0.043)	(0.042)	(0.032)	(0.023)
Post	0.860***	0.955***	0.790***	0.899***	0.902***	0.950***
	(0.224)	(0.092)	(0.213)	(0.089)	(0.281)	(0.119)
True Inclusions	163	163	179	179	151	151
Unique Treated Firms	335	335	351	351	417	417
Unique Control Firms	807	807	837	837	709	709
R-squared	0.686	0.686	0.686	0.686	0.694	0.694
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Inclusion FE	No	Yes	No	Yes	No	Yes

Panel B: Dependent Variable WPS HL	ln(Wealth-performance Sensitivity HL)					
Industry Definition	SIC CRSP		SIC COMP		HOBERG-PHILIPS	
	(1)	(2)	(3)	(4)	(5)	(6)
Treat * Post	-0.148**	-0.148***	-0.132**	-0.132***	-0.117**	-0.118**
	(0.058)	(0.052)	(0.052)	(0.045)	(0.045)	(0.045)
Post	1.263***	1.259***	1.251***	1.232***	1.569***	1.559***
	(0.264)	(0.153)	(0.256)	(0.153)	(0.370)	(0.205)
True Inclusions	163	163	179	179	151	151
Unique Treated Firms	335	335	351	351	417	417
Unique Control Firms	807	807	837	837	709	709
R-squared	0.552	0.552	0.555	0.556	0.550	0.551
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Inclusion FE	No	Yes	No	Yes	No	Yes

Table C10. Change in common ownership following index addition of a competitor.

This table presents the effect of the Treat variable on changes in firm-level common ownership of index incumbents after the inclusion. The outcome variable is the change in kappa in Panel A and the change in cosine similarity in Panel B. All specifications include the following controls (not shown): volatility, the natural log of market equity, leverage, HHI, and the natural log of tenure, and are taken as of the pre-event year. The dependent variable change in common ownership is rank-transformed to make it comparable across time and across measures. Significance levels are denoted by: *** p<0.01, ** p<0.05, * p<0.1.

Panel A: Dependent Variable: Change in Common Ownership (Kappa)						
Industry Definition	SIC CRSP		SIC COMP		HOBERG-PHILIPS	
	(1)	(2)	(3)	(4)	(5)	(6)
Treat	0.0265***	0.0300*	0.0370***	0.0351**	0.0292***	0.0405**
	(0.009)	(0.017)	(0.008)	(0.017)	(0.009)	(0.019)
True Inclusions	163	163	179	179	151	151
Unique Treated Firms	335	335	351	351	417	417
Unique Control Firms	807	807	837	837	709	709
R-squared	0.001	0.076	0.001	0.073	0.000	0.101
Firm FE	No	Yes	No	Yes	No	Yes
Year FE	No	Yes	No	Yes	No	Yes

Panel B: Dependent Variable: Change in Common Ownership (Cosine Similarity)						
Industry Definition	SIC CRSP		SIC COMP		HOBERG-PHILIPS	
	(1)	(2)	(3)	(4)	(5)	(6)
Treat	0.0429***	0.0496***	0.0567***	0.0507***	0.0305***	0.0509***
	(0.009)	(0.016)	(0.008)	(0.018)	(0.009)	(0.019)
True Inclusions	163	163	179	179	151	151
Unique Treated Firms	335	335	351	351	417	417
Unique Control Firms	807	807	837	837	709	709
R-squared	0.001	0.082	0.001	0.072	0.000	0.100
Firm FE	No	Yes	No	Yes	No	Yes
Year FE	No	Yes	No	Yes	No	Yes

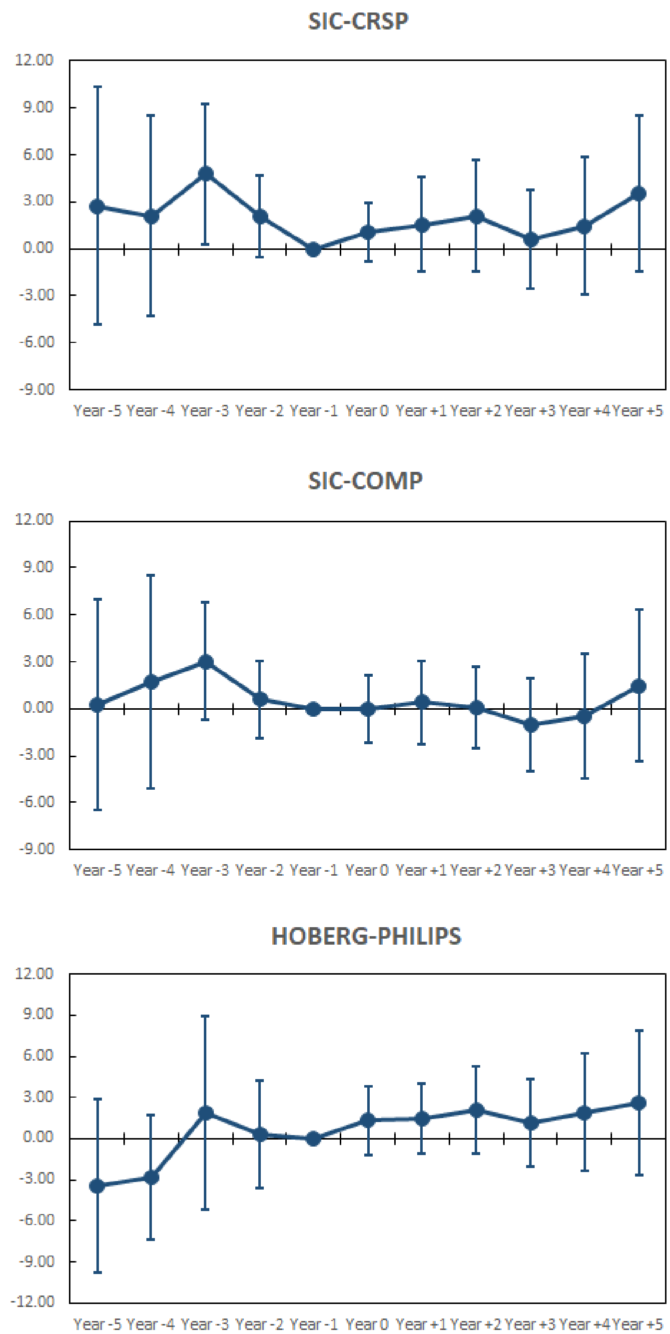

Figure C1. Estimated coefficients of S&P500 inclusions (rather than competitor index inclusions) on WPS.
The graph plots the estimated coefficient on year fixed effects in the regression on WPS. We drop the year previous to the inclusion, and thus the effect is normalized to zero for that year. We control for volatility, natural log of market equity, leverage, HHI, and natural log of tenure, each evaluated in the year previous to the inclusion, and interacted with year fixed effects. We also include firm and year fixed effects, and double-cluster standard errors at the firm and year levels.