Common Ownership, Competition, and Top Management Incentives

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Abstract

We show theoretically and empirically that managers have steeper financial incentives to expend effort and reduce costs when an industry's firms tend to be controlled by shareholders with concentrated stakes in the firm, and relatively few holdings in competitors. A side effect of steep incentives is more aggressive competition. We exploit quasi-exogenous variation in common ownership to support a causal interpretation. These findings inform a debate about the objective function of the firm.

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I Introduction

Competition is at the core of capitalism. Smith (1776) is credited with the insight that competitive markets have the ability to channel individual self-interest and increase aggregate welfare. But which factors ensure that firms act in a self-interested way and compete with other firms? The incentive theory literature has long recognized that shareholders can (and do) use compensation contracts to incentivize managers to compete more or less aggressively (Fershtman and Judd, 1987; Sklivas, 1987; Fumas, 1992; Schmidt, 1997; Joh, 1999; Raith, 2003). In short, it is well-accepted in the literature that in order to have firms act in self-interested ways, top management's economic incentives should be aligned accordingly. However, one aspect prior work has left unexplored is how intensely different types of shareholders actually *want* the firms they own to maximized individual firm profits in the first place. Does such variation in shareholder preferences exist and, if so, to which extent does it affect managerial incentives? This paper offers the first exploration of these questions. In particular, we show that managers are given stronger financial incentives to compete when an industry's firms are controlled by shareholders with fewer financial stakes in competitors.

The notion that firms maximize their own profits is a ubiquitous assumption, but it stands on shaky theoretical foundations. Hart (1979) shows that perfect competition is necessary for shareholders to agree on own-firm profit maximization as the objective of the firm. Our key point is that when one relaxes the assumption of perfect competition, then investors' self-interest may no longer be equivalent to self-interested behavior by firms. The reason is as follows. When investors also hold other firms in their portfolio, investors' self-interest is in maximizing the value of their respective portfolios rather than in the value of any single portfolio firm in isolation. When the firms act in these investors' interests, they no longer maximize their own value. The distinction between profit maximization and shareholder value maximization becomes relevant when firms interact strategically. The set of strategies that maximize an individual firm's profits are then generally different from the strategies that maximize the value of a given portfolio.

Although the question of how firms' objectives vary with shareholder preferences has implications for other fields, this paper specifically focuses on managerial incentive provision. Aggressive competition may be in the interest of an individual firm, but can at the same time reduce the industry's profitability. Shareholders with different portfolios may therefore have different opinions about the optimal competitive strategy of any given firm.[1] Therefore, it is important to ask "to which extent the conduct of firms will be different from the assumed profit maximization behavior in classical theory; and if it differs, what ramifications does that have for market outcomes" (Hart and Holmstrom, 1987), in particular the ramifications for managerial incentives.

One would expect that firms owned by a set of investors that do not hold significant stakes in competitors would be more likely to compete aggressively than firms who lack powerful shareholders with a material interest in other firms in the same industry. Consider the ownership structures of various U.S. airlines presented in Tables 1 and 1. Virgin America's top owners are Richard Branson, his Virgin Group, and a hedge fund. None of them holds significant stakes in other U.S. airlines. By stark contrast, the top owners of the other airlines in the table are institutional investors, *most of whom are also top owners in various competitors*. Whereas stealing market share from competitors may be in the interest of Richard Branson, Warren Buffett's Berkshire Hathaway would likely not benefit from aggressive competition between Delta, American, United, and Southwest.[2] The empirical question we study is whether firms whose ownership structure is dominated by shareholders with stronger incentives to compete reward their top managers with more pronounced performance incentives than firms whose top owners lack such a strong economic interest to compete due to common ownership.[3]

[1]Relatedly, the firm's investment decision can be separated from the owners' preferences, but this is only true when firms are price takers – that is, when incentivizing managers to choose an optimal strategy is a vacuous proposition. The assumptions in (Fisher, 1930) are therefore not a useful basis for the question we study.

[2]This logic is not unfamiliar to industry observers, see Quick (2016).

[3]Note that designing strong incentives to compete can be costly to shareholders. For example, implementing relative performance evaluation as predicted by Holmstrom (1982) requires the definition of a peer group, which can be controversial, difficult, and often involve costly compensation consultants. Only shareholders with strong incentives to compete can reasonably be expected to exert the effort to create strong incentives to compete.

To provide guidance for our empirical analysis, we propose a theoretical model of product market competition and managerial contracts and analyze the role of common ownership in shaping managerial incentives. In our model, similar to Raith (2003), a risk-averse manager maximizes the certainty equivalent of her compensation net of her private cost of effort. Managerial effort reduces the firm's costs and thereby increases its profits. Compensation is a function of profits and can therefore induce effort. However, because profits also contain a random component, there is a utility cost of offering to "steep" incentives. In a standard model without common ownership, the utility costs of higher-risk compensation are weighed against the effort-inducing effects of steeper incentives. Because higher effort decreases costs, effort also increases equilibrium quantities and decreases equilibrium prices when firms interact in the product market (i.e., it leads to more competition between firms). Compared to the benchmark case of separately owned firms, a common owner has weaker economic incentives to induce competition and therefore awards her manager weaker incentives that unilaterally induce lower managerial effort and consequently lead to lower output and higher prices. Thus, equilibrium incentives are predicted to be 'flatter' in industries where common ownership is more prevalent.

On the empirical side, the first contribution of our paper is to document the extent to which the same set of diversified investors own natural competitors in U.S. industries. We show how many firms and what fraction of firms have a particular common investor among the top shareholders. For example, today both BlackRock and Vanguard are among the top five shareholders of almost 70 percent of the largest 2,000 publicly traded firms in the US; twenty years ago that number was zero percent for both firms. As a result of this increase in common ownership, ownership-adjusted levels of industry concentration are frequently twice as large as those suggested by traditional concentration indexes that counterfactually assume completely separate ownership.

We then test the model's qualitative predictions. Our primary outcome variable of interest is the sensitivity of managers' wealth (including accumulated stock and options) with their firm's performance. The reason for this choice is that managerial wealth dwarfs annual "flow" pay, and therefore more accurately reflects managers' economic incentives Consistent with the main model prediction, we find a strong negative association between the wealth-performance sensitivity (WPS) and common ownership in a comprehensive panel of US stocks (i.e., after the inclusion of industry and time-fixed effects). This relation becomes stronger once we control for industry structure (HHI) as well as firm- and manager-level controls (e.g., size, book-to-market, volatility, tenure), and is robust to the inclusion of firm-fixed effects as well. Whereas the baseline results use Edmans et al. (2009)'s measure of WPS, we find similar results using the measures by Hall and Liebman (1998) and Jensen and Murphy (1990). Moreover, the results are qualitatively similar whether we employ the often-used MHHI delta measure of common ownership concentration (O'Brien and Salop, 2000; Azar et al., 2015), a model-free measure of top-5-shareholder-overlap, or the measure of connected stocks by Anton and Polk (2014). Our results are also robust to various alternative industry definitions.

To strengthen a causal interpretation of the link between common ownership concentration and top management incentives, we use plausibly exogenous variation in ownership caused by a mutual fund trading scandal in 2003, previously used by Anton and Polk (2014). The shock affected funds that jointly held 25% of total mutual fund assets, and thus led to a significant change in firm ownership. The results corroborate the findings from the panel regressions: wealth-performance sensitivities decline when an industry becomes more commonly owned compared to other industries.

Identifying a single causal mechanism driving these findings is beyond the scope of the present paper. However, it is important to document that plausible mechanisms exist. The simplest mechanism behind these results that is consistent with our model's intuition is as follows. The absence of a large active blockholder with a strong interest in the target firm and without interests in competitors is associated with reduced efforts on behalf of shareholders to design steep incentives. In other words, common owners need not actively design 'flat' incentives; they may merely fail to design "steep" ones. This interpretation is also consistent with the recent evidence of shareholder rights activists challenging the large 'lazy' (Economist, 2015) asset managers to do more to curb excessive and performance-insensitive executive compensation (Melby, 2016; Melby and Ritcey, 2016; Morgenson, 2016). Under this view, managers of firms predominantly owned by 'quasi-indexing' large mutual funds live a relatively "quiet life" with flat incentives, few price wars, and high profits.

That said, our results also allow for another channel. Asset managers claim to discuss executive compensation in almost half of the hundreds of engagement meetings they conduct every year with portfolio firms. Hence, a lack of attention or disengagement cannot fully explain our results. A lack of power can hardly be an explanation either, given that an "against" say-on-pay vote "would worry any director" (Melin, 2016) and because large institutions' perceived influence reaches far beyond pay structure.[4] Some observers thus compare the role of asset managers to those of activist investors (Flaherty and Kerber, 2016). Lastly, the asset managers are well aware of the logic underlying this paper (Novick et al., 2017). Hence, a more 'direct' channel is a possibility as well.

The remained of the paper proceeds as follows. Section II discusses the related literature, and section III presents the model. Section IV details the data set and presents the summary statistics on common ownership. The panel results are in section V, whereas section VI presents the instrumental-variable regressions. Section VII concludes.

