# Common Ownership, Competition, and Top Management Incentives*

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**Abstract**

We propose a firm-level mechanism through which common ownership can affect product market outcomes consistent with empirical evidence. We embed a canonical managerial incentive design problem in a model of strategic product market competition under common ownership. Firm-level variation in common ownership causes variation in managerial incentives *across firms* as well as variation in product prices, market shares, concentration, and output *across markets*—all without communication between shareholders and firms, coordination between firms, knowledge of shareholders' incentives, or market-specific interventions by top managers. We empirically confirm the theoretical prediction that top management incentives are less performance-sensitive in firms where large investors hold greater ownership stakes in competitors.

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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 8, 2018

# 1 Introduction

The common ownership hypothesis suggests that when large investors own shares in many firms 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.[1] Empirical contributions document the rising importance of common ownership and provide evidence to support the theory.[2] 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."

However, thus far no paper has established a mechanism through which common ownership affects product market outcomes. This gap in the literature has fueled a vigorous debate about whether existing evidence on common ownership has a plausible causal interpretation (especially in light of the fact that managers rather than investors control firm operations) and, if so, how to effectively address the arising regulatory, legal, and antitrust and corporate governance challenges. Much of that debate is informal and lacks the discipline of a theoretical model and empirical analysis. In this paper we theoretically show that low-powered managerial incentives can serve as a simple and plausible mechanism that links higher common ownership and softer product market competition. This mechanism does not rely on communication or coordination between shareholders, managers or firms. In line with existing empirical evidence our model predicts within-firm across-market correlations between common ownership and product market outcomes. We empirically confirm our main theoretical prediction that higher firm-level common ownership leads

[1]Notable theoretical contributions include early work by Rubinstein and Yaari (1983), Rotemberg (1984) and Bresnahan and Salop (1986) as well as recent papers by López and Vives (2018), Backus et al. (2019b), and Azar and Vives (2020).

[2]See the comprehensive surveys by Schmalz (2018) and Backus et al. (2019b) which summarize a variety of empirical studies providing market- and industry-level as well as economy-wide evidence. More recent contributions include Boller and Scott Morton (2020), Newham et al. (2019), Aslan (2019), Torshizi and Clapp (2019), Li et al. (2020), and Eldar et al. (2020).

to less performance-sensitive incentives for CEOs and other top managers.

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). Our model captures the agency conflicts that exist between those who manage firms (managers) and those who own them (investors) and recognizes that large investors routinely hold ownership stakes in several firms in the same industry. The central driving force of the model is that performance-sensitive managerial compensation encourages productivity-improving managerial effort, which in turn has two effects. First, in a setting in which product prices are assumed to be fixed, productivity-improving managerial effort increases firm profitability and is thus desirable for all owners. Second, with endogenous product prices, productivity enhancements also increase how fiercely the firm competes in the product market. The latter channel indirectly reduces the profitability of competing firms and thus stands in conflict with the interests of common owners who hold shares in other firms in the same industry. Therefore, the model predicts a negative relationship between common ownership and the sensitivity of top management incentives to firm performance.

By allowing for asymmetries in firm-level common ownership in a multimarket industry, the model generates additional firm- and market-level predictions. First, within the same industry more commonly-owned firms have weaker managerial incentives and compete less aggressively (i.e., set higher prices) than less commonly-owned "maverick" firms which have stronger managerial incentives, 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. By doing so, the model provides the first formal explanation of how variation in common ownership at the firm level can affect competitive behavior at the product market level. Specifically, it establishes that a completely standard firm-level corporate governance mechanism can cause the previously documented (but, until now, theoretically unexplained) market-level correlations between common ownership and product prices (+ve), output (−ve), and product market concentration (−ve).[3]

Crucially, the simple and plausible compensation mechanism we propose does *not* rely (i) on owners having access to sophisticated market-level incentives or communications to steer product market behavior in different markets, (ii) on top managers' knowledge of the ownership structure of either their own firm or their competitors, (iii) on top managers making detailed market-specific strategic choices (e.g., setting prices), nor (iv) on explicit or tacit collusion between managers, firms or shareholders. Instead, our mechanism only relies on unilateral changes in the firm's objective, managers exerting firm-wide productivity-improving effort solely based on their own explicit incentives (as in any standard corporate finance model) and market-level specialists making product market choices solely based on market demand and firms' cost structures (as in standard industrial organization models). Bridging two classic assumptions in corporate finance and industrial is all that is necessary to generate the above-mentioned predictions about ownership arrangements, managerial incentives, and product market behavior.

In addition to providing an economic mechanism that can explain previously documented but hitherto unmodeled correlations between common ownership and outcomes at the product market level, we empirically test the main prediction about the structure of top management compensation, through which the causal link between common ownership and product market outcomes is established in our model.[4] Using theoretically informed measures of common ownership from the industrial organization literature (Backus et al., 2020a; Boller and Scott Morton, 2020) we document a strong and robust negative association between a firm's common ownership and the performance sensitivity of its top management's compensation. Our regressions control for industry structure, firm- and manager-level characteristics, as well as (time-invariant) firm fixed effects

[3]In line with previous contributions to the literature on incentive design, our model focuses on product market competition as one particular channel through which the steepness of managerial incentives can affect the profits of competing firms. However, our results about common ownership reducing the performance-sensitivity of managerial incentives hold more generally. Specifically, they hold in any setting in which performance-sensitive compensation (or stronger corporate governance) encourages managers to make strategic choices (e.g., productivity improvements, entry, investment, or innovation) that have negative repercussions for the profits of other firms (partly) owned by the same shareholders.

[4]We confine our empirical analysis to a subset of the theoretical predictions of our model, namely to the main prediction about the negative relationship between common ownership and managerial incentives, and to references to existing literature that has tested auxiliary predictions. An empirical analysis of further auxiliary theoretical predictions would necessitate measuring or estimating managerial effort choices and firms' marginal costs in addition to estimating a structural model of product market competition under common ownership as in Backus et al. (2019a) for ready-to-eat cereals or Ruiz-Pérez (2019) for airlines.

and (time-varying) industry-year fixed effects. This empirical design choice ensures that we avoid spurious inferences from industry-wide trends or time-invariant firm compensation policies and base our inferences only on within-firm and within-year variation. We estimate that an interquartile range shift (25th to 75th percentile) of the firm-level degree of common ownership is associated with a 6.6% reduction of CEO wealth-performance sensitivity. To put this incentive-reducing effect of common ownership in perspective, it is comparable to the effect of a one-standard deviation reduction in firm volatility on managerial incentives. 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 results remain consistently negative, with similar (or even larger) economic magnitudes and statistical significance levels.

Whereas managerial incentives, productivity improvements, competitive actions, market shares, and profits are endogenously determined in our model, ownership of firms 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 investigate whether the negative correlation between the strength of managerial incentives and common ownership persists when our empirical estimation uses the variation in common ownership caused by index additions of industry competitors in a difference-in-differences design. Index incumbents (i.e., firms that were already in the index) experience a significant increase in common ownership after the inclusion of industry competitors (i.e., firms in the same industry) into the index. Following such index additions of industry competitors, top managers of firms which were already listed in the index before have significantly less wealth-performance-sensitive compensation.

Our model proposes unilateral incentives arising from managerial compensation as the first mechanism through which common ownership can influence product market competition. Although our empirical results are consistent with this mechanism, they do not prove that compensation is the primary mechanism, let alone the only mechanism, that causes market-level correlations between common ownership and product market outcomes as documented elsewhere in the literature. We merely prove the existence of a plausible theoretical channel and provide further empirical evidence that is consistent with it. Moreover, we make no claim that the compensation channel is the most effective way through which common ownership can affect product market competition. In fact, there are several examples of common shareholders tying compensation to explicit output targets.[5] The anti-competitive effects will also be more pronounced if owners can design managerial incentive compensation schemes that contract on firm output or on measures more directly linked to output than profits such as profit margins or relative performance. Our analysis shows that the mechanism through which common ownership affects product market competition can be much more subtle and therefore provides a conservative lower bound for the anti-competitive effects of common ownership.[6]

An ample body of theoretical work beginning with Hart (1983), Vickers (1985), Fershtman and Judd (1987) and Sklivas (1987) examines the relationship between product market competition and managerial incentives.[7] The earliest investigation of the idea that shareholder diversification requires rethinking the role of managerial incentive contracts is due to Gordon (1990). He shows in a reduced form principal-agent model without product market competition that a particular feature of managerial compensation, namely relative performance evaluation, should be less prevalent when firms benefit more from their competitors' good performance. Similar theoretical arguments have since been discussed in variations by Macho-Stadler and Verdier (1991), Hansen and Lott (1996), Rubin (2006), and Kraus and Rubin (2006).[8] Moreover, rather than focusing on a specific

[5]For example, Olson and Cook (2017) report on twelve oil investors' coordinated governance intervention to change executive incentives with the aim of reducing output and increasing portfolio firm profits. Similarly, a coalition of common shareholders successfully pressured major oil competitors to commit to fixed emissions targets. In the case of Royal Dutch Shell these require a reduction of net carbon emissions of 20% (by 2035) and 50% (by 2050). Executive pay is linked to the targets as of 2020 (Hiller and Nasralla, 2018; Crooks, 2018; Kent, 2018). Mooney and Mancini (2020) report that BlackRock, Fidelity, and Amundi called on "drug companies to put aside any qualms about collaborating with rivals" in light of the COVID-19 pandemic. Shekita (2020) documents and taxonomizes 30 separate competition-related interventions by common owners in many other industries.

[6]Several large institutional investors such as BlackRock and TIAA-CREF have argued for stronger stakeholder capitalism which takes the interests of stakeholders other than owners (e.g., employees and consumers) into account and seeks to internalize the externalities that companies impose on "the society where they work and operate" (Fink, 2020) as well as to support broader goals of social responsibility (Hart and Zingales, 2017; Oehmke and Opp, 2019; Broccardo et al., 2020; Coffee Jr, 2020) including climate change and race issues (Krueger et al., 2020; Condon, 2020; Shekita, 2020). In our analysis we make the arguably less ambitious claim that investors influence companies to partially internalize the externalities that their corporate conduct imposes on other firms in the same investors' portfolio.

[7]The vast theoretical and empirical literature on managerial incentives is reviewed by Murphy (1999) and Edmans and Gabaix (2016).

[8]Ha et al. (2020) argue that firms design incentives to encourage collusion between product market competitors when local enforcement against collusion weakens. In contrast, our framework does not feature coordinated effects

feature of compensation, our theoretical framework considers the totality of managerial incentives and explicitly considers its interplay with strategic product market behavior. Analogously, rather than focusing only on changes in salary, bonuses, and total annual compensation or even just specific features of managerial compensation, our empirical analysis of managerial incentives takes all links between firm performance and executive wealth into account as suggested by Edmans et al. (2017).[9] Finally, our theoretical and empirical analysis exclusively focuses on explicit, pecuniary managerial incentives. However, implicit incentives resulting from the managerial labor market may be important as well (Jenter and Kanaan, 2015).

The remainder of the paper proceeds as follows. Section 2 presents the theoretical model, its extensions, and discusses how its predictions are useful in understanding empirical facts about common ownership. Section 3 details the data and presents the various common ownership measures. Section 4 presents our empirical design and results. Section 5 concludes. Appendix A contains additional discussion of the theoretical framework, proofs, and model extensions. Appendix B contains additional empirical results.

# 2 Theoretical Framework

## 2.1 Setup of Baseline Model

We embed optimal managerial incentive contracts and common ownership in a model of product market competition. Ownership is taken as exogenous. Firms' marginal costs, product prices, market shares, and profits are endogenously co-determined with the simple profit-based incentive contracts given to managers by (common) owners. Managers optimally respond to their incentive schedules by choosing effort, which improves firm-wide productivity. Managers do not have any

such as collusion, but rather just unilateral effects through common ownership.

[9] 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. This approach is problematic for two reasons. First, 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. (2020a) and Backus et al. (2019a) 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 use as our primary measure of common ownership.

knowledge of the ownership structures in the industry.[10]

### 2.1.1 Product Market Competition

Consider an industry with $n$ firms, each producing a differentiated product. Each firm is owned by a majority owner[11] and a set of minority owners. Each firm is run by a single (risk-averse) top manager.[12] The model has two stages. Stage 1 is a completely standard principal-agent setup in which the majority owner (she) of each firm proposes an incentive contract to the manager (he) of that firm which the manager can accept or reject. In stage 2, each firm's top manager can improve firm productivity (i.e., marginal cost) through costly private effort that optimally responds to the managerial incentives designed in stage 1. This productivity improvement is not market specific, but applies to the production costs of all the products the firm produces. In stage 2, the firms 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 top management's effort choice as given.[13] 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.

Following Singh and Vives (1984) and Häckner (2000) we derive demand from the behavior of

[10]Our analysis does not consider additional agency conflicts between shareholders and boards, and between boards and compensation committees. We thus adopt an ubiquitous assumption in the literature studying how owners structure compensation contracts to incentivize managers to compete in the product market (Hart, 1983; Vickers, 1985; Fershtman and Judd, 1987; Sklivas, 1987; Fumas, 1992; Reitman, 1993; Alexander and Zhou, 1995; Schmidt, 1997; Kedia, 1998; Joh, 1999; Spagnolo, 2000; Raith, 2003).

[11]Aside from a literal interpretation, this assumption can also 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 in Shekita (2020), including Olson and Cook (2017). Moskalev (2020) shows conditions under which shareholders with similar portfolios can be regarded as a single block.

[12]Risk aversion of the manager is a common assumption in principal-agent models and interacts with the random firm profit assumption. However, it is not crucial to our model. As we discuss in Section A.1.1 the same qualitative predictions would hold for a risk-neutral manager.

[13]For the sake of brevity our exposition focuses on differentiated Bertrand competition (i.e., strategic complements), but all of our results also hold for differentiated Cournot competition (i.e., strategic substitutes). See Section 2.4.3 for additional discussion.

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

**Managerial Incentive Design**

Majority owners (8) propose incentive contracts $(s_i, \alpha_i)$.
Managers accept (or reject) incentive contracts.

**Product Market Competition**

Managers (6) exert productivity-improving effort $e_i$.
Pricing specialists (7) set product market prices $p_i$.
Product market profits $\pi_i$ are realized.

**Figure 1.** Model Timeline

a representative consumer with the following quadratic utility function:

$$U(\vec{q}) = \omega \sum_{i=1}^{n} q_i - \frac{1}{2}\left(\rho \sum_{i=1}^{n} q_i^2 + 2\gamma \sum_{i \neq j} q_i q_j\right) \tag{1}$$

where $q_i$ is the quantity of product $i$, $\vec{q} = (q_1, ..., q_n)$ is the vector of all quantities, $\omega > 0$ represents overall product quality, $\rho > 0$ measures the concavity of the utility function, and $\gamma$ represents the degree of substitutability between the two differentiated products $i$ and $j$. $\rho > \gamma > 0$ ensures that the products are (imperfect) substitutes. The higher the value of $\gamma$, the more alike are the products. The resulting consumer maximization problem yields linear demand for each product $i$ such that the firms face symmetric demand functions in market $l$ given by

$$q_i(\vec{p}) = A - bp_i + a \sum_{j \neq i} p_j \tag{2}$$

where $\vec{p} = (p_1, ..., p_n)$ is the vector of all product market prices, $A = \frac{\omega}{\rho+(n-1)\gamma}$, $b = \frac{\rho+(n-2)\gamma}{[\rho+(n-1)\gamma](\rho-\gamma)}$, and $a = \frac{\gamma}{[\rho+(n-1)\gamma](\rho-\gamma)}$. By assuming $\rho > \gamma > 0$ 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

$$c_i = \bar{c} - e_i \tag{3}$$

where $\bar{c} < \omega$ is a constant and $e_i$ is the effort exerted by firm $i$'s manager. By allowing managerial effort to improve firm productivity in this way we follow similar model setups used in Raith

(2003) as well as in canonical models of corporate (process) innovation under strategic competition (D'Aspremont and Jacquemin, 1988; Kamien et al., 1992). Importantly, this specification means that the marginal benefit of managerial effort rises significantly with firm size as in Baker and Hall (2004) who also verify this assumption empirically. A model in which managers choose the level of managerial perks and owners aim to limit these perks (rather than to encourage the level of managerial effort) is isomorphic to our model, as we discuss in Section A.1.2.[14]

The profits of firm $i$ are then given by

$$\pi_i = [p_i - (\bar{c} - e_i)](A - bp_i + a\sum_{j\neq i} p_j) + \varepsilon_i \tag{4}$$

Importantly, an increase in the price $p_j$ of firm $j$ has a positive effect on the profit of firm $i$: firms benefit from softer competition by rivals, as in virtually all models of product market competition. We assume that $\varepsilon_i$ is normally distributed with zero mean and variance $\sigma^2$, and is independent of the other firms' profit shocks.