II Related Literature

Previous contributions have analyzed the interplay between (i) product market competition and (ii) incentive contracts, as well as between (iii) common ownership and (i) product market

[4]For example, BLK's CEO and Chairman Larry Fink says "We can tell a company to fire 5,000 employees tomorrow" (Rolnik, 2016). Reuters headlines tell a similar story, e.g., "When BlackRock calls, CEOs listen and do deals" (Hunnicutt, 2016). Engagement meetings not only feature discussions about executive pay, but also about product market competition. For example, Chen (2016) reports that a group of seven major funds recently called a private meeting with top biotech and pharma executives in which "representatives, including those from Fidelity Investments, T. Rowe Price Group Inc. and Wellington Management Co., exhorted drug industry executives and lobbyists to do a better job defending their pricing" amid political and public pressure to do the opposite, and "encouraged them to investigate innovative pricing models." Schlangenstein (2016) reports that a common owner of six US airlines explicitly demanded that Southwest Airlines (SWA) "boost their fares but also cut capacity" – a move against what SWA's managers believe to be in SWA's best interest; see also Levine (2016).

competition. This paper completes the triangle between the three concepts by establishing a link between (ii) incentive contracts and (iii) common ownership. This link is non-trivial when firms strategically interact due to imperfect competition. We first review the literatures on the link between (i) product market competition and (ii) incentive contracts as well as (i) product market competition and (iii) common ownership before discussing prior research on the relationship between (ii) incentive contracts and (iii) common ownership.

Theoretical papers that examine the relationship between (i) product market competition and (ii) managerial incentives include Hart (1983), Fershtman and Judd (1987), Sklivas (1987), Scharfstein (1988), Hermalin (1992), Fumas (1992), Schmidt (1997), Meyer and Vickers (1997), Raith (2003), Vives (2008), and Baggs and de Bettignies (2007) while Aggarwal and Samwick (1999a) and Cunat and Guadalupe (2005, 2009) provide empirical evidence. These papers analyze both how the competitiveness of the product market influences the strength of managerial incentives as well as the reverse link of how managerial incentive contracts can be used to strengthen or soften product market interactions.[5]

Our paper is also related to a recent empirical literature that investigates the causes and consequences of (iii) common ownership of firms and its effects on (i) product market competition. Azar et al. (2015, 2016) provide evidence that common ownership causes higher product prices in the airline and banking industries, respectively. Philippon and Gutierrez (2017) show that firms owned by quasi-indexers tend to underinvest relative to investment opportunities in a broad panel of US firms. The present paper provides a potential answer to how the weaker incentives to aggressively compete of common shareholders result in the less competitive product market behavior of the firms they own. Our analysis shows that managerial incentives to compete are, at least to some extent, aligned with the interests of common shareholders. This insight supports the view that the product market effects caused by common ownership can obtain without direct

[5]Although the focus of our paper is squarely on the role of the interplay between product market competition and common ownership in shaping managerial incentives our work is, of course, also related to the vast theoretical and empirical literature on managerial incentives. For a comprehensive survey of this literature we refer the reader to Murphy (1999) and Edmans and Gabaix (2016).

or indirect coordination between firms, but are at least partially driven by changes in unilateral incentives.

Relatedly, the summary statistics on common ownership concentration (MHHID) are a significant contribution to the burgeoning literature on common ownership and increased concentration in the United States. Previous papers have provided measures of ownership for various markets within an industry, but none has calculated common ownership concentration across several industries and across time. Our analysis of the number and fraction of common ownership links created by particular investor *ranks* in various industries complements and refines an analysis by Azar (2012); He and Huang (2014); Azar (2016) who report the change over time in the likelihood that two randomly selected S&P 1500 firms in the same industry have an overlapping shareholder of a given size.

Finally, the theoretical idea that shareholder diversification (and the resulting common ownership) requires rethinking the role of managerial incentive contracts dates back at least to Arrow (1962). In particular he writes that "any individual stockholder can reduce his risk by buying only a small part of the stock and diversifying his portfolio to achieve his own preferred risk level. But then again the actual managers no longer receive the full reward of their decisions; the shifting of risks is again accompanied by a weakening of incentives to efficiency. Substitute motivations [...] such as executive compensation and profit sharing [...] may be found". To our knowledge the earliest formal investigation of this question is by Gordon (1990) who analyzes linear relative performance evaluation (RPE) contracts when the firm's owners also care about the profits of other firms. He theoretically shows that RPE should be less prevalent when firms benefit more from their competitors' performance.[6] Hartzell and Starks (2003) study how managerial incentives vary with institutional ownership in general. We specifically study how cross-sectional variation

[6]Similar arguments have since been discussed in variations by Hansen and Lott (1996), Rubin (2006), and Kraus and Rubin (2006). In Gordon's model, this is modeled by a reduced-form relationship that assumes exogenous positive effort spillovers on other firms in the industry. In contrast, we explicitly model the product market interaction between these firms. Doing so allows us to analyze product market interactions for both Cournot and Bertrand competition, which reveals the unambiguous prediction that common ownership reduces the strength of managerial incentives.

in the institutions' incentives relates to incentive provision.

The two most closely related papers are contributions by Liang (2016) and Kwon (2016) which followed the circulation of the first draft of the present study. Liang (2016) shows that common ownership concentration causes less relative performance evaluation, which is a conclusion consistent with the main argument of our paper.[7] There are two key differences. First, we focus on the more meaningful wealth-performance sensitivities rather than (annual 'flow') pay-performance sensitivities as our primary outcome variable. Second, we analyze the aggregate strength of incentives to maximize the own firm's value rather than the relative performance evaluation.[8] Kwon (2016) also studies the relationship between common ownership concentration and relative performance evaluation using flow pay as the primary outcome variable, but uses different industry definitions, measures of common ownership, empirical specifications, and identification strategies, and finds results that are qualitatively opposite to those of Liang (2016), our auxiliary results on the flow-performance relation and RPE, as well as in contradiction to the literature's theoretical predictions.[9] Bennett et al. (2017) show that equity based compensation declines with product market fluidity. None of these studies investigates how wealth-performance sensitivities vary with common ownership.

[7]The earlier version of our paper exclusively focused on relative performance evaluation proposing both a theoretical model and empirical evidence for the RPE-reducing effect of common ownership. The present version expands the analysis to analyze the strength of managerial incentives more generally. Note further that Liang (2016) uses firm-level variation in ownership, whereas our previous version used only industry-level variation.

[8]The existence or absence of a (binary) relative performance provision in contracts is not informative about the strength or even the sign of relative performance incentives – indexed pay may nevertheless positively depend on industry performance.

[9]Contrary to earlier claims by Kwon, taking logs of the outcome variable does not qualitatively change our results, as we show in the present paper. A possible explanation for the difference in results is that, by apparent contrast to Kwon, we clean the Thomson Reuters 13F ownership data for known errors, as detailed in Azar et al. (2015).

III Model and Hypothesis Development

A Setup

The following stylized model of product market competition and managerial contracts analyzes the role of common ownership.

A1 Product Market Competition

There are 2 firms producing differentiated products. Each firm i is owned by a majority owner and a set of minority owners and it is run by a single risk-averse manager. The model has two stages. At stage 1, the majority owner (she) of each firm proposes an incentive contract to the manager (he) of that firm. At stage 2, the managers simultaneously improve efficiency through costly private effort and engage in differentiated Cournot (Bertrand) competition. We assume that a manager's action choices at stage 2 are noncontractible. However, profits are contractible. The firms face symmetric inverse demand functions given by

$$P_i(q_i, q_j) = A - bq_i - aq_j, \tag{1}$$

where $i \in 1, 2$ and $b > a > 0$. Thus, the manager's action choice has a greater impact on the demand for his own product than do his competitive rivals' actions.[10]

Each firm i has a constant marginal cost given by $c_i = \bar{c} - e_i$, where $\bar{c}$ is a constant and e_i is the effort exerted by firm i's manager.

The profits of firm i are therefore given by

$$\pi_i = q_i(A - bq_i - aq_j - c_i) + \varepsilon_i. \tag{2}$$

[10] Although we assume linear demands and the presence of only 2 firms, the results of our model generalize to nonlinear demand functions and $n > 2$ firms.

We assume that ε_i is normally distributed with zero mean and variance σ^2, and is independent of the other firms' profit shocks. We assume that realized profit is contractible.

A2 Managers

The manager of firm i is offered the following total compensation in the form of a linear contract

$$w_i = s_i + \alpha_i \pi_i \tag{3}$$

where s_i is a salary and α_i is the incentive slope on firm i's profits π_i. This compensation contract mirrors real-world compensation practices as top managers' compensation is usually tied to their firm's equity value which reflects the discounted value of firm profits. We assume a linear compensation contract for expositional clarity and tractability. The manager's salary s_i is used to satisfy the individual rationality constraint which is pinned down by the manager's outside option $w_i^{'}$. All managers simultaneously choose effort levels and quantities (prices) in accordance with the incentives given by their contracts. Each manager's utility is given by $-\exp[-r(w_i - kq_ie_i^2/2)]$, where r is the agent's degree of (constant absolute) risk aversion and $kq_ie_i^2/2$ is his disutility of exerting effort. This functional form assumes that as the firm's output increases it becomes more costly for the manager to lower cost. The manager's wage has an expected value of $s_i + \alpha_i\pi_i$ and a variance of $\alpha_i^2\sigma 2$. Given the normal distribution of ϵ_i, maximizing utility is therefore equivalent to maximizing

$$s_i + \alpha_i \pi_i - \frac{r}{2}\alpha_i^2\sigma^2 - \frac{k}{2}e_i^2 \tag{4}$$

Thus, each manager i chooses effort and sets quantity (price) to maximize his expected compensation net of risk and effort costs:

$$\max_{e_i, q_i} s_i + \alpha_i[A - bq_i - aq_j - (\bar{c} - e_i)]q_i - \frac{r}{2}\alpha_i^2\sigma^2 - \frac{k}{2}q_ie_i^2 \tag{5}$$

Finally, note that this model is a single period model. As a result, the model does not distinguish between the stock (e.g., accumulated wealth) and the flow (e.g., yearly wage) of managerial compensation and provides exactly the same predictions in both cases.

A3 Owners

There are 2 owners. To simplify the exposition, we assume that these owners are symmetric such that owner i owns a majority stake in firm i and an additional share in the other firm. López and Vives (2016) show that, when the ownership stakes are symmetric, firm i's maximization problem can be restated in the following way

$$\phi_i = (\pi_i - w_i) + \lambda(\pi_j - w_j) \tag{6}$$

where the value of λ depends on the type of ownership and corresponds to what Edgeworth (1881) termed the "coefficient of effective sympathy among firms". In particular, López and Vives (2016) 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 (6).[11]

In stage 1, each majority owner publicly proposes an incentive contract (s_i, α_i) for her manager i such that the contract maximizes her profit shares in all the firms.[12] 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 shares of that other firm. Hence, the relevant maximization

[11]Note that by maximizing equation (6) 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 (6) is a normalization. Firms do not maximize a sum that is larger than the entire economy.

[12]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.

problem for the majority owner of firm i is

$$\max_{s_i,\alpha_i}(\pi_i - w_i) + \lambda(\pi_j - w_j) \tag{7}$$

$$\text{subject to} \quad w_i \geq w_i^{'} \quad \text{and} \quad (e_i^*, q_i^*) \in \arg\max_{e_i,q_i} \mathbb{E}[-\exp(-r(w_i - kq_i e_i^2/2))] \tag{8}$$

B Analysis

We solve for a symmetric equilibrium by backward induction. At stage 2 of the game, when the managers simultaneously choose effort and quantities, each manager knows his own incentive contract (s_i, α_i) as well as those of all of his competitors.

For a given contract (s_i, α_i) the manager's best response functions in stage 2 are

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

$$q_i = \frac{A - (\bar{c} - e_i) - aq_j}{2b} \tag{10}$$

First, note that the stronger the incentives α_i given to the manager the larger will be the efficiency improvements e_i that he undertakes as can be seen in equation (9). This is because a larger share of the firm's profits encourages the manager to exert more effort to cut costs. Second, stronger incentives also lead to higher quantities (lower prices) because the efficiency improvements induced by stronger incentives increase the firm's per-unit profit margin thereby encouraging the manager to set a higher quantity. This is apparent by looking at the numerator of equation (10). Stronger incentives therefore lead to more competitive product market behavior. Finally, the base salary s_i does not affect the managers' decisions.

We solve this system of best response functions $e_i(\alpha_1, \alpha_2), q_i(\alpha_1, \alpha_2)$ of the 2 firms for the managerial effort and quantity choices as a function of the vector of incentive slopes α_1, α_2 in stage 2 to obtain the equilibrium effort and quantity choices

$$e_i(\alpha_1, \alpha_2) = \frac{\alpha_i}{k} \tag{11}$$

$$q_i(\alpha_1, \alpha_2) = \frac{A - \bar{c}}{2b + a} + \frac{2b\alpha_i - a\alpha_j}{2k(4b^2 - a^2)} \tag{12}$$

In stage 1, the majority owner of firm i uses the salary s_i to satisfy the manager's individual rationality constraint and uses the incentive slope α_i to maximize her profit shares both in firm i as well as in the other firm in the industry. We substitute the expressions for stage 2 effort and quantity from equations (11) and (12) in the objective function of owner i given by (6). We then differentiate with respect to α_i and solve for the symmetric equilibrium incentive slope $\alpha_i^* = \alpha^*$ which is given by

$$\alpha^* = \frac{2k(A - \bar{c})(8b^2 - a^2 - 2\lambda ab)}{\lambda a(4b + a) + a^2 - 2ab - 12b^2 + 4(4b^2 - a^2)(2b + a)(1 + kr\sigma^2)k} \tag{13}$$

The following proposition establishes our central theoretical result.

Proposition 1. *The equilibrium incentives α^* given to managers decrease with the degree of common ownership λ, that is $\frac{\partial \alpha^*}{\partial \lambda} < 0$.*

Differentiating the equilibrium incentive slope α^* given in equation (13) with respect to common ownership λ immediately yields the result contained in the Proposition 1. The intuition for this result is also relatively straightforward. As common ownership λ increases, each owner cares relatively more about the profits of the other firm in the industry. Thus, each owner would prefer softer competition between the 2 firms that she partially owns. As a result, she sets incentives for the manager of her majority-owned firm to induce less competitive strategic behavior. She does so by decreasing α_i in stage 1 because lower incentives lead to lower managerial effort to reduce costs and thus less aggressive product market behavior in stage 2. Note further that the degree of common ownership λ has no impact on the product market shares. This is because the firms' cost structures and the market demand remain unchanged when λ changes and thus the firms' remain constant. As a result, measures of product market concentration based on market shares such as the Hirschman-Herfindal Index (HHI) are also unchanged. Accordingly, in our empirical tests, we will hold market shares constant and vary only the degree of common ownership.

IV Data

The model yields testable implications for the relationship between common ownership and the structure and level of top management pay. To test these predictions, we need data on executive compensation, performance, ownership, and a robust industry definition. In what follows, we first describe how common ownership is measured and then detail the data sources used to construct our variables.

A Measuring Common Ownership Concentration

To identify the extent to which common ownership concentration in an industry affects managerial incentives we need a measure of common ownership concentration. This endeavor is substantially more complicated in the empirical analysis than in theory, because there are typically more than two firms per industry and because different types of shareholders hold different portfolios. Fortunately, the existing literature provides a candidate measure of common ownership concentration that addresses these challenges: the "modified Herfindahl-Hirschman index" (MHHI), originally developed by Bresnahan and Salop (1986) and O'Brien and Salop (2000), used by regulators worldwide to assess competitive risks from holdings of a firm's stock by direct competitors, and previously implemented empirically by Azar et al. (2015).

One attractive property of the measure is that it allows to decompose total market concentration (MHHI) in two parts, industry concentration as measured by the Herfindahl-Hirschman Index (HHI), $\sum_j s_j^2$, where s_j is the market share of firm j and common ownership concentration, called MHHI delta (or MHHID). HHI captures the number and relative size of competitors; MHHID captures to which extent these competitors are connected by common ownership and control links. Formally,

$$\underbrace{\sum_j \sum_k s_j s_k \frac{\sum_i \gamma_{ij}\nu_{ik}}{\sum_i \gamma_{ij}\nu_{ij}}}_{\text{MHHI}} = \underbrace{\sum_j s_j^2}_{\text{HHI}} + \underbrace{\sum_j \sum_{k\neq j} s_j s_k \frac{\sum_i \gamma_{ij}\nu_{ik}}{\sum_i \gamma_{ij}\nu_{ij}}}_{\text{MHHID}} \tag{14}$$

where ν_{ij} is the ownership share of firm j accruing to shareholder i, γ_{ij} the control share of firm j exercised by shareholder i, and k indexes firm j's competitors.

In the special case of completely separate ownership MHHI is equal to HHI because MHHID is equal to 0. Another feature is that the MHHI can be interpreted in the context of a Cournot model of competition. However, we do not estimate this particular model of product market competition, but instead use MHHID as a reduced-form measure of reduced incentives to compete due to common ownership.

B Data Description

Executive Compensation. ExecuComp provides annual panel compensation data for the top five executives of S&P1500 plus 500 additional public firms. The data includes details about compensation, tenure, and position. We use the flow of total compensation (TDC1) as our main measure of compensation for several reasons. TDC1 incorporates the vesting conditions that have to be fulfilled in the future, by valuing stock and option awards at the grant-date fair value in accordance with SFAS 123R. TDC1 also captures the portion of pay that is not explicitly reflected in the contracts.[13] Specifically, total compensation (TDC1) includes salary, bonus, long-term incentive payouts, the grant-date fair value of stock and option awards, and other payouts. Summary statistics about pay level, standard deviation, and distribution are given in Table 2 Panel A. The average (median) yearly compensation of an executive in our sample is \$2.31m (\$1.36m) and average (median) tenure is 4.6 (3) years.

Firm Performance. Following Aggarwal and Samwick (1999a), we measure firm performance

[13] Contract terms are only available since 2006 onwards after SFAS 123R was implemented. De Angelis and Grinstein (2016) show that the discretionary component of performance compensation is about half of total compensation.

as the increase in the firm's market value (lagged market value multiplied by stock return), and rival performance as the value-weighted return of all firms in the industry excluding the firm in question, multiplied by the respective firm's last-period market value. This measure has at least two advantages in addition to comparability to the literature. One is that market values are what matters to shareholders, in particular to the largest institutional investors, who are typically compensated based on total assets under management. Second, when markets are reasonably efficient, market values are more informative about performance than accounting profits. Table 2 Panel A reports summary statistics about own and rival performance, sales (used to measure market shares), and volatility (a control).