### 2.1.2 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

$$w_i = s_i + \alpha_i \pi_i \tag{5}$$

where $s_i$ is a fixed salary and $\alpha_i$ is the incentive slope on firm $i$'s profits $\pi_i$. 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.[15] The manager's

[14]In our model which embeds managerial contracts in a setting of strategic competition, (managerial) productivity improvements are influenced both by the common ownership concerns of shareholders as well as the degree of product market competition. The latter effect is the principal focus in theoretical work by Raith (2003) and empirical analysis by Backus (2020).

[15]Our analysis would be simpler if we assumed, as in Raith (2003), that managers are directly rewarded for marginal cost reduction rather than firm profit. However, such an assumption would break the close match between our theoretical analysis and empirical implementation.

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 utility $u_i$ is given by $-\exp[-r(w_i - \frac{1}{2}q_i e_i^2)]$, where $r$ is the agent's degree of (constant absolute) risk aversion and $\frac{1}{2}q_i e_i^2$ is his disutility of exerting effort.

The functional form of our cost of effort function implies that cutting marginal costs is relatively harder for the manager when the firm is large. This ensures that for a given incentive slope $\alpha_i$ the manager's incentive to exert effort does not vary with the firm's output $q_i$ because both the manager's marginal impact on the firm's profit (through the marginal cost $c_i$) as well as the manager's marginal effort cost grow as the size of the firm grows. In other words, for a given incentive slope $\alpha_i$ the manager's effort is size-invariant. However, our results also hold for more general cost-of-effort functions of the form $(\xi + \tau q_i)\frac{1}{2}e_i^2$ where $\xi$ and $\tau$ are non-negative constants.[16]

The manager's wage has expected value of $\mathrm{E}[w_i] = s_i + \alpha_i \pi_i$ and variance of $\mathrm{Var}[w_i] = \alpha_i^2 \sigma^2$. Given the normal distribution of $\varepsilon_i$, maximizing utility is therefore equivalent to maximizing the certainty equivalent

$$CE_i = s_i + \alpha_i \pi_i - \frac{r}{2}\alpha_i^2 \sigma^2 - \frac{1}{2}q_i e_i^2.$$

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

$$\max_{e_i} CE_i = s_i + \alpha_i[p_i - (\bar{c} - e_i)](A - bp_i + a\sum_{j \neq i} p_j) - \frac{r}{2}\alpha_i^2 \sigma^2 - \frac{1}{2}(A - bp_i + a\sum_{j \neq i} p_j)e_i^2. \qquad (6)$$

Crucially, our model assumes that the manager only takes 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 pricing specialists who we introduce now.

[16] For example, $\tau = 0$ yields the familiar quadratic cost of effort function used in many other principal-agent models. Because of the interdependency between managerial incentives and product market competition in our model, for a given $\alpha_i$ this assumption leads to greater managerial effort as the firm's output grows.

#### 2.1.3 Pricing Specialists

All pricing specialists choose the optimal price level in stage 2 to maximize firm profits taking firm productivity (i.e., marginal cost) which is simultaneously determined by the top manager's effort choice as given

$$\max_{p_i} \pi_i = [p_i - (\bar{c} - e_i)](A - bp_i + a \sum_{j \neq i} p_j) + \varepsilon_i \tag{7}$$

We assume that this pricing decision does not involve any privately-borne costs and therefore each pricing specialist's interests perfectly coincide with the classical objective of individual firm profit maximization.

Our model is robust to changes in timing. For example, if pricing specialists set prices in stage 3 (rather than concurrently with the effort choices of top managers in stage 2), then 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.

#### 2.1.4 Owners

There are $n$ owners. To simplify the exposition, we assume that these owners are symmetric such that owner $i$ owns a majority stake in firm $i$ and a residual symmetric share in all other firms. López and Vives (2018) and Backus et al. (2020a) show that firm $i$'s maximization problem can be restated in the following way

$$\phi_i = \pi_i - w_i + \sum_{j \neq i} \kappa_{ij}(\pi_j - w_j) \tag{8}$$

where $\kappa_{ij}$ is the weight that firm $i$ places on its competitors $j$'s net profits, $\pi_j - w_j$. Given our symmetry assumptions, we have $\kappa_{ij} = \kappa$. Furthermore, we assume that the profit weight $\kappa$ is between 0 (separate ownership) and 1 (perfectly common ownership).[17] Its exact value depends

[17] Values of $\kappa$ exceeding 1 are possible, but lead to firms placing more weight on their competitors' profits than on their own profits. This would make it possible for common ownership to create incentives for the "tunneling" of profits from one firm to another (Johnson et al., 2000).

on the type of ownership and corresponds to what Edgeworth (1881) termed the "coefficient of effective sympathy among firms."[18]

In stage 1, each majority owner $i$ publicly proposes an incentive contract $(s_i, \alpha_i)$ for her manager $i$ such that product market behavior in stage 2, as induced by the incentive contract designed in stage 1, maximizes her profit shares in all the firms.[19] The optimal incentive contract for manager $i$ therefore internalizes the effect on profits of the remaining firm to the extent that the majority owner of firm $i$ also owns cash flow rights of (but does not necessarily have influence or control over) that other firm.

Hence, the relevant maximization problem for the majority owner of firm $i$ is

$$\max_{s_i,\alpha_i} \phi_i = (\pi_i - w_i) + \kappa \sum_{j \neq i} (\pi_j - w_j)$$

$$\text{subject to} \quad u_i \geq \bar{u} \quad \text{and} \quad e_i^* \in \arg\max_{e_i} \mathbb{E}[-\exp(-r(w_i - q_i e_i^2/2)] \quad \text{and} \qquad p_i^* \in \arg\max_{p_i} \pi_i.$$

To ensure that each owner's problem has an interior solution, we assume that $r\sigma^2$ is sufficiently large.

It is important to remind the reader that in our model each manager and each pricing specialist is solely rewarded for the profits $\pi_i$ of his own firm. This means that a common owner who cares about the portfolio objective $\phi_i$ rather than about individual firm profits $\pi_i$ as the manager and the pricing specialist do, can only influence competitive behavior by varying the manager's incentive slope $\alpha_i$. Table 1 provides a summary of the model setup.

[18]By maximizing equation (8) the firm essentially maximizes a weighted average of its own as well as all other firm's profits. The particular objective function given in equation (8) is a normalization. Firms do not maximize a sum that is larger than the entire economy. In particular, López and Vives (2018) consider two types of minority shareholdings: when investors acquire firms' shares (*common ownership*) with silent financial interest or proportional control and when firms acquire other firms' shares (*cross-ownership*). In both cases they show that, when the stakes are symmetric, firm-$i$'s problem is to maximize the objective function given in equation (8).

[19]The assumption that the majority owner sets the terms of the incentive contract is made for expositional simplicity. However, even with "one share, one vote" majority voting the majority owner would be able to implement the same contract. In settings without a majority owner, the largest investor usually has the greatest chance of being pivotal. Our empirical measure of common ownership accounts for this situation.

| Number | Equation | Description |
|---|---|---|
| (1) | $U(\vec{q}) = \omega \sum_{i=1}^{n} q_i - \frac{1}{2}\left(\rho \sum_{i=1}^{n} q_i^2 + 2\gamma \sum_{i \neq j} q_i q_j\right)$ | Representative Consumer |
| (2) | $q_i = A - bp_i + a \sum_{j \neq i} p_j$ | Demand for Product of Firm $i$ |
| (3) | $c_i = \bar{c} - e_i$ | Productivity Improvement |
| (4) | $\pi_i = [p_i - (\bar{c} - e_i)]q_i + \varepsilon_i$ | Firm Profits |
| (5) | $w_i = s_i + \alpha_i \pi_i$ | Managerial Compensation |
| (6) | $\max_{e_i} CE_i = s_i + \alpha_i[p_i - (\bar{c} - e_i)]q_i - \frac{r}{2}\alpha_i^2\sigma^2 - \frac{1}{2}q_i e_i^2$ | Managerial Utility |
| (7) | $\max_{p_i} \pi_i = [p_i - (\bar{c} - e_i)](A - bp_i + a \sum_{j \neq i} p_j) + \varepsilon_i$ | Pricing Specialist |
| (8) | $\max_{s_i, \alpha_i} \phi_i = \pi_i - w_i + \sum_{j \neq i} \kappa_{ij}(\pi_j - w_j)$ | Owner Objective Function |

**Table 1.** Summary of the Model Setup

## 2.2 Analysis

We solve by backward induction for a symmetric equilibrium. In stage 2 of the game, when the managers simultaneously choose effort and pricing specialists choose prices, each manager knows his own incentive contract $(s_i, \alpha_i)$ as well as that of his competitors.[20]

For a given contract $(s_i, \alpha_i)$ manager $i$'s first-order condition with respect to productivity-improving effort $e_i$ and the pricing specialist's first-order condition with respect to price $p_i$ can be rearranged to yield the following best-response functions

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

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

First, note that the stronger the incentives $\alpha_i$ given to the manager the larger will be the efficiency improvements $e_i$ that he undertakes as can be seen by the effect of $\alpha_i$ 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. Indeed, this result illustrates that $\alpha$, in addition to representing an explicit incentive slope, can also serve as a reduced-form mechanism for any governance intervention that has the effect of inducing efficiency improvements in the firm. Second, stronger

[20]This observability assumption is common in the literature on managerial incentives and product market competition (Schmidt, 1997; Raith, 2003) and just serves to simplify the theoretical analysis.

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 because it improves the firm's profit margin and increases the size of the firm. Third, the base salary $s_i$ does not affect the managers' decisions.

The first-order conditions (9) and (10) yield a system of $2n$ linear equations which we solve for the equilibrium efforts $e_i^*(\vec{\alpha})$, equilibrium prices $p_i^*(\vec{\alpha})$, 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 $\kappa$.

Recall that the objective function of the majority owner of firm $i$ given in equation 8 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 $\alpha_i$ on the stage 2 equilibrium efforts and prices, she uses the incentive slope $\alpha_i$ to maximize her objective function $\phi_i$. The derivative of the owner's objective function with respect to $\alpha_i$ is given by

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

The last term that includes $\kappa$ captures the impact of changing $\alpha_i$ 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 equilibrium profits of all other firms $j \neq i$ and because the majority owner of firm $i$ cares about these profits with intensity $\kappa$ this leads to our central theoretical result.

**Proposition 1.** *If firms interact strategically in the product market ($a > 0$) the symmetric equilibrium incentives $\alpha_i = \alpha^*$ given to managers decrease with the degree of common ownership $\kappa$, that is $\frac{\partial \alpha^*}{\partial \kappa} < 0$.*

Managers (optimally) face weaker incentives to improve firm efficiency as common ownership increases. In other words, by foregoing the provision of high-powered incentive contracts common owners are “excessively deferential” toward managers (Bebchuk et al., 2017; Bebchuk and Hirst, 2019)—relative to undiversified owners (and relative to the corporate finance benchmark level of intervention premised on the assumption that firms do not interact strategically in the product market)—but that outcome is optimal from the perspective of the common owner, taking equilibrium effects into account. This channel is economically distinct from an alternative reason for relatively weak governance by index funds emphasized by Bebchuk et al. (2017), Bebchuk and Hirst (2019), and Gilje et al. (2020), namely a higher cost of engagement due to a large number of portfolio firms.

The intuition for this result is relatively straightforward. As common ownership measured by $\kappa$ increases, the (majority) owner of firm $i$ cares relatively more about the net profits of firm $j$ in the industry (see equation (8)). 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 a higher price $p_i$ because that benefits the profits $\pi_j$ of firm $j$. Whereas the majority owner of firm $i$ does not directly control the product market price $p_i$, she can induce less aggressive product market behavior (and thus a higher price $p_i$) by setting a lower incentive slope $\alpha_i$ 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 in stage 2 which leads to a higher price $p_i$ set by the pricing specialist in stage 2. This, in turn, benefits the net profits of firm $j$ which become relatively more important as common ownership $\kappa$ increases.[21]

Proposition 1 also emphasizes the role of strategic product market competition between firms in our model. If the firms operated in separate markets (i.e., $a = 0$) and thus each firm’s pricing decision had no impact on the demand and profits of the other firm, the degree of common ownership $\kappa$ between the firms would not have any impact on the equilibrium managerial incentives $\alpha^*$. 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 $\kappa$ will not influence managerial incentives $\alpha^*$.[22]

[21] Of course, the model does not imply that common owners consciously employ the above calculation. The model merely provides an “as-if” explanation for the empirically observed phenomenon that common owners appear less active monitors than undiversified activists.

[22] In Section A.1.3 we discuss additional insights of our theoretical framework that result from comparative statics

In summary, our model offers a plausible channel, namely simple and commonly 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.

## 2.3 Multimarket Firm-level Variation in Common Ownership

Our baseline model considers effects of common ownership in a single-market industry with symmetric firms, but it ignores how changes in firm-level common ownership can differentially affect firms' product market strategies across multiple markets. We first show that firm-level variation in common ownership can lead to firm-level variation in managerial incentives and then demonstrate that it can also generate market-level variation in competitive behavior within the same firm.

Consider an industry with three firms ($i = 1, 2, 3$) and three (geographically) separate markets ($l = \mathrm{I}, \mathrm{II}, \mathrm{III}$). 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.[23] 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 before, each firm is run by a single top manager who only optimally responds to a linear profit-based incentive contract $w_i = s_i + \alpha_i \pi_i$. This incentive contract only rewards firm-wide performance and attaches equal weights to the profits in both markets in which firm $i$ operates. In stage 1, majority owners set incentive contracts. In stage 2, top managers choose effort levels to maximize the expected utility given their incentive contract and pricing specialists choose prices to maximize market-level (or firm) profits.[24]

of the degree of product differentiation $a$.

[23] Our results generalize to any number of $n$ firms each producing $n-1$ products competing in symmetric numbers in $n$ distinct markets.

[24] As before, prices could also be chosen by any other entity that cares about or is incentivized to maximize market-level (or firm) profits.

The firms face symmetric demand functions in market $l$ given by

$$q_{i,l}(p_{i,l}, p_{j,l}) = A - bp_{i,l} + ap_{j,l}.$$

As before, each firm $i$ has a constant marginal cost given by $c_i = \bar{c} - e_i$. Note that the efficiency improvement induced by effort exertion is not market-specific but applies to the production costs of all the products the firm produces. The combined profits of firm 1 which sets prices $p_{1,\mathrm{I}}$ for market I and $p_{1,\mathrm{II}}$ for market II, are given by

$$\pi_1 = (p_{1,\mathrm{I}} - c_1)(A - bp_{1,\mathrm{I}} + ap_{3,\mathrm{I}}) + (p_{1,\mathrm{II}} - c_1)(A - bp_{1,\mathrm{II}} + ap_{2,\mathrm{II}}) + \varepsilon_i.$$

Each manager $i$ chooses effort $e_i$ to maximize his expected compensation net of risk and effort costs

$$\max_{e_i} s_i + \alpha_i \pi_i - \frac{r}{2}\alpha_i^2 \sigma^2 - \frac{1}{2} q_i e_i^2$$

where $q_i = \sum_l q_{i,l}$ is the firm's total output in both markets in which it operates. The pricing specialist of firm $i$ for market $l$ sets $p_{i,l}$ to maximize market-level profit $\pi_{i,l}$ of firm $i$ in market $l$

$$\max_{p_{i,l}} (p_{i,l} - c_i)(A - bp_{i,l} + ap_{j,l}).$$

For firm 1 this results in the following familiar best-response functions

$$\begin{aligned} e_1 &= \alpha_1 \\ p_{1,\mathrm{I}} &= \frac{A + b(\bar{c} - e_i) + ap_{3,\mathrm{I}}}{2b} \\ p_{1,\mathrm{II}} &= \frac{A + b(\bar{c} - e_i) + ap_{2,\mathrm{II}}}{2b} \end{aligned}$$

which feature the same positive and negative relationship, respectively, between managerial incentives for effort and prices as in our baseline model.

The majority owner of firm $i$ solves

$$\max_{s_i,\alpha_i}(\pi_i - w_i) + \kappa_{i,j}(\pi_j - w_j) + \kappa_{i,k}(\pi_k - w_k)$$
$$\text{subject to} \quad u_i \geq \bar{u} \quad \text{and} \quad e_i^* \in \arg\max_{e_i} \mathbb{E}[-\exp(-r(w_i - q_i e_i^2/2))] \quad \text{and} \quad p_{i,l}^* \in \arg\max_{p_{i,l}} \pi_{i,l}$$

where $\kappa_{i,j}$ and $\kappa_{i,k}$ capture the impact of the minority ownership shares that the majority owner of firm $i$ holds in firms $j$ and $k$.

Specifically, we assume that there is one undiversified "maverick" owner who owns 100% of firm 1 (which we call the "maverick" firm) and the remaining two owners of firms 2 and 3 each own $\delta$ 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 $\kappa$ which is monotonically related to $\delta$. Figure 2 summarizes the model setup.

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 with its different geographic markets and routes and its 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, or 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.[25] Given these stark

[25] Backus et al. (2020a) show that the significant common ownership in the airline industry is by no means an exception, but that common ownership by large asset management companies is, in fact, the rule.

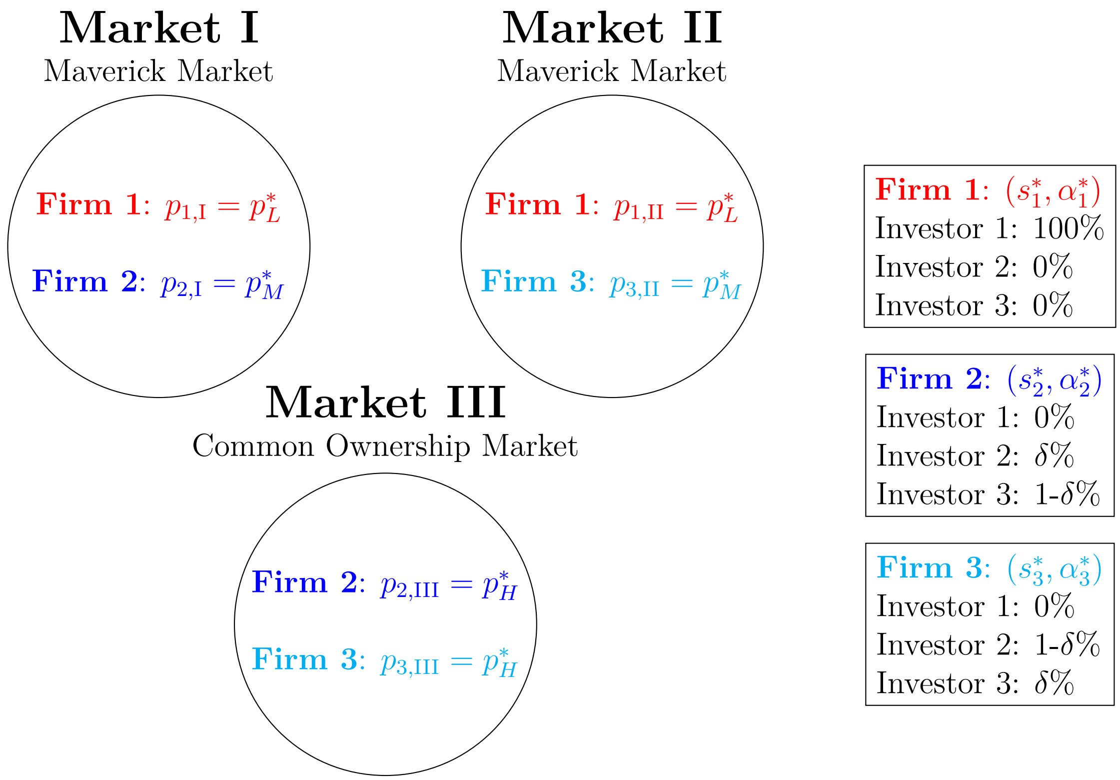


**Figure 2.** Model Setup and Equilibrium Incentives and Prices for Multimarket Firm-level Variation in Common Ownership: Firm 1 is the "maverick" firm whereas firm 2 and 3 are the commonly-owned firms where $50\% \leq \delta < 100\%$. In equilibrium, $\alpha_1^* > \alpha_2^* = \alpha_3^*$ (Proposition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

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).[26]

**[Insert TABLE 2 Here.]**

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 $\alpha_1^*$ and $\alpha_2^* = \alpha_3^*$ and the equilibrium prices are $p_L^* \equiv p_{1,\mathrm{I}}^* = p_{1,\mathrm{II}}^*$

[26] 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.

for the prices set by the maverick firm 1 in markets I and II, $p_M^* \equiv p_{2,\mathrm{II}}^* = p_{3,\mathrm{I}}^*$ 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 $p_H^* \equiv p_{2,\mathrm{III}}^* = p_{3,\mathrm{III}}^*$ 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, $\alpha_1^*$. Therefore, $c_2 = c_3 > c_1$. The difference in both the strength of incentives and the costs is increasing in the degree of common ownership $\kappa$ between the commonly-owned firms 2 and 3.*

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 $\alpha_i$ immediately establishes the proposition. The intuition is also exactly the same as in our baseline model. 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 output choices these common owners set less high-powered managerial incentive contracts than the maverick owner does. When the degree of common ownership $\kappa$ increases, the common owners of firms 2 and 3 care more about the impact of their choice of $\alpha_2$ and $\alpha_3$ on the profit of the other commonly-owned firm and thus reduce these incentive slopes by a greater amount.

In our analysis in Section 4 we investigate whether the empirical evidence is consistent with this link between managerial incentives and common ownership.

## 2.4 Discussion

Beyond establishing a negative relationship between the strength of managerial incentives and common ownership, our model also allows us to analyze product market outcomes of common ownership documented in the prior literature, to evaluate the plausibility of the proposed mechanism, and to discuss the robustness of the model to different assumptions about strategic interaction between firms. Sections A.1.1, A.1.2, and A.1.3 in the appendix present additional discussion of the role of managerial risk aversion, managerial perks, and product market differentiation.

### 2.4.1 Product Market Effects

We now analyze the impact that our proposed mechanism based on managerial incentives has on product market outcomes including prices, quantities, and market concentration. 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 that is in accordance with prior empirical findings in the common ownership literature. We begin by studying the effect on product market prices.

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

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 is increasing in the degree of common ownership $\kappa$, so is the difference in prices between the common-ownership market III and the maverick markets I and II.

Corollary 1 provides an explanation for the positive relationship between market-level common ownership and prices that has been empirically documented for airlines (Azar et al., 2018), banking (Azar et al., 2019), agricultural seeds (Torshizi and Clapp, 2019), and consumer goods (Aslan, 2019). Interestingly, Aslan (2019) finds that the positive relationship between common ownership and retail prices in consumer goods is channeled largely through marginal cost variation which is also precisely the channel through which common ownership affects prices in our model. Ruiz-Pérez (2019) also documents 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. Recall that our theoretical framework assumes that owners (who care about their profit shares in other firms as in equation (8)) can only influence the managers' productivity improvements, but that market specialists set prices solely to maximize their own firm profits (see equation (7)). 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 firm profits, fits the data the best.

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

Another straightforward corollary of Proposition 2 is that the quantities, 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. airlines industry. Moreover, in the maverick markets the maverick has a larger market share than the commonly-owned firm, whereas in the common ownership market, 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., 2019), but which until now does not have a theoretical explanation.

**Corollary 2.** *The equilibrium output and product market concentration in the common-ownership market is lower 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 common-ownership and maverick markets is increasing in the degree of common ownership $\kappa$.*

To our knowledge, these results constitute the first theory that can rationalize the within-firm market-level correlations between product prices and common ownership as well as the negative correlation between market concentration and common ownership—all within a model that explicitly recognizes agency conflicts between shareholders and managers. As such, it provides the first formal 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.

| Theory | Prediction | Level | Empirical Evidence |
|---|---|---|---|
| Prop. 1 | Incentive Slopes ($-$ve) | Firm (symmetric) | Section 4 |
| Prop. 2 | Incentive Slopes ($-$ve) | Firm | Section 4 |
| | Costs (+ve) | Firm | Aslan (2019) |
| Coro. 1 | Prices (+ve) | Firm & Market | Azar et al. (2018), Aslan (2019), Azar et al. (2019), Torshizi and Clapp (2019) |
| Coro. 2 | Output ($-$ve) | Market | Azar et al. (2018) |
| | Concentration ($-$ve) | Market | Azar et al. (2018), Azar et al. (2019) |
| | Entry ($-$ve) | Firm & Market | Newham et al. (2019), Ruiz-Pérez (2019) |
| | Investment ($-$ve) | Industry | Gutiérrez and Philippon (2018) |

**Table 3.** Theoretical Predictions and Empirical Evidence

Finally, our model uses prices (or quantities) as the competitive actions through which firms affect the profitability of their competitors and demonstrates how these are driven by strength of managerial incentives. However, other competitive actions such as entry or investment influence the profits of competitors in very similar ways. Therefore, our theoretical framework also relates, albeit more loosely, to another set of empirical results. Newham et al. (2019) and Ruiz-Pérez (2019) find evidence that common ownership leads to less aggressive entry decisions in pharmaceuticals and airlines. Gutiérrez and Philippon (2018) documents that quasi-indexer ownership appears to lower investment.

### 2.4.2 Plausibility of the Mechanism

In our model, all that is necessary for common ownership to differentially influence market-level prices is that top managers choose firm-wide productivity-improving efforts according to the simple profit-based incentive contracts given to them by their respective owners. Crucially, our theoretical results do *not* rely (i) on owners using sophisticated market-level incentives to steer competitive behavior differentially in different markets, (ii) on top managers' knowledge of the underlying ownership structures, (iii) on top managers making market-specific strategic choices, nor on (iv) market-level specialists being aware of different owners' differential portfolio incentives or of top managers' preferred strategic choices. In practice, common ownership may operate through much more direct channels than executive compensation (e.g., active intervention on strategic choices of firms by either undiversified activists, or by common owners), but these channels are not necessary at all for common ownership to have the anti-competitive product market effects documented in previous empirical work.

Our theoretical results are in stark contrast to widespread misconceptions about the mechanism of common ownership among scholars in corporate finance, law & economics, and in legal academia as well as among legal practitioners. For example, in law & economics a series of papers (Bebchuk et al., 2017; Bebchuk and Hirst, 2019; Hirst and Bebchuk, 2019) 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 anti-competitive behavior." As we have shown, one can agree with the premise of this argument, but the conclusion does not follow, due to equilibrium effects. 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 anti-competitive effects of common ownership. This insight is important, because it calls into question policy prescriptions that aim to reduce common owners' governance efforts. Within our model, such an intervention would weaken both governance and competition at the same time.

In a related vein, Hemphill and Kahan (2020) question the plausibility of executive compensation as a possible mechanism through which common ownership can affect product market competition because "across-the-board strategies, such as the avoidance or suppression of pay-for-performance compensation structures, result in a wholesale dilution of incentives to maximize firm value."[27] They further argue that "compensation-related mechanisms do not give [common owners] an effective method to increase portfolio value because they weaken managers' overall incentive to compete." But, as we have shown, it is exactly this blunting of "across-the-board" managerial incentives which weakens managers' incentive to enhance productivity and ends up affecting product market outcomes. Similarly, in the legal practitioner space, critics of the common ownership literature have incorrectly claimed that in order for common ownership to generate the observed product market variation "the manager has to (i) know what the owners' specific interests regarding specific competitive actions are, and (ii) decide how much weight to give each owner's preferences in deciding what to do" (Kuhn and Caroppo, 2019). As we have shown, the top manager does not need to know anything other than the incentive contract given to him.

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 of a common owner it may be optimal to act as a "lazy owner", a behavior that is often associated with bad corporate governance. In other words, good governance—in the sense of measures to promote efficiency and shareholder returns from the perspective of an individual firm—imposes an externality on product market rivals. Therefore, common owners of product market rivals may optimally provide reduced levels of governance interventions.

The endogeneity of market shares is another important feature of our theoretical framework. 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

[27] Similarly, in their literature survey of common ownership Rock and Rubinfeld (2020) write that "[w]hile shareholders have a periodic non-binding vote on management compensation, this is likewise too blunt an instrument to be plausible," but they do not explain why they find this instrument implausible.

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. (2019), 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.[28] 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 anti-competitive effects of common ownership as in Dennis et al. (2019). 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.

Finally, our model highlights the importance of recognizing the principal-agent moral hazard problem that underlies the relationship between owners and top managers in studies of common ownership. As in standard principal agent models, our managers' interests diverge from those of their owners', and these diverging interests cannot be fully aligned with the incentive contracts given to managers. Therefore, in equilibrium, owner interests (i.e., their profit weights $\kappa_{ij}$) do not perfectly translate into owners' desired product market behavior, which is in the hands of managers and pricing specialists. As a result of this principal-agent problem, the common ownership effects on product market behavior are more muted than what would be implied by a model that simply assumes that each firm acts exactly in accordance with the profit shares of its (diversified) owners. This is also in line with findings of Backus et al. (2019a) and Ruiz-Pérez (2019). Using a structural model of the ready-to-eat cereal industry, Backus et al. (2019a) document that an exact version of the common ownership hypothesis in which firms compete according to the exact profit weights

[28]Specifications in Azar et al. (2018) and Azar et al. (2019) 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.

of their diversified owners, yields implied marginal costs that "would be much too low" (or even negative) and markups that would be much too high to be plausible. However, they do not reject that common ownership has an effect on product market behavior. Similarly, Ruiz-Pérez (2019) finds that a model of exact common ownership in which airlines make entry and pricing decisions exactly according to the profit weights of their (diversified) shareholders, only does as well 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 (8)) for entry decisions and then choose prices to maximize just their own firm profits (i.e., $\max_{p_i} \pi_i$ as in equation (7)) fits the data even better.

#### 2.4.3 Form of Strategic Interaction

Although our model and its extension focus on product market competition and, more specifically, 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 show in Appendix A.4 our results 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.[29]

[29] The only quantitative change is that the incentive-reducing effect of common ownership is smaller with strategic substitutes because in addition to a direct positive effect that is present under both forms of competition, the reduction in managerial incentives has a positive (negative) strategic effect on the firm's profits under strategic complements (substitutes).

# 3 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, ownership, as well as 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.

## 3.1 Data Description

### 3.1.1 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 over which of these measures 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 percentage change in firm value divided by annual pay. We denote this measure by 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 (3)) as well as an expansion in firm output due to lower prices (see equations (2) and (10)). For this reason, WPS EGL is our primary measure of managerial incentives.[30] 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 by WPS JM ($B^{II}$ in Edmans et al.