Ownership. To construct the ownership variables, we use Thompson Reuters 13Fs, which are taken from regulatory filings of institutional owners. We describe the precise construction of the common ownership variables in the following section. A limitation implied by this data source is that we do not observe holdings of individual owners. We assume that these stakes 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 (Azar et al., 2015, 2016) suggests that the stakes individual shareholders own in large publicly traded firms are rarely significant enough to substantially alter the measure of common ownership concentration we use, even in the most extreme cases. For example, even Bill Gates's ownership of about 5% of Microsoft's stock is small compared to the top five diversified institutional owners' holdings, which amount to more than 23%. As a result, including or discarding the information on Bill Gates' 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 a bias toward zero in our regressions.[14]

Because common ownership summary statistics are a contribution in their own right, we discuss them in a separate subsection below. However, given that common ownership is the main

[14]We are not aware of a publicly available data set that provides more accurate information on ownership for both institutions and individuals than the one we use. For example, we determined by manual inspection that ownership information provided by alternative data sources that contains individual owners (e.g., Osiris) is often inaccurate; we hence prefer regulatory data from the SEC.

explanatory variable of our study, some considerations on what drives the variable's variation are in order. Variation over time within and across industries in common ownership comes from any variation in the structure of the ownership network, i.e., from any change in top shareholder positions. These changes include transactions in which an actively managed fund increases or offloads a position in an individual stock, as well as transactions in which an index fund increases its holdings across a broad set of firms because of inflows the fund needs to invest. It also includes variation from combinations of asset managers. Some of this variation could be thought of being endogenous to executive incentives. For example, an undiversified investor might accumulate a position in a single firm that has an inefficiently structured compensation policy in place, thus decreasing common ownership density, which would be followed by a change in compensation structure. Or, an investor might buy shares from undiversified investors and accumulate positions in competing firms, thus increasing common ownership density, with the aim of decreasing competition between them.[15] We will later address in the second-to-last section of this paper how the exogenous and potentially endogenous parts of the variation can be decomposed and separately used in the analysis.

Industry Definitions. Regarding the definition of markets and industries, we again start with the benchmark provided by the existing corporate finance literature, and then offer several refinements. Our baseline specifications define industries by four-digit SIC codes from CRSP. We construct the industry-year level HHI indices based on sales from Compustat North America. For robustness, we also use the coarser three-digit SIC codes. The advantage of doing so is that broader industry definitions 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. We then provide alternative tests checks using the arguably more precise, 10K-text-based industry classifications of Hoberg and Phillips (2010, 2016) (HP).

[15] See Flaherty and Kerber (2016) for a recent example of such conduct and a brief discussion of potential legal consequences.

Despite our efforts to use robust industry definitions, we acknowledge that none 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 implies 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 cross-industry studies, the imperfection implied by coarser industry definitions is unavoidable: available data sets on ownership and industries also limit existing studies in the literature to public firms. We do not have a concrete reason in mind why these limitation should lead to qualitatively misleading results, but it is advisable to keep these constraints in mind when attempting a quantitative interpretation of the results.

C Common Ownership Across Industries and Over Time

Our sample contains yearly data from 1993 to 2014. Table 2 Panel A provides summary statistics for HHI and $MHHID$ at the four-digit SIC code industry level over these years. In the average and median industry, common ownership concentration is about a quarter as large as product market concentration. However, these economy-wide summary statistics obscure the variation in both product market and ownership concentration across different sectors of the economy and over time. Panel B reports the same measures of HHI and $MHHID$, but separately for each two-digit SIC code sector. More precisely, the concentration measures are computed for each four-digit industry and then averaged across these industries, for each two-digit code.

Figure I shows that there has been a significant increase in $MHHID$ for the average four-digit SIC code industry in various sectors over the past two decades. In particular, in construction, manufacturing, finance, and services, the average industry $MHHID$ has increased by more 600 HHI points. While this number is a lower bound due to the coarse industry definitions we use, it is three times larger than the 200-point threshold the DoJ/FTC horizontal merger guidelines find "likely to enhance market power." This increase in ownership concentration is largely decoupled from a relatively constant product market concentration. To illustrate, Figure II shows the average HHI and $MHHID$ time series for the manufacturing sector where the average is taken across four-digit SIC code industry definitions.

Figure II also shows that common ownership concentration $MHHID$ can add a quantitatively large amount of concentration to standard measures of industry concentration HHI. At the end of our sample, in 2013, $MHHI$ is more than 1,500 points higher than HHI. Again, these magnitudes are likely underestimates of the true extent of increased market concentration, among others because antitrust enforcement typically considers market-level concentration measures as a proxy for competitive threats. Indeed, larger magnitudes have been reported with market-level concentration measures in the airlines and banking industry by Azar et al. (2015, 2016).

Where does this ownership concentration come from? Table 4 shows that large mutual fund companies play an important role. Panel A reports the number and fraction of firms for which a particular investor is the largest shareholder of the firm, by two-digit industry. Panel B repeats the exercise, but instead reports the proportion of firms for which a particular investor is among the top ten shareholders of the firm. Although the two panels reveal a significant amount of sectoral variation in ownership concentration, even the average magnitude of common ownership is quite large across the entire sample of firms. For example, BlackRock is now among the largest ten shareholders of almost 70% of all the firms in our sample (roughly the 2,000 largest publicly traded firms in the U.S.). Vanguard follows very close behind.

Panel C shows that the role of these investors has become more important over the last two decades. Whereas a very small proportion of firms had one of the investors listed in the panel as one of their top ten shareholders at the beginning of our sample, a very large proportion did so at the end. For example, whereas both BlackRock and Vanguard were among the top ten shareholders in almost no firms in 1994, both were among the top ten in almost 70% of the sample firms in the final years of our sample. To put that number in perspective, recall that our sample includes quite small corporations outside the S&P1,500 as well. It is less typical for large asset managers to hold large blocks of shares in that universe.

V Panel Regressions

This section details how we translate the model's predictions into empirically testable hypotheses.

A Empirical methodology

Our main interest is whether the strength of top management incentives varies across industries by their level of common ownership concentration. We measure the strength of incentives with various measures of wealth-performance sensitivities (WPS) from Edmans et al. (2009) and common ownership concentration with $MHHID$ as detailed above. Our baseline analysis regresses

$$WPS_{ijzt} = k_{ij} + \beta \cdot F(MHHID_{zt}) + \gamma \cdot X_{ijzt} + \eta_z + \eta_t + \varepsilon_{ijzt}, \tag{15}$$

where i indexes managers, j firms, z industries, X is a vector of controls, η are fixed effects, and $F(MHHID_{zt})$ is the rank-transformed measure of common ownership. Given the fixed effects, the identifying variation are differences across industries in changes over time in common ownership concentration. In addition, we show robustness to the introduction of firm-fixed effects. Furthermore, 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 5% level.

B WPS Panel Regression Results

Table 5 presents the baseline results. Column (1) regresses the log wealth-performance sensitivity (WPS) which we calculate as in Table 2 of Edmans et al. (2009), on the rank-transformed common ownership concentration as measured by $F(MHHID)$, industry-fixed effects and year-fixed effects. The coefficient is negative, -0.265, and highly statistically significant. Column (2) adds the rank-transformed $F(HHI)$, size, the logarithm of book-to-market, volatility, leverage, and the logarithm of the executive's tenure with the firm as controls. Introducing these controls increases the magnitude of the common ownership coefficient to -0.597 and increases its statistical significance. Column (3) differences out unobserved firm-level determinants of wealth-performance sensitivity by introducing firm-fixed effects. The estimated effect of common ownership concentration on WPS remains highly statistically significant and similar in magnitude to column (1), at -0.327. This means that moving from the least concentrated industry in terms of common ownership to the most concentrated industry decreases wealth-performance sensitivity by 28%. Specification (4) is similar to specification (2); the only difference is the industry definition (Hoberg-Philips instead of SIC-4). The coefficient on common ownership in column (4) of -0.327 is similar to the previous specifications. Introducing firm-fixed effects in column (5) renders the common ownership coefficient statistically indistinguishable from zero.

One basic question regarding the evidence presented in Table 5 is to which extent the insights are robust to the way wealth-performance sensitivities are calculated. To investigate that question, Table 6 offers fully saturated specifications similar to Table 5 specifications (2) through (5), using alternative measures of the wealth-performance sensitivity. Columns (1) through (4) use Jensen and Murphy (1990)'s sensitivity of executive pay to performance; columns (5) through (8) use Hall and Liebman (1998)'s version of the wealth-performance sensitivity. The results are generally similar to those presented in Table 5 using Edmans et al. (2009)'s measure, showing a negative relation between common ownership concentration and the relationship between executive wealth and firm performance. Consistently across the measures of performance sensitivities, the effects are mitigated when firm-fixed effects are included; also, the effects are stronger both in magnitude and statistical significance for the SIC-4 industry definition, compared to the Hoberg-Philips (HP400) industry definition. All estimates are highly statistically significant, with the exception of columns (4) and (8). Those use the HP400 industry definition and include firm-fixed effects and don't indicate a statistically significantly effect. Finally,

A further concern with our baseline results are potential criticisms of the measure of common ownership concentration ($MHHID$) we use. Although this particular measure has several attractive properties both from an empirical and theoretical perspective, we want to ensure that our results are robust to using alternative measures of the degree to which competitors are commonly owned. We offer two alternatives. First, we calculate to which extent the top five shareholders in competitors overlap. Second, we use Anton and Polk (2014) (AP)'s measure of common ownership. We present the results in Table 7. The results are consistent with and in some ways stronger than the baseline results. Both the top-5 shareholder overlap measure and the AP measure of common ownership are negatively relative to the EGL-WPS. This is true both for the SIC-4 and HP400 industry definition, although the coefficient in column (6) – the estimate of top-5-shareholder overlap using HP400 and firm fixed effects – loses statistical significance. Note that in column (8) the correlation between the AP measure of common ownership and EGL-WPS remains statistically significant at the 5 percent level even with firm fixed effects and with the HP400 industry definition, which generally yielded weaker results in our baseline tests. Finally, our results are also robust to using SIC-4 codes as defined by Compustat instead of CRSP (not reported). The point estimates and significance levels are very similar for both cases.

C Relative Performance Incentives

Our main motivation for studying wealth-performance sensitivities, as detailed above, is that variation in wealth changes dwarfs variation in 'flow' pay, and thus dominates executives' economic incentives. However, a more nuanced prediction of the basic relationship can be tested by studying the sensitivities of pay to own performance and the performance of rival firms, respectively – and how these sensitivities vary with common ownership concentration. Intuitively, one should expect that if an industry's relevant firms are more commonly owned by the same investors, these investors should want to reward managers relatively less for an individual firm's idiosyncratic performance, and relatively more for the performance of the industry (i.e., of rival firms). A model in the appendix details this prediction.

A basic equation that defines pay-for-performance sensitivity and the sensitivity of pay to rival firms' performance is

$$\omega_{ij} = k_{ij} + \alpha_{ij}\pi_j^o + \beta_{ij}\pi_j^r + \varepsilon_{ij}, \tag{16}$$

where manager i works in firm j, and superscript o refers to own firm performance, and r refers to rivals' firm performance. α_{ij} is the pay-for-performance sensitivity, and β_{ij} is the sensitivity of manager i's pay ω_{ij} to firm j's rivals' performance. To examine how α_{ij} and β_{ij} depend on product market concentration, one can extend this equation to

$$\begin{aligned}\omega_{ij} &= k_i + \alpha_1\pi_j^o + \alpha_2\pi_j^o F(HHI_j) + \\ &\quad +\beta_1\pi_j^r + \beta_2\pi_{jt}^r F(HHI_j) + \\ &\quad +\gamma_1 F(HHI_j) + \varepsilon_{ij},\end{aligned} \tag{17}$$

where $F(HHI)$ is the industry's concentration rank, and take a particular interest in the coefficients α_2 and β_2. Going beyond, the present paper investigates if the incentive slopes α and β vary with common ownership concentration (MHHID), obtained from the generalized measure of market concentration MHHI (= HHI + MHHID) introduced above. To answer this question, by contrast to some of the existing literature, we employ panel regressions, i.e., use both cross-sectional and time-series variation. In sum, our baseline empirical model is,

$$\begin{aligned}\omega_{ijt} &= k_i + \alpha_1\pi_{jt}^o + \alpha_2\pi_{jt}^o F(HHI_{jt}) + \alpha_3\pi_{jt}^o F(MHHID_{jt}) + \\ &\quad +\beta_1\pi_{jt}^r + \beta_2\pi_{jt}^r F(HHI_{jt}) + \beta_3\pi_{jt}^r F(MHHID_{jt}) + \\ &\quad +\gamma_1 F(HHI_{jt}) + \gamma_2 F(MHHID_{jt}) + \varepsilon_{ijt},\end{aligned} \tag{18}$$

where our interest is chiefly in the coefficients α_3 and β_3 to test Proposition 1, and in coefficient γ_2 to test Proposition 2.

Following the literature, we also offer specifications that control for firm size (Rosen, 1982), CEO tenure (Bertrand and Mullainathan, 2001), and stock return volatility as a proxy for operating risk (Core and Guay, 2003; Aggarwal and Samwick, 1999b). Furthermore, time and industry fixed effects are included in all specifications. The use of time fixed effects is to mitigate the following concern: both common ownership and executive pay have increased over time, and so have a large number of other unmeasured variables. The concern is that the true driver of executive pay and common ownership is such an omitted variable. Time fixed effects difference out such an effect by making use only of the changes in the cross-sectional variation over time. Time fixed effects do not rule out, however, that a heterogeneous increase in executive pay across industries, which also experienced a differential increase in common ownership, is driven by a heterogeneous exposure to an omitted trending variable. We attempt to attenuate that concern with an instrumental variables (IV) strategy in the next section.

Industry fixed effects are included to rule out that an omitted variable that is correlated both with the cross-sectional distribution of $MHHID$ and with the level of executive pay drives the results. Specifications that include industry fixed effects identify the effect of $MHHID$ on pay from variation over time in both pay and $MHHID$, ruling out that an omitted cross-sectional common determinant of both pay structure and common ownership drives our results. In agreement with the literature (Albuquerque, 2009; Frydman and Saks, 2010; Custódio et al., 2013), we recognize that pay levels are likely to be correlated across executives within firm, and thus cluster all regressions at the firm level.

We are interested specifically in testing whether the ratio β/α from the theory is increasing in $MHHID$. To compute α and β we need to differentiate the expression (18) with respect to π_j^o and π_j^r, respectively:

$$\begin{aligned} \frac{\partial \omega_{ij}}{\partial \pi_j^o} &= \alpha = \alpha_1 + \alpha_2 F(HHI_{jt}) + \alpha_3 F(MHHID_{jt}) \\ \frac{\partial \omega_{ij}}{\partial \pi_j^r} &= \beta = \beta_1 + \beta_2 F(HHI_{jt}) + \beta_3 F(MHHID_{jt}). \end{aligned} \tag{19}$$

The final step is to differentiate the ratio β/α with respect to the c.d.f. of $MHHID$ to be able to test Proposition 1:

$$S = \frac{\partial\left(\beta/\alpha\right)}{\partial F(MHHID)} = \frac{(\alpha_1\beta_3 - \alpha_3\beta_1) + (\alpha_2\beta_3 - \alpha_3\beta_2) * F(HHI)}{(\alpha_1 + \alpha_2 F(HHI) + \alpha_3 F(MHHID))^2}. \tag{20}$$

Proposition 1 predicts that under both Cournot (strategic substitutes) and Bertrand (strategic complements) models of competition, $S > 0$. We test this hypothesis at the median value of the c.d.f.'s, i.e.: $F(HHI) = 0.5$ and $F(MHHID) = 0.5$.

D RPE Panel Regression Results

Table 8 presents the main results. We start with a benchmark result. Column (1) presents a regression of executive pay on the explanatory variables performance of own and rival firm, and those variables interacted with market concentration (HHI), corresponding to Equation (17). It most closely corresponds to the regressions in Aggarwal and Samwick (1999a).[16]

The highly significant and positive coefficient (0.226) on *Own* [firm's performance] indicates that executives take home more pay when their firm performs better. In other words, the "pay-performance sensitivity" is positive. This effect is stronger in more concentrated industries (higher HHI) as we can see in the positive (0.137) coefficient of the interaction term $Own * HHI$. HHI itself has no significant correlation with executive pay. The positive coefficient on *Rival* [firms' performance] indicates a lack of strong-form relative performance evaluation (RPE). The negative and highly significant $Rival * HHI$ coefficient indicates that contracts come closer to the RPE prediction when an industry's HHI rank is higher.

For a quantitative interpretation of these results, note that executive compensation is denom-

[16] There is a large literature examining extent and variation in the use of RPE, including theory and empirics by Holmstrom (1979, 1982); Antle and Smith (1986); Gibbons and Murphy (1990); Barro and Barro (1990); Janakiraman et al. (1992); Aggarwal and Samwick (1999b); Bertrand and Mullainathan (2001); Garvey and Milbourn (2003, 2006); Gopalan et al. (2010); Albuquerque (2014); De Angelis and Grinstein (2016); Jenter and Kanaan (2015); Jayaraman et al. (2015); see surveys by Murphy (1999), Frydman and Jenter (2010), and Edmans and Gabaix (2016); we discussed distinctions in section II. Elhauge (2016) discusses that the patterns discovered by this literature are most easily understood in the context of common ownership.

inated in thousands and firm performance is denominated in millions of constant 2015 dollars. A coefficient of 0.01 thus indicates one cent of compensation per thousand dollars of shareholder wealth. The coefficients in column (1) indicate that the (own-firm) pay-performance sensitivity ranges from 22.6 to 36.3 cents of compensation for every thousand dollars of incremental shareholder wealth per year, moving from the least concentrated ($F(HHI) = 0$) to the most concentrated industry ($F(HHI) = 1$).

These results experience a striking reinterpretation once the HHI measure of market concentration is complemented with the $MHHID$ measure of common ownership concentration, corresponding to Equation (18). Recall that under the O'Brien and Salop (2000) theory, the empirically relevant concentration measure $MHHI$ is the sum of $MHHID$ and HHI. Hence, omitting $MHHID$ from a regression can lead to bias; a change of coefficients on HHI is expected once $MHHID$ and its interactions with performance are introduced. That is indeed what we find.

Column (2) shows that the pay-performance and pay-for-rival-performance sensitivities themselves remain stable, but the previously significant interactions between pay-performance sensitivity and pay-for-rival-performance sensitivity and HHI are no longer present in the data. Moreover, the coefficients are not robust to the inclusion of controls, as columns (3) to (5) show.

The first key result is in the first three rows of column (2): the pay-for-performance sensitivity decreases, the pay-for-rival-performance increases, and unconditional pay increases when common ownership concentration (MHHID) increases. The formal test of the main theoretical prediction and its empirical analogue (Equation (20)) is given in Panel B: the inverse compensation ratio increases with the level of MHHID. The probability of a false positive is lower than 0.6 percent.