[30]Furthermore, Edmans et al. (2009) advocate WPS EGL "as the preferred empirical measure of incentives", provide empirical validation for its superiority over the other two potential measures and show that it allows for straightforward comparability across firms and over time.

(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 (4)), 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 by 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 (4) but had no impact on prices and hence output), WPS HL would be the correct measure. We use these additional two measures as robustness checks of the WPS EGL measure since they have been widely used in the incentives literature. Summary statistics about the mean, standard deviation, and distribution of the three leading wealth-performance sensitivity measures as well as CEO tenure are given in Table 4.[31]

**[Insert TABLE 4 Here.]**

Our empirical analysis uses the ExecuComp database which contains over 2500 U.S. publicly listed companies. Specifically, it covers companies that are currently in the S&P 1500, companies that used to be part of the S&P 1500, and trading companies removed from the S&P 1500.

### 3.1.2 Ownership

To construct the ownership variables (see Section 3.2), we use Thomson Reuters 13Fs, which are taken from SEC regulatory filings by institutions with at least $100m total assets under management. We augment this data by scraping SEC 13F filings following Ben-David et al. (2020), which resolves the issues on stale and omitted institutional reports, excluded securities and missing holdings from 2000 onwards.[32] We describe the precise construction of the common ownership variables from these data in the following section.

A limitation implied by this data source is that we do not observe holdings of individual owners except if they are employed as an officer of the company or serve on its board in which case we

[31] We thank Alex Edmans for providing the code to compute these wealth-performance sensitivity measures.

[32] This correction allows us to enjoy a full set of filing by institutional holders for the large universe of Compustat firms. For a detailed description of the problems with the original 13F database by Thomson Reuters and the solutions provided by the WRDS SEC platform see https://wrds-www.wharton.upenn.edu/documents/752/Research_Note_-Thomson_S34_Data_Issues_mldAsdi.pdf.

complement these data with Execucomp. We assume that the remaining individual stakes of outsiders are relatively small and in most cases do not directly exert a significant influence on firm management. Inspection of proxy statements of all firms in particular industries suggests that the stakes that individual outside shareholders own in large publicly traded firms are rarely significant enough to substantially alter the measure of common ownership concentration even in the more prominent cases. For example, even Bill Gates's ownership of about 1.3% of Microsoft's stock is small compared to the top five diversified institutional owners' holdings, which amount to more than 23%.[33] As a result, including or discarding the information on Bill Gates's holdings does not have a large effect on the measure of common ownership used. We thus expect that the arising inaccuracies introduce measurement noise and an attenuation bias toward zero in our regressions.

#### 3.1.3 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 as well as 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,

[33] As of 2020, Bill Gates no longer holds an officer or board position at Microsoft and thus is an outsider.

leads to measurement error. We do not have a reason in mind why 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.

### 3.2 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 particularly closely related to the theoretical literature on common ownership including our own model.

From equation (8) 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 $\kappa_{ij}$ is the weight that firm $i$ places on its industry competitors $j$'s net profits, $\pi_j - w_j$. The weighted sum of these profit weights $\kappa_{ij}$ across all the industry competitors of firm $i$ is the principal object of interest of the common ownership hypothesis (Backus et al., 2020a) and therefore our main measure of common ownership. We refer to this 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", or more formally

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

where the weighting $\omega_j$ is the stock market value of firm $j$ that competes in the same industry as firm $i$.

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 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 frameworks of Rotemberg (1984) and O'Brien and Salop (2000), Backus et al. (2020a) show that under proportional control ("one share, one vote") each profit weight $\kappa_{ij}$ can further be decomposed into

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

The first term is the cosine of the angle between the vector $\nu_i$ of ownership positions $\nu_{io}$ that owners (indexed by $o$) hold in firm $i$ and the corresponding vector $\nu_j$ for firm $j$. The second term is the ratio of the "investor Herfindahl–Hirschman indices" $IHHI_i = \sum_o \nu_{io}^2$ and $IHHI_j = \sum_o \nu_{jo}^2$ 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 $\cos(\nu_i, \nu_j)$ is restricted to the $[0, 1]$ interval. Cosine similarity of zero corresponds with no common owners and cosine similarity of 1 corresponds to identical shareholding structure. Since this is an $L_2$ similarity measure, the metric puts more weight on large owners than small owners.[34] The second source of variation in common ownership profit weights comes from the ratio of the IHHI indices and ties the theory of common ownership to the notion that investor concentration drives a wedge between control rights and cash flow rights. All other things being equal, firms with concentrated investors will place more weight on their own profits and less weight on competitor profits.

Ownership similarity is the symmetric component of the profit weight and 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 equal-weighted average of the cosine similarity across all the $n-1$ competitors (indexed by $j$) of firm $i$

[34] Note that the Hoberg-Phillips industry definitions also use a cosine similarity measure which relies on the pairwise vectors of firm 10K product descriptions.

as a firm-specific measure for common ownership which is given by

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

An alternative measure we employ is the average fraction of competitor shares held by the firm's top 5 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

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

where $\nu_{jo}$ 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 often used 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 total shares outstanding of $S_i$, 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 measure of common ownership

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

We also use the modified cross-holdings measure from Harford et al. (2011) (henceforth HJL measure) which accounts for the incentives of common investors during the merger of two firms. In their setting 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 and aggregate these relative weights across investors in the bidding firm. Specifically, this pair-level measure is given by $HJL_{ij} = \sum_o \frac{\nu_{jo}}{\nu_{io}+\nu_{jo}}$ and we use the (weighted) average of this measure across all industry competitors of firm $i$ given by

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

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 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 which extent these competitors are connected by common ownership. Formally,

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

where $\nu_{io}$ is the ownership share of firm $i$ accruing to shareholder $o$. 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 (i.e., $\overline{\kappa}_i$, $\overline{\cos}_i$, $\overline{Top5}_i$, $\overline{AP}_i$, $\overline{HJL}_i$)[35] 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 "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 common

[35] 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., 2020b) 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 which is based on strategic interactions between firms.

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.

Table 4 also reports summary statistics for the different common ownership measures. For the most exhaustive description and analysis of the sizable increase of common ownership among S&P 500 firms from 1980 to 2017 see Backus et al. (2020a).[36]

# 4 Empirical Analysis

## 4.1 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 outcomes. We thereby provide an explanation of various previously documented (but unmodeled) results in the literature. However, the central prediction of our proposed mechanism that 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), the most comprehensive measure of managerial incentives (Edmans et al., 2009, 2017), and several common ownership measures as detailed in Section 3.

We do not empirically investigate the theoretical predictions about the relationship between common ownership, managerial incentives, and product market outcomes for two reasons. First, some of these correlations, in particular those between common ownership and pricing, have previously been documented as shown in Table 3. Second, a thorough empirical analysis of the model's precise mechanism would necessitate measuring (or estimating) managerial productivity improvements and firms' marginal costs in addition to estimating a structural model of product market competition under common ownership in the particular industries of concern. Lastly, we do not wish to distract from the conceptual point that any governance intervention at the firm level that affects firm productivity can have product market-level consequences. Our reduced-form

[36] Earlier.

framework does not allow us to investigate the relative quantitative importance of non-exclusive governance channels, which include engagement, pay structure, or other previously documented effects of ownership changes such as poison pills (Appel et al., 2016)).

Our baseline analysis uses the following specification

$$WPS_{ijzt} = \beta \cdot CO_{it} + \gamma \cdot X_{ijzt} + \eta_{z_2t} + \mu_i + \varepsilon_{ijzt}, \tag{18}$$

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, ${}_{z_2t}$ and $\mu_i$ are industry-year and firm fixed effects, respectively, and $CO_{it}$ is our principal variable of interest, a measure of common ownership. We use rank-transformed measures of common ownership to allow for easier comparisons across different 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. All these common ownership measures are at the firm level with the exception of 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.[37] The firm fixed effects ensure that the results are not driven by unobserved omitted firm characteristics that happen to be correlated both with 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).

[37]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.

## 4.2 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 rank-transformed equal-weighted average $\overline{\kappa}_{it}$, while controlling for size, book-to-market, volatility, leverage, executive's tenure with the firm as well as using (time-invariant) firm fixed effects and (time-varying) industry-year fixed effects.[38] The coefficient on $\overline{\kappa}_{it}$ is negative, -0.133, 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 value-weighted average $\overline{\kappa}_{it}$ as measure of common ownership. The coefficient estimate for $\overline{\kappa}_{it}$ is very similar in magnitude (-0.128) and also statistically significant at the 1% level.

**[Insert TABLE 5 Here.]**

All specifications use firm fixed effects to remove firm invariant characteristics and as well industry-time fixed effects to account for trends in wealth-performance sensitivity (WPS) that are industry specific and may change over 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 and base our inferences only on within-firm and within-year variation.

Notably, because our regressions include firm (and industry-year) fixed effects the results should be interpreted as within-firm (and within-industry-year) associations. It is not merely the case that firms with high common ownership versus firms with low common ownership have low managerial wealth-performance sensitivity. Rather, firms appear to change the wealth-performance sensitivity of their CEO's compensation based on whether or not their shareholders currently place a lot of weight on the profits of industry competitors.

[38] Because our model also has a multiplicative structure of managerial effort, this specification closely follows the seminal analysis of CEO incentives in Table 2 of Edmans et al. (2009). The key differences are the additional fixed effects, additional industry controls, and the common ownership measure.

In terms of economic significance, shifting a firm's average profit weight from the 25th percentile to the 75th percentile of the distribution of average kappa would be associated with a 6.6% decrease ($= e^{-0.133\times(0.75-0.25)} - 1$) of CEO wealth-performance sensitivity. To put this effect in perspective, note that this effect is quite similar in magnitude to our estimated effect of firm volatility on wealth-performance sensitivity which in turn matches the coefficient estimates for firm volatility in Table 4 of Edmans et al. (2017): a one-standard deviation reduction in firm volatility implies a 7% decrease in CEO wealth-performance sensitivity.

#### 4.2.1 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 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 which 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 the 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. However, the coefficient estimate of the value-weighted average $\overline{\kappa}_{it}$ using Hoberg-Phillips industry definitions in column (6) is weakest and only statistically significant at the 10% level.

We conclude that our baseline results are robust to what is considered a competitor for any given firm and how industries are defined.

#### 4.2.2 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 $j$ 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 therefore examine how results change as we employ several alternatives that capture to which extent firms should display "effective sympathy" to their industry competitors. First, following Backus et al. (2020a) we decompose the profit weights into its subcomponents and compute a firm's average of the cosine similarity with its industry competitors. Second, we calculate to which extent the top five shareholders in a firm own competitor stock 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 MHHID, which only varies at the industry level.

We present the results in Table 6. The results are in line with our baseline results. All measures of common ownership are significantly negatively related to CEO wealth-performance sensitivity. Note that all of the alternative common ownership measures imply even larger magnitudes for the negative association between common ownership and managerial incentives. An interquartile range move in the various alternative common ownership measures corresponds to a decrease of 8.5% ($= e^{-0.177\times(0.75-0.25)} - 1$) to 19.1% ($= e^{-0.423\times(0.75-0.25)} - 1$) in CEO wealth-performance sensitivity.

**[Insert TABLE 6 Here.]**

In Appendix Table B1, we further show that this pattern also holds when using alternative industry definitions. We obtain very similar coefficient estimates that are statistically significant across 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 $\kappa$ is principally responsible for the negative impact on wealth-performance sensitivity. In Appendix Table B4 we show that the cosine similarity is negatively associated whereas the IHHI ratio is either insignificant or positively related. This explains why in Table 6 and throughout our paper, the negative effect for kappa is smaller in magnitude than for the cosine similarity. This result is in line with the findings of Boller and Scott Morton (2020) who also document a stronger effect on the stock returns of index incumbents' upon index inclusion of a competitor when using the cosine similarity as a measure of common ownership.

#### 4.2.3 Alternative Measures of Wealth-performance Sensitivity

Another important question regarding the evidence we presented so far is to which 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.]**

Columns (1) through (3) use Jensen and Murphy (1990)'s sensitivity of executive pay to performance and columns (4) through (6) use Hall and Liebman (1998)'s version of the wealth-performance sensitivity. The results are qualitatively similar in magnitude to those presented in Table 5 and Table 6, and statistically significant throughout.

In Table B2 in the appendix 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.

#### 4.2.4 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 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.]**

Finally, in Appendix Table B3, 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 an unexplained reason (but not their economic incentives) 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.

## 4.3 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 which extent the correlations reported so far have a causal interpretation we employ a strategy (first used in Boller and Scott Morton (2020)) 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.[39]

S&P500 additions have been extensively used as a shock to ownership in the empirical literature over the past two decades.[40] There are two fundamental criticisms for 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&P500, and hence the decision can be somewhat affected by the recent performance of the company. Second, once the firm is added to the S&P500, 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. Therefore, the change in ownership (or in common ownership) may not be as exogenous as one would like. Therefore, following Boller and Scott Morton (2020) we use the addition of a stock in the S&P500 as a shock to the common ownership of *its competitors that are already in the S&P500*. The competitors do not experience a direct increase in monitoring, or attention (because they are already members of the S&P500), or any of the confounding effects that the added firm experiences. However, as Boller and Scott Morton (2020) show (and as we confirm in our own analysis), the degree of common ownership does change for these competing firms. We investigate to which extent the structure of their executive pay packages changes as compared to firms that are unaffected by the same index inclusion, either because they are not in the same industry or because they are not in the index.

Recall that common ownership measures the degree of overlap in ownership in a specific industry. If an industry has one more firm included in the S&P500, all S&P500 index tracking funds will buy shares of the newly included firm. Empirically, ownership by large funds increases as

[39] Lewellen and Lewellen (2018) as well as Egen (2019) criticize the use of various instruments the previous literature has used for identification, in particular the addition of a firm to the S&P500 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.

[40] See Afego (2017) for a comprehensive review of the literature on index inclusions more generally, and Boller and Scott Morton (2020) for its use as a shock to common ownership in particular.

a result, as we show below. Consider an industry with three firms (A, B, and C), two of which (A and B) are already in the S&P500. 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.[41]

In the period 1994-2019 we identify 379 additions to the S&P500. Boller and Scott Morton (2020) show that the effect on peers is more pronounced when there is a true addition (the company added was previously not in the S&P400 nor 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 true additions and are left with 289 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&P500. The control firms are those firms that are in the S&P500, but that are 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.

**[Insert FIGURE 3 Here.]**

Figure 3 shows that the index inclusion of a direct industry competitor shifts the distribution of average kappa (left panels) and cosine similarity (right panels) of other firms in the same industry that were already in the index to the right for all industry definitions. 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.

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

$$WPS_{ijzt} = \alpha \cdot Treat_{ijz_4} + \beta \cdot Treat_{ijz_4} \cdot Post_t + \gamma \cdot X_{ijzPre} + \phi \cdot X_{ijzPre} \cdot Post_t + \eta_i + \eta_{inc} + \mu_t + \varepsilon_{ijzt}, \quad (19)$$

where $i$ indexes firms, $j$ indexes managers (CEOs), $z_4$ denotes industries at the four-digit level,

[41]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 there is an increase of common ownership.

$X_{ijzPre}$ is a vector of controls measured in the year of the addition (to avoid using potentially endogenous post-treatment variation in controls), $\eta_i$, $\eta_{inc}$, and $\mu_t$ are the firm, inclusion, and year fixed effects, respectively. The estimation is run on a sample with five pre- and five post-years of the event treatment year. $Post_t$ is a dummy variable equal to 1 for the year of inclusion and the five years after the inclusion event, and 0 for the five years before the event. $Treat_{ijz_4}$ is a dummy variable equal to 1, for all sample years, if during our sample period 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 $i$), and 0 otherwise. The firm being treated 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 zero for all other sample firms—for all years of the sample. When in another industry (featuring firms X, Y, and Z), Z is added to the index the treatment dummy is 1 for X and Y, but zero for A, B, C. That is to say, A, B, and C serve as controls for the event of Z's inclusion. This is true irrespective of whether the Z-inclusion event occurs in the same year as the C-inclusion event. 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 are not absorbed in the above design. $Post_t$ is a dummy that is specific to any inclusion event, and therefore does not get absorbed by year fixed effects either. By 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. 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 firm. The remaining variation is differences across firms in variation of common ownership within firms over time that is due to the index inclusion of competitors.