For a quantitative interpretation, when we fix industry concentration at the median ($F(HHI) = 0.5$), the own-firm pay-performance sensitivity ranges from $33 + 0.5 \cdot 5.43 = 35.72$ cents in the industry with lowest common ownership ($F(MHHID) = 0$) to $33 + 0.5 \cdot 5.43 + 11.7 = 24.02$ cents in the industry with highest common ownership ($F(MHHID) = 1$) for every thousand dollars of incremental shareholder wealth per year. Similarly, the rival-firm pay-performance sensitivity goes from $18.2 + 0.5 \cdot (-3.22) = 16.6$ in the industry with lowest common ownership to

$18.2 + 0.5 \cdot (-3.22) + 14.8 = 31.4$ in the industry with highest concentration of common ownership. Moreover, executives in the most commonly owned industries receive up to \$888k (a quarter of total average pay) more than managers in the least commonly owned industries. Those appear to be quantitatively significant magnitudes.

Column (3) includes standard controls and is the most saturated specification. The pay-for-rival-performance sensitivity becomes statistically indistinguishable from zero, but the main result that relative performance evaluation (as measured by the inverse compensation ratio) decreases with common ownership is unaffected. The result that unconditional executive pay increases with $MHHID$ retains a positive point estimate but loses statistical significance.

Columns (4) and (5) reveal why this is the case: common ownership increases unconditional pay for CEOs, but not (in statistically significant ways) for non-CEO top managers. We will show shortly that this lack of significance is due to the industry definition used here. However, for both types of executives, the use of relative performance evaluation decreases with common ownership: the formal compensation ratio tests in Panel B confirm the model prediction at the 1 percent confidence level, with the exception of the CEO subsample, where confidence drops to the 5 percent level. The drop in significance is not surprising given that only about a sixth of the sample consists of CEOs.

To obtain a quantitative interpretation of the coefficients in column (3), we again fix industry concentration at the median. The own-firm pay-performance sensitivity drops from $23+0.5\cdot(-6) = 20$ cents in the least commonly owned industry to $23 + 0.5 \cdot (-6) - 9.18 = 11.82$ cents in the most commonly owned industry, for every thousand dollars of incremental shareholder wealth per year. The rival-firm pay-performance sensitivity ranges from $-1.83 + 0.5 \cdot (6.76) = 1.55$ cents in the least commonly owned industry to $-1.83 + 0.5 \cdot (6.76) + 10.6 = 12.15$ cents in the most commonly owned industry.

The above results used CRSP 4-digit SIC codes as the industry definition. Previous research has shown great sensitivity of RPE tests to industry definitions. We are therefore interested in examining how the correlations between common ownership and pay structure depend on alternative industry definitions.

Table 9 examines the robustness of our results to different industry definitions. The first column replicates specification (3) from Table 8 with full controls for easier comparison. Column (2) refines the definition of the rival group as the size tertile within the 4-digit SIC code. The only significant difference of interest is that the $MHHID$ coefficient becomes highly significant, indicating that also the average executive (i.e., not only CEOs) receives more pay that is unrelated to performance when we refine the industry definition. This fact raises our confidence about the validity of the prediction: attenuation bias could explain the lower significance levels in the previous specifications that use coarser, and thus presumably less accurate, industry definitions.

This refinement of the rival group definition also alleviates another concern. One might reasonably hypothesize that there is a greater incidence of industry classification errors for larger firms, because those are more likely to operate in multiple segments. At the same time, common ownership is partially driven by index funds and could therefore have a correlation with firm size. Also, CEO pay tends to increase with firm size. Taken together, these considerations might lead to a worry about a positive bias in the MHHID by an imperfect size control.[17] The fact that the results become stronger, not weaker, when tests are explicitly run within size groups, alleviates this concern.

Columns (3) and (4) use the Hoberg and Phillips (2010) (HP) industry definition, first as is and then with the size-split refinement. The coefficient on Rival*MHHID becomes statistically insignificant in both cases. The compensation ratio test loses significance (but retains its sign) in column (3) but regains a one percent level of statistical significance when the finer industry definition is used in column (4).

We find this result remarkable for two reasons. One is, as previously explained, that Albuquerque (2009) shows that relative performance evaluation becomes more prevalent with size splits, which should work against finding support for our model. However, the results in the literature of

[17] A concern about the pay-for-(rival-)performance coefficients could be constructed similarly, although it would require additional levels of joint correlations.

course omit MHHID. Once common ownership is included, consistent with the interpretation that size splits increase the accuracy of industry definitions, the statistical significance of the results confirming the model predictions increases. The second reason is that the results, by contrast to some in the literature, are robust across SIC and HP definitions.

A last set of industry definitions uses coarser classifications instead. The intuitive motivation is that many firms operate and compete in multiple segments. A coarser industry classification may decrease the probability that a firm's industry is inappropriately classified, thus reducing attenuation bias, and increasing the significance of results. An alternative interpretation, more consistent with the industrial organization literature, would be more akin to a placebo test: coarser industry classifications are necessarily less precise. Columns (5) and (6) report such results for SIC and HP classifications, respectively. The point estimates are the same, but significance levels in general are lower. We interpret these results to be consistent with coarser industry definitions being less precise, and supporting the "placebo" interpretation.

E Robustness of RPE results to the Measures of Pay and Common Ownership

A concern with the results reported above might be that we run level of pay on levels of performance, whereas the true relationship might be that percentage changes in ownership translate in percentage changes of pay. Also, unobserved variation at the executive-level might confound the results. To test for the empirical import of these concerns, in Table 10 we run a log-on-logs specification with executive-fixed effects included. The results are qualitatively robust.

So far we have shown robustness of the RPE results to alternative industry definitions, and to alternative measures of managerial incentives. The last major category of robustness checks is with respect to the measure of common ownership. Market shares enter MHHID, and market shares may be endogenous to top management incentives. Therefore, we want to investigate how much our main results depend on this measure of common ownership. To that end, in Table 11 we run regressions similar to those in Tables 8 and 9, with the difference that we calculate $MHHID$ assuming that each firm in the industry has a market share of one divided by the number of firms in the industry.[18] We show these regressions both with and without controls, and for both SIC and HP industry definitions. Moreover, we use the most detailed industry measure (size splits similar to Albuquerque (2009)) which the existing literature has shown to be most conducive to finding evidence for relative performance evaluation (i.e., the opposite of what the alternative theory we propose predicts).

Let us first examine what we should expect to see under the different hypotheses. Under the null hypothesis that the O'Brien and Salop (2000) model is correct, equal-weighting makes for a less precise but directionally correct measure of common ownership, which should attenuate coefficients.[19] In contrast, under the hypothesis that the standard model is right, and all our results are driven by the endogenous nature of market shares, the test should produce pure noise.

The coefficients in Table 11 indicate that the potential endogeneity of market shares is not the main driver of the results. A market-share free measure of common ownership does not lead to a reversal of our conclusion. All coefficients of interest retain their direction, albeit some drop a level of significance. However, the compensation ratio test remains significant even at 3 percent levels.

F Remaining Concerns

One remaining concern may be that sorting of executives with particular characteristics and preferences could be driving the results and change the interpretation. For example, less aggressive CEOs might sort into firms that are held by index funds and that (for an unexplained reason other

[18] We are grateful to Daniel Ferreira for suggesting this measure.

[19] The reason for the expected attenuation is that a measure of common ownership that assigns equal market shares to all firms fails to distinguish between the following two situations. In both cases, there are three firms: A, B, and C. A and B have 45% market share, and C has 10%. If there is perfect common ownership between A and B, the industry is practically monopolized. If there is common ownership between A and C and B or C, by contrast, common ownership is not very important in the industry. The variation across these two scenarios in the importance of common ownership is entirely ignored by a measure of common ownership concentration that ignores market shares altogether.

than their economic incentives) also systematically offer "flatter" compensation packages. While we think that this is a plausible story our conclusions are entirely unaffected: the purpose of the paper is to show that in firms whose largest owners are widely diversified, managers "get away" with flatter pay structures because there are no powerful undiversified shareholders in whose interest and power it is to change them. In sum, given that this is part of the explanation we propose, we do not intend to challenge such a sorting hypothesis.

A relevant remaining concern, however, is that reverse causality is driving these correlations, or (more likely) that an omitted variable that determines both $MHHID$ and the structure of CEO pay both in the time series and in the cross section is the true cause for these patterns. The following section attempts to alleviate such concerns by using variation in ownership that was caused by a mutual fund trading scandal, and is therefore plausibly exogenous to compensation contracts.

VI IV Strategy and Results

A Variation in Common Ownership from a Mutual Fund Scandal

The motivating theory of this paper treats common ownership λ as an exogenous parameter. However, real-world ownership patterns are endogenously determined and could potentially be related to top management incentives, be that because of their effect on competition or for other reasons. As a result, the correlations from the previous section's panel regression results cannot necessarily be interpreted causally. This section uses a subset of the variation in ownership, namely that stemming from a mutual fund trading scandal which was plausibly exogenous to both compensation contracts and competition. That variation is more difficult to attribute to endogenous forces. Hence, if changes of ownership that derive from this shock correlate in similar ways with changes in executive pay levels and structures, the reverse causality and omitted variable concerns are attenuated.

The instrument, previously employed by Anton and Polk (2014), relies on the mutual fund trading scandal of 2003, in which funds from 25 mutual fund families were accused of engaging in late trading and market timing. The affected families included well-known and large firms such as Janus, Columbia Management Group, Franklin Templeton, etc. The news became public in September 2003; implicated families had an aggregate amount of assets under management of $236.5b, which amounts to 24.8% of the US mutual fund universe. Investors aggressively pulled out money from those families (with largely actively managed funds) over the following months leading to variation in common ownership changes across industries due to the shock.