**[Insert TABLE 9 Here.]**

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 13.4% ($= e^{-0.144} - 1$). 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 weakest for the Hoberg-Phillips industry definitions for which the decline in WPS is equal to 9.9% ($= e^{-0.104} - 1$).

**[Insert FIGURE 4 Here.]**

Importantly, 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 increases in magnitude over time following the competitor's index inclusion and is consistently statistically significant.

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.

# 5 Conclusion

In this paper, we examine how shareholder interests affect optimal managerial incentive contracts under strategic product market competition. Our theoretical model predicts 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. The resulting lower-powered managerial incentives can differentially soften competition across markets even within the same firm and within the same industry in ways that are consistent with prior empirical evidence. Although our model focuses on product market competition as one particular channel through which firms' interaction can affect the steepness of incentives, our theoretical conclusions about common ownership reducing the performance-sensitivity of managerial incentives hold more generally. Any setting in which governance interventions encourage managers to make strategic choices that have negative repercussions for the profits of other firms will yield similar predictions.

Our empirical analysis documents robust support for our theoretical predictions and provides an answer to the question of which mechanism could potentially induce the less competitive product market behavior of firms that arise from higher concentrations of common ownership. Shareholder pressure to maximize firm value (e.g., through high-powered managerial incentive contracts that spur competitive behavior) is more valuable in firms and industries that have less common ownership. We thereby provide an explanation for why large institutional investors, such as largely passive mutual fund families, have reduced incentives to engage in corporate governance activities that promote profit maximization in any single firm. Our findings complement previous contributions which emphasize the motive of saving on governance costs and the presence of agency problems within mutual fund families that may limit their incentives to engage in the same way that a large concentrated investor (such as an entrepreneur-founder or activist investor) would.

Our paper raises additional questions about the source of the proposed mechanism. Do shareholders (or rather board members) explicitly think about the effect of competition when they set managerial incentives contracts? Are board members proposed (and elected) who tend to support more optimal incentive contracts if elected to the compensation committee? Do the contracts themselves make explicit mention of these considerations, or are the incentives only implicit in the payoff structure, as documented in the present paper? These questions are challenging to answer: theories of shareholder or board members' thought processes pose challenges for gathering evidence for an empirical evaluation, and looking at the language, features or provisions of managerial incentive contracts is not necessarily informative even about the sign of competitive incentives that these features imply.[42] We therefore leave these questions to future research.

At a more general level, our results challenge the validity of a ubiquitous and fundamental assumption in industrial organization, organizational economics, and corporate finance that has

[42]For example, relative performance evaluation can give pro-competitive incentives if performance is measured in terms of firm value creation, but can have anti-competitive effects if performance is measured in terms of margins. Merely checking for the presence of relative performance provisions in contracts is therefore not informative about the question of competitive incentives, but requires new methods of analyzing contracts.

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 findings may therefore motivate future studies that re-examine related questions by testing hypotheses derived from alternative objective functions of the firm against each other.

# References


**Afego, Pyemo N**, "Effects of changes in stock index compositions: A literature survey," *International Review of Financial Analysis*, 2017, *52*, 228–239.

**Alexander, Donald L and Huizhong Zhou**, "Product-market competition and executive compensation," *Journal of Economics and Business*, 1995, *47* (5), 441–456.

**Antón, Miguel and Christopher Polk**, "Connected stocks," *Journal of Finance*, 2014, *69* (3), 1099–1127.

**Antón, Miguel, Florian Ederer, Mireia Giné, and Martin C Schmalz**, "Common Ownership and Relative Performance Evaluation," *Yale SOM Working Paper*, 2016.

**Appel, Ian R, Todd A Gormley, and Donald B Keim**, "Passive investors, not passive owners," *Journal of Financial Economics*, 2016, *121* (1), 111–141.

**Aslan, Hadiye**, "Common Ownership, Creative Destruction, and Inequality: Evidence from U.S. Consumers," *Working Paper*, 2019.

**Azar, Jose**, "A new look at oligopoly: Implicit collusion through portfolio diversification," *Ph.D. Thesis, Princeton University*, 2012.

**Azar, José**, "Portfolio Diversification, Market Power, and the Theory of the Firm," *Available on SSRN 2811221*, 2016.

**Azar, José and Xavier Vives**, "Oligopoly, macroeconomic performance, and competition policy," *Econometrica*, 2020.

**Azar, José, Martin Schmalz, and Tecu Isabel**, "Anticompetitive Effects of Common Ownership," *Journal of Finance*, 2018, *74* (3).

**_ , Sahil Raina, and Martin Schmalz**, "Ultimate Ownership and Bank Competition," *Working Paper*, 2019.

**Backus, Matthew**, "Why is productivity correlated with competition?," *Econometrica*, 2020.

**_ , Christopher Conlon, and Michael Sinkinson**, "Common ownership and competition in the ready-to-eat cereal industry," *New York University Stern Working Paper*, 2019.

**_ , _ , and _** , "The common ownership hypothesis: Theory and evidence," *Economic Studies at Brookings*, 2019.

**_ , _ , and _** , "Common Ownership in America: 1980-2017," *American Economic Journal: Microeconomics*, 2020.

**_ , _ , and _** , "Theory and Measurement of Common Ownership," *AEA Papers and Proceedings*, 2020, *110*, 557–60.

**Baker, George P and Brian J Hall**, "CEO incentives and firm size," *Journal of Labor Economics*, 2004, *22* (4), 767–798.

**Bebchuk, Lucian A., Alma Cohen, and Scott Hirst**, "The Agency Problems of Institutional Investors," *Journal of Economic Perspectives*, August 2017, *31* (3), 89–102.

**Bebchuk, Lucian A and Scott Hirst**, "Index Funds and the Future of Corporate Governance: Theory, Evidence, and Policy," *Columbia Law Review*, 2019.

**Ben-David, Itzhak, Francesco Franzoni, Rabih Moussawi, and John Sedunov**, "The granular nature of large institutional investors," *Management Science*, 2020.

**Boller, Lysle and Fiona Scott Morton**, "Testing the Theory of Common Stock Ownership," *NBER Working Paper*, 2020.

**Bresnahan, Timothy F. and Steven C. Salop**, "Quantifying the competitive effects of production joint ventures," *International Journal of Industrial Organization*, 1986, *4* (2), 155 – 175.

**Brito, Duarte, António Osório, Ricardo Ribeiro, and Helder Vasconcelos**, "Unilateral effects screens for partial horizontal acquisitions: The generalized HHI and GUPPI," *International Journal of Industrial Organization*, 2018, *59*, 127 – 189.

**Broccardo, Eleonora, Oliver D Hart, and Luigi Zingales**, "Exit vs. Voice," Technical Report, National Bureau of Economic Research 2020.

**Condon, Madison**, "Externalities and the Common Owner," *Washington Law Review*, 2020, *95* (1), 81.

**Crooks, Ed**, "Investors Push Exxon to List Emissions Targets in Annual Reports," *Financial Times (Dec 16, 2018) https://perma. cc/D7WB-X257*, 2018.

**D'Aspremont, Claude and Alexis Jacquemin**, "Cooperative and Noncooperative R&D in Duopoly with Spillovers," *American Economic Review*, 1988, *78* (5), 1133–1137.

**Dennis, Patrick J, Kristopher Gerardi, and Carola Schenone**, "Common ownership does not have anti-competitive effects in the airline industry," *SSRN Working Paper*, 2019.

**Edgeworth, Francis Ysidro**, *Mathematical psychics: An essay on the application of mathematics to the moral sciences*, Vol. 10, Kegan Paul, 1881.

**Edmans, Alex and Xavier Gabaix**, "Executive compensation: A modern primer," *Journal of Economic Literature*, 2016.

**_ , _ , and Augustin Landier**, "A multiplicative model of optimal CEO incentives in market equilibrium," *Review of Financial Studies*, 2009, *22* (12), 4881–4917.

**_ , _ , and Dirk Jenter**, "Executive compensation: A survey of theory and evidence," in "The handbook of the economics of corporate governance," Vol. 1, Elsevier, 2017, pp. 383–539.

**Egen, Eyub**, "Common-Ownership and Portfolio Rebalancing," *Working Paper*, 2019.

**Eldar, Ofer, Jillian Grennan, and Katherine Waldock**, "Common ownership and startup growth," *Duke Law School Public Law & Legal Theory Series*, 2020.

**Elhauge, Einer**, "Horizontal Shareholding," *Harvard Law Review*, 2016, *109* (1267).

**Fershtman, Chaim and Kenneth L Judd**, "Equilibrium incentives in oligopoly," *The American Economic Review*, 1987, pp. 927–940.

**Fink, Larry**, "Stakeholder capitalism set to become more and more important," *CNBC Squawk-Box*, 2020. Available at https://www.cnbc.com/2020/07/17/stakeholder-capitalism-set-to-become-more-and-more-important-says-blackrocks-fink.html.

**Fumas, Vicente Salas**, "Relative performance evaluation of management: The effects on industrial competition and risk sharing," *International Journal of Industrial Organization*, 1992, *10* (3), 473–489.

**Gilje, Erik P, Todd A Gormley, and Doron Levit**, "Who's paying attention? Measuring common ownership and its impact on managerial incentives," *Journal of Financial Economics*, 2020, *137* (1), 152–178.

**Gordon, Roger H**, "Do publicly traded corporations act in the public interest?," Technical Report, National Bureau of Economic Research 1990.

**Gutiérrez, Germán and Thomas Philippon**, "Ownership, concentration, and investment," *AEA Papers and Proceedings*, 2018, *108*, 432–37.

**Ha, Sangeun, Fangyuan Ma, and Alminas Zaldokas**, "Motivating Collusion," *Working*

*Paper*, 2020.

**Hall, Brian J. and Jeffrey B. Liebman**, "Are CEOs really paid like bureaucrats?," *The Quarterly Journal of Economics*, 1998, *113* (3), 653–691.

**Hansen, Robert G and John R Lott**, "Externalities and corporate objectives in a world with diversified shareholder/consumers," *Journal of Financial and Quantitative Analysis*, 1996, *31* (01), 43–68.

**Harford, Jarrad, Dirk Jenter, and Kai Li**, "Institutional cross-holdings and their effect on acquisition decisions," *Journal of Financial Economics*, 2011, *99* (1), 27–39.

**Hart, Oliver and Luigi Zingales**, "Companies should maximize shareholder welfare not market value," *ECGI-Finance Working Paper*, 2017, *2.*

**Hart, Oliver D.**, "The market mechanism as an incentive scheme," *Bell Journal of Economics*, 1983, *14*, 366–382.

**Hemphill, C Scott and Marcel Kahan**, "The Strategies of Anticompetitive Common Ownership," *Yale Law Journal*, 2020, pp. 18–29.

**Hiller, Jennifer and Shadia Nasralla**, "Five Oil Majors Face 2019 Climate Target Pressure by Investors," *Reuters (Dec 19, 2018, https://perma.cc/Z2BF-U5VD*, 2018.

**Hirst, Scott and Lucian Bebchuk**, "The Specter of the Giant Three," *Boston University Law Review*, 2019, *99* (3), 721.

**Hoberg, Gerard and Gordon Phillips**, "Product market synergies and competition in mergers and acquisitions: A text-based analysis," *Review of Financial Studies*, 2010, *23* (10), 3773–3811.

**_ and _** , "Text-based network industries and endogenous product differentiation," *Journal of Political Economy*, 2016, *124* (5), 1423–1465.

**Holmstrom, Bengt and Paul Milgrom**, "Aggregation and linearity in the provision of intertemporal incentives," *Econometrica: Journal of the Econometric Society*, 1987, pp. 303–328.

**Häckner, Jonas**, "A Note on Price and Quantity Competition in Differentiated Oligopolies," *Journal of Economic Theory*, 2000, *93* (2), 233 – 239.

**Jensen, Michael and Kevin Murphy**, "Performance Pay and Top-Management Incentives," *Journal of Political Economy*, 1990, *98* (2), 225–264.

**Jenter, Dirk and Fadi Kanaan**, "CEO Turnover and Relative Performance Evaluation," *The Journal of Finance*, 2015, *70* (5), 2155–2184.

**Joh, Sung Wook**, "Strategic managerial incentive compensation in Japan: Relative performance evaluation and product market collusion," *Review of Economics and Statistics*, 1999, *81* (2), 303–313.

**Johnson, Simon, Rafael La Porta, Florencio Lopez de Silanes, and Andrei Shleifer**, "Tunneling," *American Economic Review*, 2000, *90* (2), 22–27.

**Jr, John C Coffee**, "The Future of Disclosure: ESG, Common Ownership, and Systematic Risk," *Columbia Law School Working Paper*, 2020.

**Kamien, Morton I., Eitan Muller, and Israel Zang**, "Research Joint Ventures and R&D Cartels," *American Economic Review*, 1992, *82* (5), 1293–1306.

**Kedia, Simi**, "Product market competition and top management compensation," *SSRN Working Paper 10977*, 1998.

**Kent, Sarah**, "Shell to Link Carbon Emissions Targets to Executive Pay," *Wall Street Journal (Dec 3, 2018) https://perma.cc/7HRL-32FB*, 2018.

**Koch, Andrew, Marios Panayides, and Shawn Thomas**, "Common ownership and compe-

tition in product markets," *Journal of Financial Economics*, 2020.
**Kraus, Alan and Amir Rubin**, "Managerial Stock Options when Shareholders are Diversified," *University of British Columbia and Simon Fraser University working paper*, 2006.
**Krueger, Philipp, Zacharias Sautner, and Laura T Starks**, "The importance of climate risks for institutional investors," *The Review of Financial Studies*, 2020, *33* (3), 1067–1111.
**Kuhn, Tilman and Cristina Caroppo**, "Five things investors and listed companies need to know about the common ownership debate and why it matters," *Global Banking & Finance Review*, 2019. Available at https://www.globalbankingandfinance.com/five-things-investors-and-listed-companies-need-to-know-about-the-common-ownership-debate-and-why-it-matters/.
**Kwon, Heung Jin**, "Executive Compensation under Common Ownership," *University of Chicago Working Paper*, 2016.
**Lewellen, Jonathan and Katharina Lewellen**, "Institutional investors and corporate governance: The incentive to be engaged," *SSRN Working Paper*, 2018.
**Li, Xuelin, Tong Liu, and Lucian A Taylor**, "Do Venture Capitalists Stifle Competition?," *Available at SSRN 3479439*, 2020.
**Liang, Lantian (Max)**, "Common Ownership and Executive Compensation," *University of Texas at Dallas Working Paper*, 2016.
**López, Ángel L and Xavier Vives**, "Cross-ownership, R&D Spillovers, and Antitrust Policy," *Journal of Political Economy*, 2018, *forthcoming.*
**Macho-Stadler, Ines and Thierry Verdier**, "Strategic Managerial Incentives and Cross Ownership Structure: A Note," *Journal of Economics*, 1991, *53* (3), 285–297.
**Mooney, Attracta and Donato Paolo Mancini**, "Drugmakers urged to collaborate on coronavirus vaccine," *Financial Times*, 2020, *April* (23). Available at https://www.ft.com/content/b452ceb9-765a-4c25-9876-fb73d736f92a.
**Morton, Fiona Scott and Herbert Hovenkamp**, "Horizontal shareholding and antitrust policy," *Yale Law Journal*, 2017, *127*, 2026.
**Moskalev, Alexandr**, "Objective Function of a Non-Price-Taking Firm with Heterogeneous Shareholders," *University of Michigan Dissertation, available on SSRN 3471564*, 2020.
**Murphy, Kevin J.**, "Executive compensation," in O. Ashenfelter and D. Card, eds., *Handbook of Labor Economics*, Vol. 3 of *Handbook of Labor Economics*, Elsevier, 1999, chapter 38, pp. 2485–2563.
**Newham, Melissa, Jo Seldeslachts, and Albert Banal-Estanol**, "Common Ownership and Market Entry: Evidence from Pharmaceutical Industry," *DIW Berlin Discussion Paper*, 2019.
**O'Brien, D. P. and S. C. Salop**, "Competitive effects of partial ownership: Financial interest and corporate control," *Antitrust Law Journal*, 2000, pp. 559–614.
**Oehmke, Martin and Marcus M Opp**, "A theory of socially responsible investment," *CEPR Discussion Paper No. DP14351*, 2019.
**Olson, Bradley and Lynn Cook**, "Wall Street Tells Frackers to Stop Counting Barrels, Start Making Profits," *Wall Street Journal*, 2017, *December* (13). Available at https://www.wsj.com/articles/wall-streets-fracking-frenzy-runs-dry-as-profits-fail-to-materialize-1512577420.
**Petersen, Mitchell A**, "Estimating standard errors in finance panel data sets: Comparing approaches," *The Review of Financial Studies*, 2009, *22* (1), 435–480.
**Raith, Michael**, "Competition, Risk and Managerial Incentives," *American Economic Review*, 2003, *93*, 1425–1436.

**Reitman, David**, "Stock options and the strategic use of managerial incentives," *The American Economic Review*, 1993, pp. 513–524.

**Rock, Edward B and Daniel L Rubinfeld**, "Does Common Ownership Explain Higher Oligopolistic Profits?," *NYU Law and Economics Research Paper 20-18*, 2020.

**Rotemberg, Julio**, "Financial transaction costs and industrial performance," *MIT Sloan Working Paper*, 1984.

**Rubin, Amir**, "Diversification and corporate decisions," *Corporate Ownership and Control*, 2006, *3*, 209–212.

**Rubinstein, Ariel and Menahem E Yaari**, "The competitive stock market as cartel maker: Some examples," *LSE STICERD Working Paper*, 1983.

**Ruiz-Pérez, Alexandro**, "Market Structure and Common Ownership: Evidence from the US Airline Industry," *CEMFI Working Paper*, 2019.

**Schmalz, Martin C.**, "Common Ownership Concentration and Corporate Conduct," *Annual Review of Financial Economics*, 2018, *10.*

**Schmidt, Klaus M.**, "Managerial Incentives and Product Market Competition," *The Review of Economic Studies*, 1997, *64* (2), 191–213.

**Shekita, Nathan**, "Interventions by Common Owners," *SSRN Working Paper 3658726*, 2020.

**Singh, Nirvikar and Xavier Vives**, "Price and Quantity Competition in a Differentiated Duopoly," *RAND Journal of Economics*, 1984, *15* (4), 546–554.

**Sklivas, Steven D**, "The strategic choice of managerial incentives," *Rand Journal of Economics*, 1987, pp. 452–458.

**Spagnolo, Giancarlo**, "Stock-Related Compensation and Product-Market Competition," *RAND Journal of Economics*, 2000, *31* (1), 22–42.

**Taggart, Steve**, "Virgin America Continues Disruption in the Travel Industry," *Loyalty 360*, 2016, *July* (7). Available at https://loyalty360.org/content-gallery/daily-news/virgin-america-continues-disruption-in-the-travel.

**Torshizi, Mohammad and Jennifer Clapp**, "Price Effects of Common Ownership in the Seed Sector," *Working paper*, 2019.

**Vickers, John**, "Delegation and the Theory of the Firm," *Economic Journal*, 1985, *95*, 138–147.

# Figures

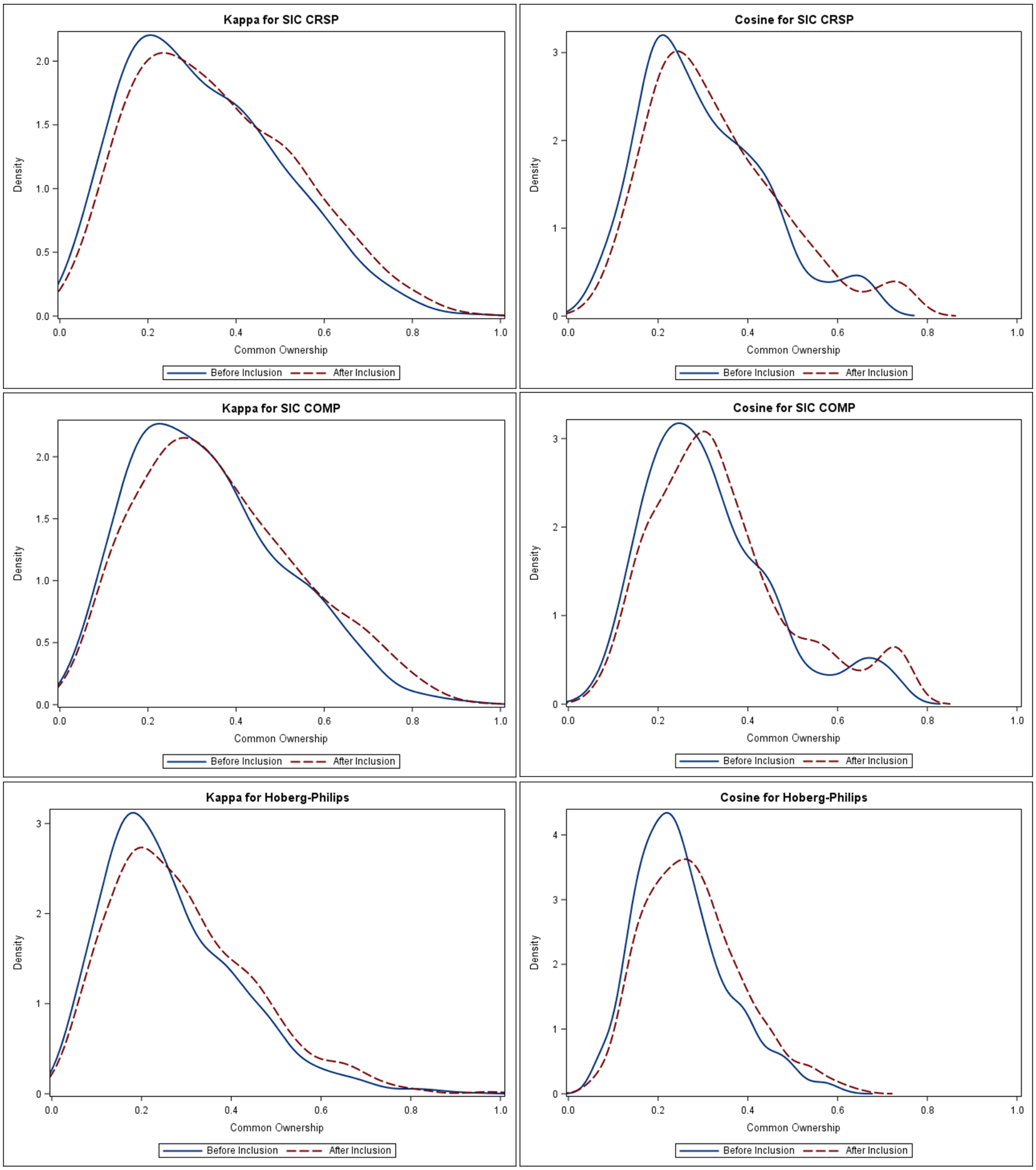


**Figure 3. Distributions of kappa and cosine similarity before and after index inclusion of a competitor** This figure plots the distributions of kappa (left panels) and cosine similarity (right panels) before (solid blue line) and after (dashed red line) index inclusion of a competitor for four-digit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

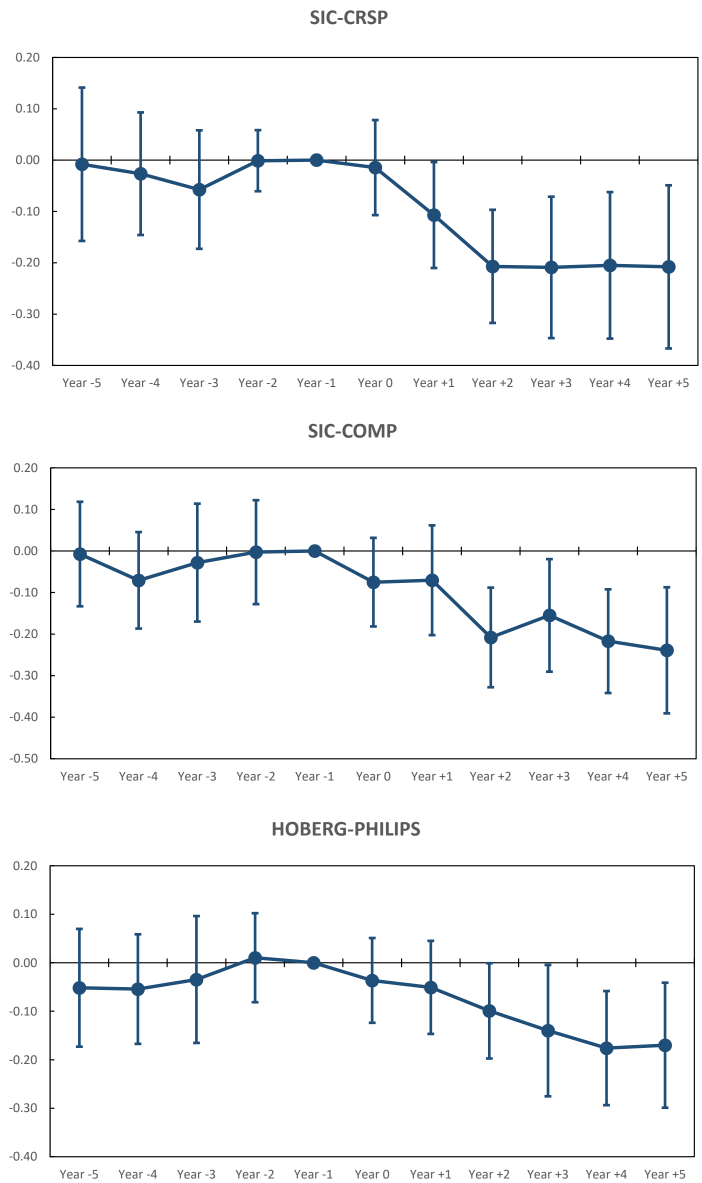


**Figure 4. Estimated Coefficients of S&P500 inclusion treatment indicator interacted with year fixed-effects on WPS.**

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, Anton-Polk, Harford-Jenter-Li), and at the industry level (HHI and MHHID).

| Variables | N | Mean | Median | Std | 10% | 90% |
|---|---|---|---|---|---|---|
| *CEO variables* | | | | | | |
| WPS EGL | 48,192 | 20.32 | 5.77 | 44.48 | 1.04 | 44.17 |
| WPS JM | 48,192 | 16.82 | 5.62 | 28.08 | 0.51 | 47.18 |
| WPS HL | 48,192 | 51.59 | 18.06 | 84.43 | 2.11 | 142.33 |
| Tenure (in years) | 48,651 | 7.39 | 6.00 | 4.73 | 2.00 | 15.00 |
| *Firm and industry variables* | | | | | | |
| ln(Market Equity) | 47,898 | 7.680 | 7.570 | 1.597 | 5.741 | 9.834 |
| Volatility | 47,847 | 0.102 | 0.089 | 0.052 | 0.493 | 0.172 |
| Leverage | 47,704 | 0.242 | 0.219 | 0.214 | 0.000 | 0.498 |
| HHI (at industry SIC-4 level) | 11,225 | 0.459 | 0.427 | 0.249 | 0.151 | 0.851 |
| *Common ownership measures (SIC-4 CRSP)* | | | | | | |
| Kappa | 44,571 | 0.327 | 0.238 | 0.947 | 0.070 | 0.544 |
| Cosine Similarity (1st component of Kappa) | 44,571 | 0.272 | 0.244 | 0.157 | 0.095 | 0.493 |
| Ratio of IHHIs (2nd component of Kappa) | 44,571 | 1.230 | 0.934 | 2.994 | 0.591 | 1.614 |
| Top 5 Shareholder Overlap | 43,673 | 0.073 | 0.059 | 0.055 | 0.014 | 0.158 |
| Anton-Polk FCAP Measure | 44,571 | 0.226 | 0.213 | 0.122 | 0.074 | 0.405 |
| Harford-Jenter-Li Measure | 44,571 | 0.086 | 0.078 | 0.050 | 0.026 | 0.162 |
| MHHID (at industry SIC-4 level) | 11,225 | 0.156 | 0.120 | 0.149 | 0.010 | 0.340 |