To use this shock as an IV, we decompose total common ownership concentration $MHHID$ into common "scandal" ownership and common "non-scandal" ownership,

$$MHHID_{Scandal} = \sum_j \sum_{k \neq j} s_j s_k \frac{\sum_i \gamma_{ij} \beta_{ik}}{\sum_i \gamma_{ij} \beta_{ij}},$$

where in the numerator, $\sum_i \gamma_{ij} \beta_{ik}$, we sum only across scandal funds, whereas in the denominator, $\sum_i \gamma_{ij} \beta_{ij}$, we sum across all funds. That is, the instrument is the ratio of scandalous common ownership over all common ownership in September 2003 at the time of the scandal

$$ScandalRatio = \frac{MHHID_{Scandal}}{MHHID}.$$

The identifying assumption is that the *ScandalRatio* in 2003 per se is un-related to how firms were planning (and going) to change incentives in the years to come, and in particular that the firms in industries with high *ScandalRatio*s were planning to set flatter pay schedules, all conditional on controls. In addition to focusing on variation in common ownership that can be attributed to the scandal, we furthermore reduce the potential for a spurious link between common ownership and top management incentives by focusing on CEOs alone. The reason is that one might suspect incentives to be correlated across executives of a given firm, perhaps in ways that firm-level clustering might not adequately address. The safe way to exclude 'double-counting' the observations is thus to focus on the CEO alone.

The results of the first-stage regression are reported in Table 12. The 'Ratio' is statistically significant at levels of at least 5% in specifications (1) (SIC-4 industry definition) and (3) (HP definition) and the F-stats are above 50 (untabulated), albeit significance is reduced by one level once firm-fixed effects are introduced.

The second-stage results are presented in Table 13. The (instrumented) MHHID has a negative point estimate throughout all specifications (SIC-4 or HP400 industry definitions, with or without firm-FE). In specifications (1) and (3), the effect is highly statistically significant at 1 percent levels. As in the panel regressions, the statistical significance is lower for the HP industry definitions and when firm-FE effects are introduced. Overall, the IV results corroborate the impressions obtained from the panel regressions.

B IV applied to pay-performance results

We also apply the IV to specifications focusing on pay-performance sensitivities (as opposed to WPS) to investigate these results robustness to taking out potentially endogenous variation. The results are somewhat stronger than for WPS. Given the relatively sluggish response of WPS to changes in concurrent compensation (compared to pay-performance sensitivities), this is expected.

In addition to instrumenting for $MHHID$, here we also need to instrument for its interactions with own performance and rival performance. We do so by multiplying the $ScandalRatio$ with own and rival performance. Consequently, we report three first-stage regressions, where dependent variables are $F(MHHID_{jt})$, $\pi^o_{jt}F(MHHID_{jt})$, and $\pi^r_{jt}F(MHHID_{jt})$, each in the years 2004 until 2006. We provide the results both for SIC and for HP industry classifications, making for six specifications in total. The second stage will regress CEO total compensation on the fitted values from the first-stage regression, for the same years as for the first stage.

The results of the first stage regression are in Table 14. The main observation is that there is a statistically highly significant relationship between the $ScandalRatio$ and $MHHID$. Owing to the different industry definitions, the ratio takes the opposite sign in column (1) than in column (4), but is also highly significant. The *ScandalRatio* interaction with profits and rival profits is likewise highly significant. Panel B shows the different tests for underidentification and weak identification for each endogenous regressor. In this setting with multiple endogenous variables, the conventional first stage F statistics are not appropriate (Angrist and Pischke, 2009). Therefore, we provide the adjusted test proposed by Sanderson and Windmeijer (2016). We can reject the null hypothesis that the endogenous regressors are "weakly identified." Furthermore, we report the Kleibergen and Paap (2006) Wald test for the full model which yields similar conclusions.

Results of the second stage regression are in Table 15. We report results for all executives and for non-CEOs for SIC and HP industry classifications. (Owing to the restriction to only 3 years of data, the sample for CEOs alone is too small for the tests to have statistical power.) The coefficients on the interaction of $MHHID$ and own profits are negative, and significant at 5 percent levels in the SIC specifications. The coefficient on $MHHID$ interacted with rival performance is positive throughout but marginally significant only in the HP specifications. The crucial statistic for our hypothesis test is reported in Panel B. Across all specifications, the inverse compensation ratio is positive and highly statistically significant.

Importantly for the test of the theory's second main prediction, the effect of $MHHID$ on the level of executive pay is highly significant and economically large across all specifications, corroborating the results from the panel analysis.

These results do not rule out, but attenuate, the identification concerns that remained after the fixed-effects panel regressions. We conclude that it is likely that there is a causal effect of common ownership concentration, as measured by $MHHID$, on a reduced propensity to use RPE.

C Summary

In sum, we provided statical evidence supporting a causal interpretation of the correlation between common ownership and weaker managerial incentives. In the introduction, we also provided anecdotal evidence that large shareholders put much effort and thought into questions of executive compensation and competition between portfolio firms. The accumulated evidence suggests that common owners somewhat consciously act to maximize their economic incentives. Notwithstanding, our results are also consistent with a seemingly more benign interpretation that large mutual funds are "lazy owners" (Economist, 2015) that do nothing other than allowing management to live a quiet life (Bertrand and Mullainathan, 2003) with flat incentives, high profit margins, and little competition. In fact, they may help to achieve such an outcome simply by crowding out and occasionally voting against activist investors who would otherwise attempt to induce tougher competition.[20] That said, research into the precise mechanism of action by which shareholders affect compensation structure remains an interesting question for future research.

VII Conclusion

This paper examined variation in the extent to which different shareholders have different economic incentives to induce their firms to compete, and whether managerial incentives reflect these shareholder preferences. We found that the sensitivity between top managers' wealth and their firm's performance is weaker when the firms' largest shareholders are also large shareholders of competitors. The wealth-performance relation for managers is steeper when firms are owned by shareholders without significant stakes in competitors.

By documenting these patterns, the present paper provided an answer to the open question which mechanism could potentially induce the less competitive product market behavior of firms that arises from higher concentrations of common ownership (Azar et al., 2015) and ultimate ownership (the combination of common ownership and cross-ownership) (Azar et al., 2016). The answer we propose here is that high-powered managerial incentive contracts that spur competitive behavior are more likely to be present in firms and industries with little common ownership.

More generally, our results question the validity of a fundamental assumption in financial eco-

[20] Schmalz (2015) discusses a potential occurrence of such an event.

nomics. If managers take product market decisions that maximize their own economic interest the fact that firms' ownership structures and shareholders' competitive preferences affect the structure of managerial incentives implies that a firm's behavior and objectives depend on who owns the firm. Thus, the ubiquitous assumption that firms maximize own profits irrespective of shareholder preferences would no longer be correct. Our findings therefore suggest that entertaining alternative objective functions of the firm may be a fruitful area for future research in corporate governance and corporate finance.

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Figures

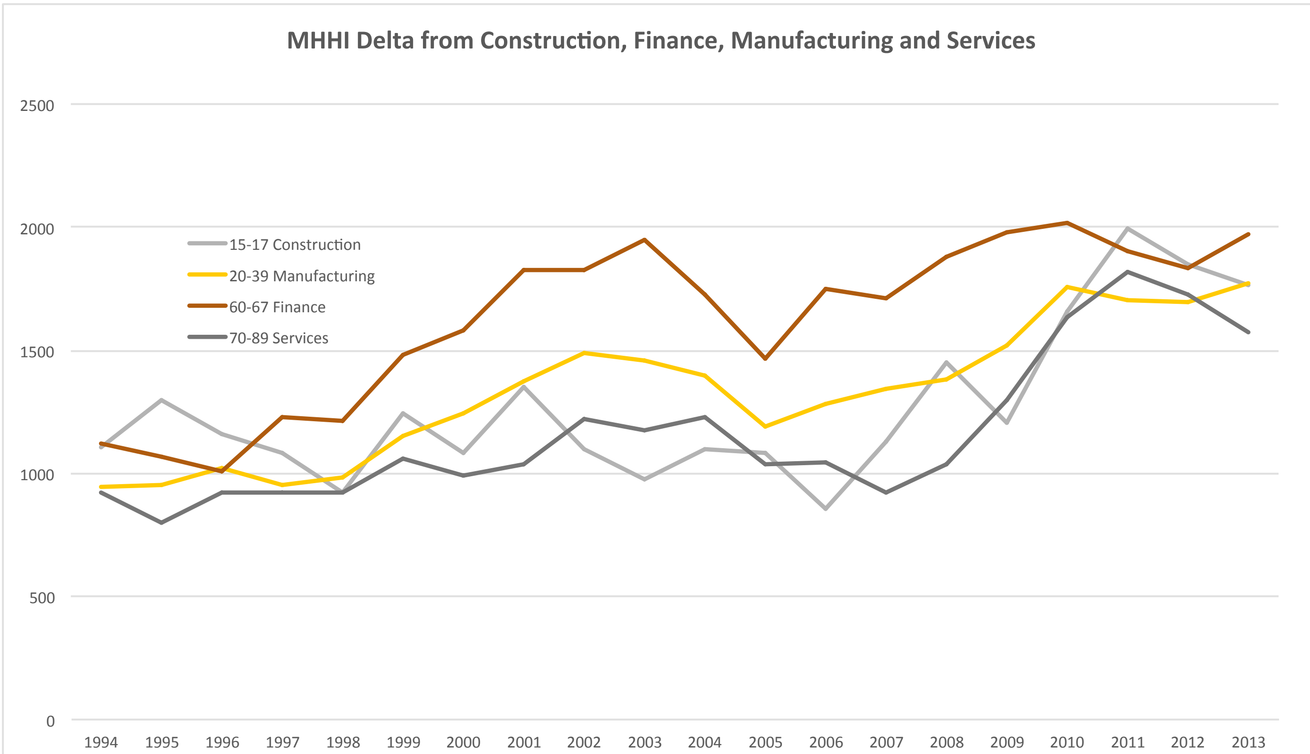

Figure I. Common Ownership Concentration (MHHID) in Various Sectors Over Time.
This figure plots the ownership concentration as measured by $MHHID$ averaged across four-digit SIC code industries for various sectors (construction, manufacturing, finance, and services) for the years 1994 to 2013.