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

This table presents the coefficients from regressions of the Edmans, Gabaix and Landier (2009) measure of wealth-performance sensitivity (EGL) on common ownership (equal- and value-weighted Kappa) while controlling for firm fixed effects and industry × year fixed effects. The universe covers all CEOs from 1992 to 2019. We use industry definitions based on 4-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-PHILLIPS | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Common Ownership (Kappa EW) | -0.133*** | | -0.114*** | | -0.101** | |
| | (-2.953) | | (-2.973) | | (-2.428) | |
| Common Ownership (Kappa VW) | | -0.128*** | | -0.114** | | -0.0771* |
| | | (-3.045) | | (-2.669) | | (-1.828) |
| Volatility | 1.363*** | 1.370*** | 1.023*** | 1.022*** | 1.050*** | 1.051*** |
| | (4.898) | (4.914) | (3.533) | (3.525) | (3.855) | (3.846) |
| ln(Market Equity) | 0.346*** | 0.348*** | 0.343*** | 0.345*** | 0.368*** | 0.369*** |
| | (17.91) | (18.06) | (18.21) | (18.23) | (15.68) | (15.61) |
| Leverage | 0.0377 | 0.0384 | 0.0141 | 0.0153 | 0.0332 | 0.0348 |
| | (0.581) | (0.591) | (0.231) | (0.250) | (0.456) | (0.479) |
| HHI | -0.113 | -0.116 | -0.0158 | -0.0162 | 0.0116 | 0.0150 |
| | (-1.528) | (-1.569) | (-0.172) | (-0.177) | (0.203) | (0.262) |
| ln(Tenure) | 0.487*** | 0.486*** | 0.479*** | 0.479*** | 0.493*** | 0.492*** |
| | (16.43) | (16.47) | (16.60) | (16.65) | (13.99) | (13.97) |
| Observations | 42,788 | 42,788 | 45,670 | 45,670 | 34,161 | 34,161 |
| R-squared | 0.682 | 0.682 | 0.687 | 0.687 | 0.698 | 0.698 |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry (SIC-2) × 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 kappa uses several alternative common ownership measures. We use industry definitions based on 4-digit SIC codes from CRSP. Table B1 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) | -0.133*** | | | | | | |
| | (-2.953) | | | | | | |
| CO (Cosine Similarity) | | -0.280*** | | | | | |
| | | (-5.868) | | | | | |
| CO (Top 5 Overlap) | | | -0.177*** | | | | |
| | | | (-4.404) | | | | |
| CO (Anton and Polk) | | | | -0.423*** | | | |
| | | | | (-5.813) | | | |
| CO (Harford, Jenter and Li) | | | | | -0.410*** | | |
| | | | | | (-5.811) | | |
| CO (MHHID) | | | | | | -0.338*** | |
| | | | | | | (-5.638) | |
| CO (MHHID 1/N) | | | | | | | -0.260*** |
| | | | | | | | (-5.162) |
| Volatility | 1.363*** | 1.300*** | 1.329*** | 1.253*** | 1.261*** | 1.330*** | 1.343*** |
| | (4.898) | (4.725) | (4.787) | (4.625) | (4.649) | (4.807) | (4.856) |
| ln(Market Equity) | 0.346*** | 0.351*** | 0.346*** | 0.356*** | 0.357*** | 0.343*** | 0.342*** |
| | (17.91) | (18.12) | (17.99) | (17.86) | (17.99) | (17.47) | (17.34) |
| Leverage | 0.0377 | 0.0345 | 0.0451 | 0.0344 | 0.0341 | 0.0389 | 0.0386 |
| | (0.581) | (0.536) | (0.703) | (0.534) | (0.528) | (0.600) | (0.595) |
| HHI | -0.113 | -0.123 | -0.149** | -0.126* | -0.129* | -0.289*** | -0.133* |
| | (-1.528) | (-1.681) | (-2.092) | (-1.718) | (-1.755) | (-3.576) | (-1.816) |
| ln(Tenure) | 0.487*** | 0.491*** | 0.492*** | 0.492*** | 0.492*** | 0.485*** | 0.485*** |
| | (16.43) | (16.76) | (16.79) | (16.85) | (16.89) | (16.48) | (16.45) |
| Observations | 42,788 | 42,788 | 42,030 | 42,788 | 42,788 | 42,794 | 42,794 |
| R-squared | 0.682 | 0.683 | 0.681 | 0.683 | 0.683 | 0.682 | 0.682 |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry (SIC-2) × 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, but in addition to kappa uses several alternative alternative measures of wealth-performance sensitivity. In columns (1) to (4) the dependent variable is the Jensen and Murphy (1990) measure while columns (5) to (8) use the Hall and Liebman (1998) measure (both in natural logs). We use industry definitions based on 4-digit SIC codes from CRSP. Table B2 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) | -0.164*** | | | -0.120** | | |
| | (-3.872) | | | (-2.616) | | |
| CO (Cosine Similarity) | | -0.258*** | | | -0.192*** | |
| | | (-5.964) | | | (-4.265) | |
| CO (Top 5 Overlap) | | | -0.196*** | | | -0.131*** |
| | | | (-5.630) | | | (-3.706) |
| Volatility | 1.526*** | 1.464*** | 1.506*** | 1.734*** | 1.689*** | 1.712*** |
| | (5.738) | (5.520) | (5.627) | (5.962) | (5.837) | (5.940) |
| ln(Market Equity) | 0.0724*** | 0.0753*** | 0.0717*** | 0.680*** | 0.683*** | 0.680*** |
| | (3.161) | (3.296) | (3.146) | (31.06) | (31.19) | (31.22) |
| Leverage | -0.544*** | -0.547*** | -0.536*** | 0.0693 | 0.0675 | 0.0726 |
| | (-8.825) | (-8.873) | (-8.732) | (1.113) | (1.087) | (1.149) |
| HHI | -0.116* | -0.121* | -0.145** | -0.0987 | -0.103 | -0.128* |
| | (-1.796) | (-1.907) | (-2.302) | (-1.426) | (-1.499) | (-1.874) |
| ln(Tenure) | 0.392*** | 0.395*** | 0.398*** | 0.569*** | 0.571*** | 0.574*** |
| | (15.15) | (15.40) | (15.41) | (16.76) | (16.91) | (17.14) |
| Observations | 42,788 | 42,788 | 42,030 | 42,788 | 42,788 | 42,030 |
| R-squared | 0.791 | 0.792 | 0.792 | 0.792 | 0.792 | 0.792 |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry (SIC-2) × 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 4-digit SIC codes from CRSP. 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) | -0.0468** | | | | | | |
| | (-2.739) | | | | | | |
| CO (Cosine Similarity) | | -0.0868*** | | | | | |
| | | (-5.441) | | | | | |
| CO (Top 5 Overlap) | | | -0.0761*** | | | | |
| | | | (-5.608) | | | | |
| CO (Anton and Polk) | | | | -0.153*** | | | |
| | | | | (-6.463) | | | |
| CO (Harford, Jenter and Li) | | | | | -0.153*** | | |
| | | | | | (-6.680) | | |
| CO (MHHID) | | | | | | -0.0934*** | |
| | | | | | | (-4.177) | |
| CO (MHHID 1/N) | | | | | | | -0.0691*** |
| | | | | | | | (-3.794) |
| Volatility | -0.0439 | -0.0576 | -0.0857 | -0.0669 | -0.0647 | -0.0538 | -0.0512 |
| | (-0.286) | (-0.375) | (-0.540) | (-0.435) | (-0.421) | (-0.351) | (-0.333) |
| ln(Market Equity) | 0.368*** | 0.369*** | 0.367*** | 0.373*** | 0.373*** | 0.367*** | 0.367*** |
| | (34.89) | (35.15) | (33.46) | (34.31) | (34.48) | (34.34) | (34.24) |
| Leverage | 0.0802*** | 0.0796*** | 0.0857*** | 0.0800*** | 0.0799*** | 0.0817*** | 0.0815*** |
| | (2.858) | (2.845) | (3.015) | (2.837) | (2.838) | (2.920) | (2.906) |
| HHI | -0.0618** | -0.0653** | -0.0576** | -0.0683*** | -0.0697*** | -0.108*** | -0.0648** |
| | (-2.603) | (-2.746) | (-2.340) | (-2.870) | (-2.917) | (-3.701) | (-2.746) |
| ln(Tenure) | 0.293*** | 0.295*** | 0.297*** | 0.298*** | 0.298*** | 0.293*** | 0.293*** |
| | (9.818) | (9.910) | (10.10) | (9.985) | (9.968) | (9.846) | (9.837) |
| Observations | 231,804 | 231,804 | 226,500 | 231,804 | 231,804 | 231,829 | 231,829 |
| R-squared | 0.797 | 0.797 | 0.797 | 0.797 | 0.797 | 0.797 | 0.797 |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry (SIC-2) × 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 around the S&P500 Inclusions. 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 five years after the inclusion, and takes value of 0 for the event year and 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 double-clustered 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 | -0.144*** | -0.143*** | -0.151*** | -0.150*** | -0.104** | -0.104*** |
| | (-3.660) | (-3.453) | (-3.209) | (-3.276) | (-2.699) | (-2.994) |
| Post | 0.886*** | 0.862*** | 0.897*** | 0.866*** | 0.883*** | 0.888*** |
| | (4.484) | (7.971) | (4.603) | (8.449) | (3.199) | (5.056) |
| Observations | 923,952 | 923,952 | 972,832 | 972,832 | 692,496 | 692,496 |
| R-squared | 0.533 | 0.534 | 0.534 | 0.534 | 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 |

# A Theoretical Appendix

## A.1 Additional Discussion

### A.1.1 Managerial Risk Aversion

In contrast to other moral hazard models of managerial effort in our model it is neither necessary to assume that the manager is risk-averse nor that profits include a random shock. Setting risk aversion $r$ or the variance $\sigma^2$ equal to zero does not lead to the principal "selling the firm" to the agent and does not alter our predictions.

The central problem of underprovision of managerial effort in a canonical moral hazard setup derives from the fact that the principal is unwilling to provide strong incentives because this would impose too much risk on the agent and would be excessively costly. In our model, however, in addition to this risk cost a common-owner principal also does not want to provide strong incentives because, from her point of view, this would lead to excessive effort provision and undesirably intense product market competition.

### A.1.2 Managerial Perks

Our results also hold in a different type of model in which the manager can divert corporate funds to himself, but by doing so he raises the firm's marginal costs. In such a model which is isomorphic to ours, increasing the incentive slope $\alpha$ gives the manager a stronger incentive to maximize profits and thus he will divert fewer funds. Because such personal enrichment leads to lower firm profits any owner has an incentive to deter such behavior by designing performance-sensitive compensation plans. However, the incentive to design more performance-sensitive pay is weaker for a common owner because flatter compensation leads to less aggressive product market behavior and therefore higher profits for other firms that are also owned by the same investor.

### A.1.3 Product Market Differentiation

The incentive-reducing effect of common ownership also depends on the degree of product heterogeneity. The negative effect of common ownership $\kappa$ on equilibrium incentives $\alpha^*$ 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. (2020a)) has emphasized that anti-competitive 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.

## A.2 Baseline Model

In this section we present the proofs for Proposition 1.

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

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

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

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

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

In stage 1 the majority owner of firm $i$ chooses $\alpha_i$ 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

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

and hence

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

From the manager's incentive compatibility we have $e_i = \alpha_i$. 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 $\alpha_i$ can be rewritten as

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

Taking the derivative of the owner's objective function with respect to $\alpha_i$ yields

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

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

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

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

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

The derivatives of the firms' equilibrium profits with respect to $\alpha_i$ are given by

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

Similarly, the derivatives of the firms' quantity choices with respect to $\alpha_i$ are given by

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

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

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

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

Substituting all the derivatives into the expression for $\kappa$ in equation (23) and noting that

$q_i^* = q^*$ and $\pi_i^* = \pi^*$ we obtain

$$\begin{aligned}\kappa &= \frac{2b^2-(n-1)a^2-(n-2)ab}{(n-1)ab} + \frac{r\sigma^2\alpha^* + by^*\alpha^*}{\sum_{j\neq i}\left[-\frac{2ab^2}{(2b+a)[2b-(n-1)a]}y^* + \frac{(\alpha^*)^2}{2}\frac{ab^2}{(2b+a)[2b-(n-1)a]}\right]} \\ &= M_1 + M_2\Omega\left(\alpha^*\right)\end{aligned}$$

where

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

and

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

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 $\Omega\left(\alpha^*\right)$ is decreasing in $\alpha^*$. The numerator of the derivative of $\Omega\left(\alpha^*\right)$ is a quadratic function of $\alpha^*$ and is always negative if $k_2 > 0$ which is the case, when $\omega > \bar{c}$.

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 $\alpha^*$. However, as $k_2 > 0$, because $\omega > \bar{c}$, there is only one positive root (and one negative root). This guarantees that for each $\kappa \in [0, 1]$ there is a unique positive $\alpha^*$ such that equation (23) holds. This establishes Proposition 1.

## A.3 Multimarket Firm-level Variation in Common Ownership

In this section we present the proofs for Proposition 2, Corollary 1, and Corollary 2.

By similar algebra as before we obtain the following equations for quantities and firm profits,

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

where

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

and $l\backslash i$ means the firm which is active in market $l$ except 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

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

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

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

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

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

where the difference of the two equations gives:

$$\left[3k_1(\alpha_1+\alpha_2)+k_2\alpha_2+2k_3+\frac{r\sigma^2}{b}-(4k_1-2k_2)k_1\right](\alpha_2-\alpha_1)=$$
$$\kappa k_2\left(2k_1\alpha_2+2k_2\alpha_2+2k_3-\frac{\alpha_2^2}{2}\right)\quad(24)$$

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, $\alpha_2$ ($\alpha_1$) can be explicitly written as a function of $\alpha_1$ ($\alpha_2$). 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 $\alpha^*$ and the second as $\alpha^{**}$. 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

$$(3k_1 + 2k_2)\alpha^{*2} + \left(\frac{r\sigma^2}{b} + 2k_3 - 4k_1^2 - 4k_1k_2\right)\alpha^* - 4k_1k_3 = 0 \tag{25}$$

$$(3k_1 + 2k_2)\alpha^{**2} + \left(\frac{r\sigma^2}{b} + 2k_3 - 4k_1^2 - 4k_1k_2\right)\alpha^{**} - 4k_1k_3 + \kappa k_2\left(\frac{\alpha^{**2}}{2} - (2k_1 + 2k_2)\alpha^{**} - 2k_3\right) = 0 \tag{26}$$

Both have a unique positive root. Equation (25) 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 (26) would be strictly positive if it is evaluated at $\alpha^*$ instead of $\alpha^{**}$. As the LHS of equation (26) 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 (25) being positive, which yields a contradiction. Thus, $0 < \alpha^{**} < \alpha^* < 2k_1$.

**Theorem 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 $\alpha_1, \alpha_2 > 0$.*[43]

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

1. Curve 1 crosses the $\alpha_2$-axis at $(0, -\frac{k_3}{k_2})$ where $-\frac{k_3}{k_2} > 2k_1$.

2. On Curve 1, as $\alpha_1$ approaches $2k_1$ from the left, $\alpha_2 \to -\infty$.

3. The function represented by Curve 1 either first increases and then decreases in $\alpha_1$ over $(0, 2k_1)$, or it is always decreasing in $\alpha_1$ over $(0, 2k_1)$. This can be shown by taking derivatives, and is omitted here.

4. Curve 2 crosses the $\alpha_1$-axis at $(-\frac{k_3(4k_1+2\kappa k_2)}{2k_1k_2}, 0)$, where $-\frac{k_3(4k_1+2\kappa k_2)}{2k_1k_2} > 2k_1$.

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

(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 $(\alpha^*, \alpha^*)$ 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 $\alpha_1$ 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 $\alpha_1$ is uniquely pinned down by $\alpha_2$, it follows that the function represented by Curve 2 must be decreasing in $\alpha_1$ 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 $\alpha_2$.

(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 (24). 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

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

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 (4), 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 $\kappa$. At the same time, Curve 2 moves monotonically with $\kappa$. 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 $\alpha_2$, as $\kappa$ increase, $\alpha_1$ must decrease in order to stay on Curve 2. In other words, in a graph where $\alpha_1$ is the $x$-axis and $\alpha_2$ is the $y$-axis, as $\kappa$ increases, Curve 1 does not change, but Curve 2 moves downwards. Then it is clear that $\alpha_1^*$ ($\alpha_2^*$) increases (decreases) in $\kappa$, and it follows that $\alpha_1^* - \alpha_2^*$ increases in $\kappa$. It follows that when $\kappa$ 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 $\kappa$ increases.

## A.4 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 $A = \omega$, $b = \rho$, and $a = \gamma$.

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

$$\max_{s_i,\alpha_i} \pi_i - w_i + \sum_{j\neq i} \kappa(\pi_j - w_j)$$

$$\text{subject to} \quad u_i \geq \bar{u} \quad \text{and} \quad e_i^* \in \arg\max_{e_i} \mathbb{E}[-\exp(-r(w_i - q_i e_i^2/2)] \quad \text{and} \qquad q_i^* \in \arg\max_{q_i} \pi_i.$$

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

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

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 $i$

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

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 $\alpha_i$ to maximize her profit shares both in firm $i$ and all other firms $j \neq i$ taking into account the effects of $\alpha_i$ 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

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

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

The only quantitative change is that the incentive-reducing effect of common ownership is smaller with strategic substitutes because in addition to a direct positive effect that is present under both forms of competition, the reduction in managerial incentives has a positive (negative) strategic effect on the firm's profits under strategic complements (substitutes).

To see this recall that when common ownership $\kappa$ increases, the owner of firm $i$ lowers $\alpha_i$

which leads to a higher price $p_i$ and under differentiated Bertrand competition this in turn leads to higher $p_j$ which benefits firm $i$. In contrast, lowering $\alpha_i$ under differentiated Cournot leads to a lower quantity $q_i$ which in turn induces higher $q_j$ which hurts firm $j$. Thus, although increases in common ownership still decrease managerial incentives $\alpha^*$ under strategic substitutes, they do so less than under strategic complements.

# B Additional Empirical Results

**Table B1.** Panel A. Wealth-performance sensitivity as a function of different measures of common ownership (for industry classification SIC COMP).

This table presents the association between common ownership (MHHID) and the Edmans, Gabaix and Landier (2009) measure of wealth performance sensitivity (EGL), after controlling for industry- and year-fixed effects. The universe covers all CEOs from 1993 until 2014. An industry is defined at the CRSP 4-digit SIC code as well as the Hoberg & Philips definition at the 400 level. Column 1 presents the coefficient estimates for the measure of common ownership (MHHID) and WPS. Column 2 adds the measure of product market concentration (HHI) and a full set of controls. Column 3 adds firm-fixed effects. Columns 4 and 5 use the Hoberg & Philips peers definition at the 400 level. Note that the Hoberg & Phillips industry definitions are available starting in 1996.

| Dependent Variable | ln(Wealth Performance Sensitivity EGL) | | | | | | |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| CO (Kappa) | -0.114*** | | | | | | |
| | (-2.973) | | | | | | |
| CO (Cosine Similarity) | | -0.304*** | | | | | |
| | | (-6.150) | | | | | |
| CO (Top 5 Overlap) | | | -0.208*** | | | | |
| | | | (-5.334) | | | | |
| CO (Anton and Polk) | | | | -0.451*** | | | |
| | | | | (-5.026) | | | |
| CO (Harford, Jenter and Li) | | | | | -0.455*** | | |
| | | | | | (-5.039) | | |
| CO (MHHID) | | | | | | -0.0263 | |
| | | | | | | (-0.314) | |
| CO (MHHID 1/N) | | | | | | | 0.00390 |
| | | | | | | | (0.0660) |
| Volatility | 1.023*** | 0.981*** | 1.035*** | 0.924*** | 0.943*** | 1.007*** | 1.005*** |
| | (3.533) | (3.411) | (3.614) | (3.246) | (3.301) | (3.501) | (3.484) |
| ln(Market Equity) | 0.343*** | 0.349*** | 0.345*** | 0.356*** | 0.357*** | 0.338*** | 0.338*** |
| | (18.21) | (18.66) | (18.25) | (18.03) | (18.20) | (17.58) | (17.55) |
| Leverage | 0.0141 | 0.00813 | 0.0114 | 0.00360 | 0.00209 | 0.0159 | 0.0163 |
| | (0.231) | (0.134) | (0.184) | (0.0593) | (0.0344) | (0.261) | (0.267) |
| HHI | -0.0158 | -0.0169 | -0.0147 | -0.0437 | -0.0452 | -0.0164 | -0.00731 |
| | (-0.172) | (-0.186) | (-0.159) | (-0.486) | (-0.502) | (-0.160) | (-0.0797) |
| ln(Tenure) | 0.479*** | 0.485*** | 0.483*** | 0.485*** | 0.486*** | 0.478*** | 0.478*** |
| | (16.60) | (17.06) | (16.98) | (17.08) | (17.17) | (16.56) | (16.57) |
| Observations | 45,670 | 45,670 | 45,393 | 45,670 | 45,670 | 45,676 | 45,676 |
| R-squared | 0.687 | 0.688 | 0.688 | 0.688 | 0.688 | 0.687 | 0.687 |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry (SIC-2) × Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

**Table B1.** Panel B. Wealth-performance sensitivity as a function of different measures of common ownership (Hoberg-Phillips).

This table presents the association between common ownership (MHHID) and the Edmans, Gabaix and Landier (2009) measure of wealth performance sensitivity (EGL), after controlling for industry- and year-fixed effects. The universe covers all CEOs from 1993 until 2014. An industry is defined at the CRSP 4-digit SIC code as well as the Hoberg-Phillips definition at the 400 level. Column 1 presents the coefficient estimates for the measure of common ownership and WPS. Column 2 adds the measure of product market concentration (HHI) and a full set of controls. Column 3 adds firm-fixed effects. Columns 4 and 5 use the Hoberg-Philips peers definition at the 400 level. Note that the Hoberg-Phillips industry definitions are available starting in 1996.

| Dependent Variable | ln(Wealth Performance Sensitivity EGL) | | | | | | |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| CO (Kappa) | -0.101** | | | | | | |
| | (-2.428) | | | | | | |
| CO (Cosine Similarity) | | -0.204*** | | | | | |
| | | (-4.735) | | | | | |
| CO (Top 5 Overlap) | | | -0.152*** | | | | |
| | | | (-4.095) | | | | |
| CO (Anton and Polk) | | | | -0.372*** | | | |
| | | | | (-4.257) | | | |
| CO (Harford, Jenter and Li) | | | | | -0.350*** | | |
| | | | | | (-4.276) | | |
| CO (MHHID) | | | | | | -0.169** | |
| | | | | | | (-2.101) | |
| CO (MHHID 1/N) | | | | | | | -0.0315 |
| | | | | | | | (-0.584) |
| Volatility | 1.050*** | 1.003*** | 1.007*** | 0.963*** | 0.978*** | 1.034*** | 1.036*** |
| | (3.855) | (3.686) | (3.684) | (3.563) | (3.600) | (3.811) | (3.811) |
| ln(Market Equity) | 0.368*** | 0.372*** | 0.366*** | 0.381*** | 0.380*** | 0.364*** | 0.364*** |
| | (15.68) | (15.98) | (15.64) | (15.89) | (15.90) | (15.26) | (15.26) |
| Leverage | 0.0332 | 0.0285 | 0.0260 | 0.0281 | 0.0275 | 0.0356 | 0.0360 |
| | (0.456) | (0.392) | (0.355) | (0.384) | (0.377) | (0.490) | (0.496) |
| HHI | 0.0116 | 0.00405 | 0.0131 | -0.0169 | -0.0178 | -0.0563 | 0.0171 |
| | (0.203) | (0.0708) | (0.238) | (-0.288) | (-0.303) | (-0.825) | (0.296) |
| ln(Tenure) | 0.493*** | 0.496*** | 0.495*** | 0.497*** | 0.497*** | 0.492*** | 0.492*** |
| | (13.99) | (14.28) | (14.23) | (14.43) | (14.47) | (13.96) | (13.97) |
| Observations | 34,161 | 34,161 | 33,959 | 34,161 | 34,161 | 34,172 | 34,172 |
| R-squared | 0.698 | 0.698 | 0.697 | 0.698 | 0.698 | 0.698 | 0.698 |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry (SIC-2) × Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

**Table B2.** Panel A. Wealth-performance sensitivities as a function of common ownership: alternative WPS measures (Compustat).

This table presents coefficients from regressions of wealth-performance sensitivities on common ownership. The difference to Table B1 is that we use alternative measures of wealth performance sensitivity. The universe covers all CEOs from 1993 until 2014. An industry is defined at the CRSP 4-digit SIC code as well as the Hoberg & Philips definition at the 400 level. Note that the Hoberg & Phillips industry definitions are available starting in 1996. In columns 1 to 3 the dependent variable is Jensen and Murphy (1990) measure while in columns 4 to 6 it is the Hall and Liebman (1998) measure (both in logs).

| Dependent Variable | ln(WPS JM) | | | ln(WPS HL) | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| CO (Kappa) | -0.136*** | | | -0.0910** | | |
| | (-3.615) | | | (-2.110) | | |
| CO (Cosine Similarity) | | -0.248*** | | | -0.176*** | |
| | | (-5.819) | | | (-3.700) | |
| CO (Top 5 Overlap) | | | -0.192*** | | | -0.135*** |
| | | | (-5.824) | | | (-3.746) |
| Volatility | 1.260*** | 1.218*** | 1.271*** | 1.456*** | 1.427*** | 1.472*** |
| | (4.486) | (4.357) | (4.515) | (4.838) | (4.773) | (4.952) |
| ln(Market Equity) | 0.0782*** | 0.0818*** | 0.0784*** | 0.681*** | 0.684*** | 0.681*** |
| | (3.444) | (3.634) | (3.476) | (31.88) | (31.99) | (32.02) |
| Leverage | -0.553*** | -0.557*** | -0.552*** | 0.0672 | 0.0642 | 0.0673 |
| | (-9.215) | (-9.305) | (-9.214) | (1.093) | (1.048) | (1.080) |
| HHI | -0.0744 | -0.0729 | -0.0789 | -0.0386 | -0.0379 | -0.0426 |
| | (-0.894) | (-0.877) | (-0.936) | (-0.452) | (-0.444) | (-0.491) |
| ln(Tenure) | 0.386*** | 0.390*** | 0.391*** | 0.560*** | 0.563*** | 0.563*** |
| | (15.35) | (15.63) | (15.63) | (17.37) | (17.51) | (17.50) |
| Observations | 45,670 | 45,670 | 45,393 | 45,670 | 45,670 | 45,393 |
| R-squared | 0.793 | 0.794 | 0.794 | 0.793 | 0.793 | 0.793 |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry (SIC-2) × Year FE | Yes | Yes | Yes | Yes | Yes | Yes |

**Table B2.** Panel B. Wealth-performance sensitivities as a function of common ownership: alternative WPS measures (Hoberg-Phillips).

This table presents coefficients from regressions of wealth-performance sensitivities on common ownership. The difference to Table B1 is that we use alternative measures of wealth performance sensitivity. The universe covers all CEOs from 1993 until 2014. An industry is defined at the CRSP 4-digit SIC code as well as the Hoberg-Philips definition at the 400 level. Note that the Hoberg-Phillips industry definitions are available starting in 1996. In columns 1 to 3 the dependent variable is Jensen and Murphy (1990) measure while in columns 4 to 6 it is the Hall and Liebman (1998) measure (both in logs).

| Dependent Variable | ln(WPS JM) | | | ln(WPS HL) | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| CO (Kappa) | -0.106** | | | -0.0511 | | |
| | (-2.511) | | | (-1.161) | | |
| CO (Cosine Similarity) | | -0.165*** | | | -0.0930** | |
| | | (-3.979) | | | (-2.197) | |
| CO (Top 5 Overlap) | | | -0.166*** | | | -0.105*** |
| | | | (-5.099) | | | (-3.085) |
| Volatility | 1.453*** | 1.412*** | 1.420*** | 1.475*** | 1.453*** | 1.457*** |
| | (5.257) | (5.099) | (5.088) | (5.376) | (5.328) | (5.308) |
| ln(Market Equity) | 0.115*** | 0.118*** | 0.115*** | 0.722*** | 0.724*** | 0.722*** |
| | (3.758) | (3.878) | (3.821) | (31.19) | (31.40) | (31.54) |
| Leverage | -0.556*** | -0.559*** | -0.563*** | 0.0928 | 0.0908 | 0.0865 |
| | (-8.906) | (-8.935) | (-9.018) | (1.470) | (1.437) | (1.414) |
| HHI | -0.0153 | -0.0189 | -0.0158 | 0.0188 | 0.0159 | 0.0204 |
| | (-0.256) | (-0.315) | (-0.268) | (0.353) | (0.297) | (0.389) |
| ln(Tenure) | 0.394*** | 0.396*** | 0.397*** | 0.538*** | 0.540*** | 0.541*** |
| | (13.86) | (14.07) | (14.09) | (17.53) | (17.72) | (17.76) |
| Observations | 34,161 | 34,161 | 33,959 | 34,161 | 34,161 | 33,959 |
| R-squared | 0.803 | 0.803 | 0.803 | 0.814 | 0.814 | 0.814 |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry (SIC-2) $\times$ Year FE | Yes | Yes | Yes | Yes | Yes | Yes |

**Table B3.** Wealth-performance sensitivity as a function of common ownership: robustness to coarser industry definitions (at the 3-digit level).

This table presents regressions similar to those in Table B1. The outcome variable is the Edmans, Gabaix and Landier (2009) measure of wealth performance sensitivity (EGL), whereas we use two alternative common ownership measures. The first measure captures for each firm's top 5 shareholders the amount of overlap among peers. The second measure is based on Anton and Polk (2012) and captures for each firm the average total value of stock held by the common funds of any two stock pair, scaled by the total market capitalization of the two stocks. The universe covers all CEOs from 1999 until 2014. An industry is defined at the CRSP 4-digit SIC code as well as the Hoberg-Philips definition at the 400 level. Note that the Hoberg-Phillips industry definitions are available starting in 1996.

| Dependent Variable | ln(Wealth Performance Sensitivity EGL) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| CO (Kappa) | -0.0878** | | | -0.0652 | | | -0.105** | | |
| | (-2.087) | | | (-1.545) | | | (-2.669) | | |
| CO (Cosine Similarity) | | -0.233*** | | | -0.248*** | | | -0.207*** | |
| | | (-5.303) | | | (-5.666) | | | (-5.015) | |
| CO (Top 5 Overlap) | | | -0.145*** | | | -0.169*** | | | -0.134*** |
| | | | (-4.214) | | | (-4.771) | | | (-3.842) |
| Volatility | 1.354*** | 1.321*** | 1.310*** | 1.276*** | 1.247*** | 1.226*** | 1.150*** | 1.106*** | 1.100*** |
| | (5.107) | (5.031) | (4.998) | (4.601) | (4.549) | (4.454) | (4.181) | (4.059) | (4.065) |
| ln(Market Equity) | 0.344*** | 0.349*** | 0.345*** | 0.340*** | 0.347*** | 0.342*** | 0.378*** | 0.382*** | 0.377*** |
| | (17.43) | (17.67) | (17.39) | (17.01) | (17.52) | (17.29) | (16.73) | (17.00) | (16.70) |
| Leverage | 0.0137 | 0.00804 | 0.0261 | -0.00653 | -0.0136 | 0.00331 | 0.0142 | 0.00989 | 0.0151 |
| | (0.229) | (0.135) | (0.445) | (-0.106) | (-0.221) | (0.0542) | (0.202) | (0.141) | (0.218) |
| HHI | -0.0290 | -0.0442 | -0.0366 | -0.0839 | -0.104 | -0.0997 | -0.0261 | -0.0347 | -0.0290 |
| | (-0.544) | (-0.826) | (-0.687) | (-0.971) | (-1.200) | (-1.142) | (-0.561) | (-0.745) | (-0.591) |
| ln(Tenure) | 0.479*** | 0.483*** | 0.480*** | 0.476*** | 0.481*** | 0.476*** | 0.489*** | 0.492*** | 0.492*** |
| | (16.02) | (16.29) | (16.35) | (16.02) | (16.35) | (16.47) | (14.20) | (14.37) | (14.38) |
| Observations | 46,483 | 46,483 | 46,254 | 46,808 | 46,808 | 46,692 | 34,953 | 34,953 | 34,853 |
| R-squared | 0.648 | 0.648 | 0.648 | 0.647 | 0.648 | 0.648 | 0.672 | 0.672 | 0.672 |
| 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 B4.** 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, Gabaix and Landier (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 $\kappa_{ij}$ 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) |
| $\overline{\kappa}_i$ | -0.133*** | | | | |
| | (-2.953) | | | | |
| $\overline{\log(\kappa_{ij})}$ | | -0.0270** | | | |
| | | (-2.537) | | | |
| $\overline{\log(\cos_{ij})}$ | | | -0.0752*** | | -0.0811*** |
| | | | (-5.245) | | (-5.608) |
| $\overline{\log\sqrt{\frac{IHHI_j}{IHHI_i}}}$ | | | | 0.0172 | 0.0336** |
| | | | | (1.173) | (2.155) |
| Volatility | -0.113 | 0.343*** | 0.347*** | 0.340*** | 0.348*** |
| | (-1.528) | (17.75) | (18.00) | (17.32) | (17.96) |
| ln(Market Equity) | 0.346*** | 1.357*** | 1.326*** | 1.350*** | 1.311*** |
| | (17.91) | (4.850) | (4.791) | (4.817) | (4.749) |
| Leverage | 1.363*** | 0.0367 | 0.0321 | 0.0378 | 0.0309 |
| | (4.898) | (0.561) | (0.494) | (0.576) | (0.473) |
| HHI | 0.0377 | -0.125 | -0.128 | -0.112 | -0.123 |
| | (0.581) | (-1.366) | (-1.421) | (-1.223) | (-1.365) |
| ln(Tenure) | 0.487*** | 0.486*** | 0.489*** | 0.484*** | 0.489*** |
| | (16.43) | (16.33) | (16.53) | (16.33) | (16.59) |
| Observations | 42,788 | 42,706 | 42,706 | 42,706 | 42,706 |
| R-squared | 0.682 | 0.682 | 0.682 | 0.682 | 0.682 |
| Firm FE | Yes | Yes | Yes | Yes | Yes |
| Industry (SIC-2) × Year FE | Yes | Yes | Yes | Yes | Yes |