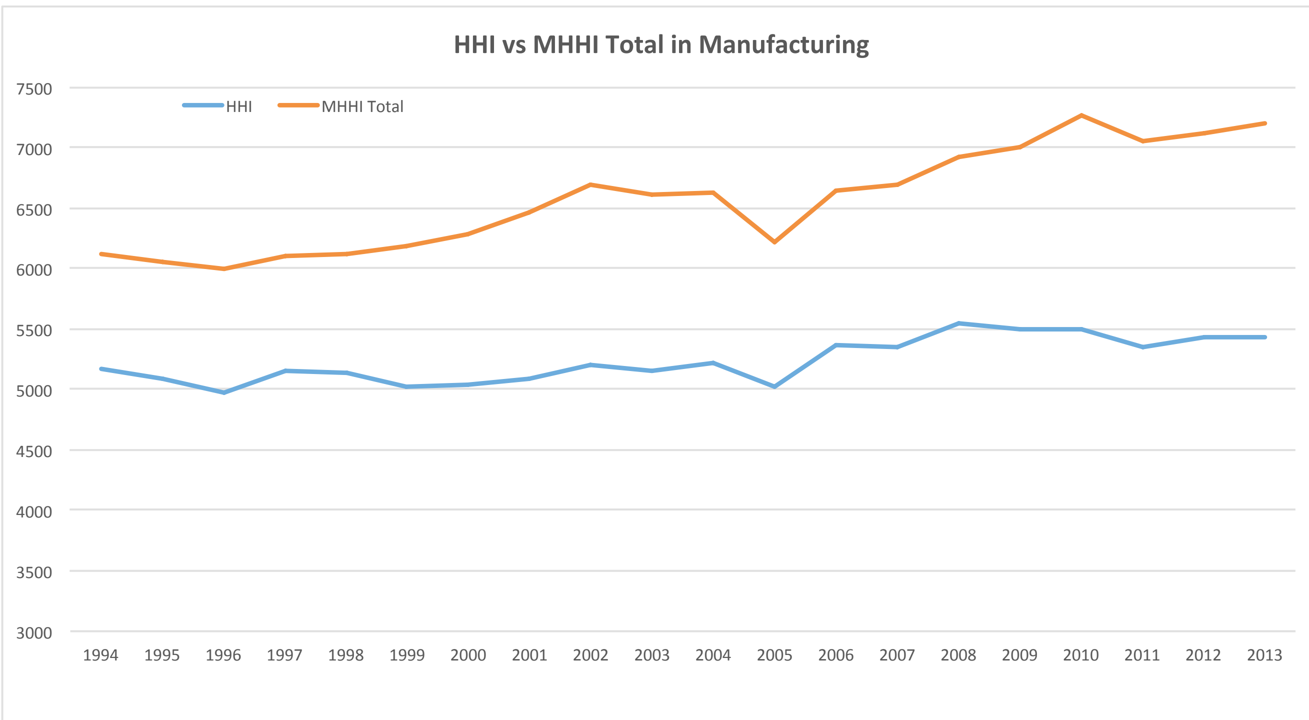

Figure II. Four-digit SIC HHI versus MHHI over time in Manufacturing.
This figure plots the product market and ownership concentration in manufacturing industries as measured by HHI and $MHHID$ averaged across four-digit SIC code industries in manufacturing for the years 1994 to 2013.

Tables

Table 1. Panel A: Virgin America's largest shareholders.
The data source is S&P Capital IQ, as of the second quarter 2016, and reflects 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 1. Panel B: Major US airlines' largest shareholders.
The data source is S&P Capital IQ, as of the fourth quarter 2016. The table is taken from Azar et al. (2015).

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 2. Summary Statistics for Key Variables.

We report the average and other summary statistics for the variables at the manager level (total compensation and tenure), at the firm level (performance, size, and volatility), and at the industry level (HHI and MHHI Delta).

Variables	N	Mean	Median	Std	10%	90%
At the manager level						
TDC1 (Compensation '000)	223605	2308	1364	2413	411	5967
Tenure (years)	252443	4.6	3	3.7	1	10
At the firm level						
Own Performance	39426	521.8	119.8	1693.7	-822	2607.2
Rival Performance (SIC4)	36797	504.3	108.7	1528.1	-639.4	2301.2
Log(Sale)	41760	7.06	6.99	1.66	5.08	9.25
Volatility	38249	0.1218	0.1075	0.0639	0.0598	0.2014
At the industry level (SIC4)						
HHI	9340	4814	4674	2942	853	8963
MHHI Delta	9340	1437	1140	1285	94	3203

Table 3. Panel A: Cross-sectional Variation of Production Market (HHI) and Common Ownership ($MHHI$ *Delta*) Concentration Across and Within industries.

This table reports summary statistics for product market and ownership concentration for the average two-digit SIC industry, whereas average are taken across four-digit SIC industries.

			HHI			MHHI Delta		
Main SIC group and Description	# of 4-digit SIC in 2013	# of 4-digit SIC-Years	Mean	10%	90%	Mean	10%	90%
01-09 Agriculture, Forestry, Fishing	4	214	6882	5314	9955	448	4	1260
10-14 Mining	77	1684	4510	1174	8806	1609	24	3504
15-17 Construction	24	981	4761	1542	8168	1204	60	2719
20-39 Manufacturing	707	23761	5247	2230	8949	1253	53	2932
40-49 Transportation & Public Utilities	152	4184	3826	1028	7211	1797	133	3831
50-51 Wholesale Trade	107	3222	5034	2346	8660	1272	60	2839
52-59 Retail Trade	120	3903	4552	1669	7887	1452	141	3157
60-67 Finance, Insurance, Real Estate	168	5241	3817	1017	7908	1520	82	3618
70-89 Services	246	7409	4722	1681	8576	1113	62	2518

Table 3. Panel B: Time-series variation of Production Market (HHI) and Common Ownership ($MHHI\ Delta$) Concentration, by Industry.

This table reports the variation over time in the conventional HHI measure of product market concentration and the additional piece to concentration stemming from common ownership, MHHI Delta, in various industries. The concentration numbers are averages across four-digit SIC industries, for each two-digit SIC industry group.

		1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
01-09 Agriculture, Forestry, Fishing	HHI	6945	6858	6370	6198	6842	6543	6134	5802	5808	5620	8048	7991	8462	9972	9491	8011	7747	9961	9987	9991
	MHHID	393	818	417	139	94	358	1016	926	361	675	47	305	90	0	2	231	604	8	2	0
10-14 Mining	HHI	4746	4203	4481	4816	4579	4814	4796	4156	4375	4096	4509	3761	4837	4563	4965	4585	4173	4230	4081	4487
	MHHID	1227	1920	1706	1418	1307	1241	1764	1502	1703	1933	1533	1066	1460	1404	1700	1578	2224	2047	1981	1899
15-17 Construction	HHI	4359	4223	4922	4149	4071	3517	4044	4634	4808	4839	4773	5039	4799	5699	5929	4998	5611	4234	3959	4040
	MHHID	1103	1299	1158	1080	923	1242	1080	1351	1101	980	1099	1085	856	1131	1449	1206	1655	1998	1847	1763
20-39 Manufacturing	HHI	5173	5095	4973	5152	5139	5028	5044	5094	5206	5155	5222	5030	5362	5355	5542	5490	5503	5349	5426	5428
	MHHID	942	953	1025	953	985	1151	1246	1377	1492	1460	1398	1188	1280	1345	1379	1516	1761	1705	1700	1771
40-49 Transportation & Public Ut.	HHI	4298	4503	4152	3803	3643	3557	3399	3246	3388	3482	3795	3754	3470	3881	3802	3760	3714	3893	3967	3868
	MHHID	1557	1447	1363	1434	1318	1563	1726	1845	2400	2374	1999	1335	1781	1942	1884	2228	2239	2398	2111	2322
50-51 Wholesale Trade	HHI	5223	4884	4689	4876	4459	4323	4752	4549	4292	4366	4751	5079	5428	5442	5373	5809	5590	5702	5465	5469
	MHHID	882	864	951	765	944	1036	1287	1358	1947	1811	1584	1706	1642	1395	1674	1449	1790	1587	1405	1540
52-59 Retail Trade	HHI	3960	4052	4204	4404	4221	4459	4590	4454	4507	4178	4298	4443	4772	4862	4724	5051	4714	4379	4623	4577
	MHHID	1102	1224	1372	1211	1330	1293	1423	1438	1645	1957	1949	1578	1596	1282	1449	1542	1902	1908	1770	2243
60-67 Finance, Insurance, Real Estate	HHI	3736	3708	3724	3545	3534	3693	3462	3220	3629	3603	3867	3886	4455	4393	4253	3971	3866	3909	3722	3693
	MHHID	1121	1068	1009	1226	1216	1485	1579	1826	1829	1948	1725	1468	1753	1712	1880	1981	2016	1903	1837	1968
70-89 Services	HHI	4766	4827	4601	4378	4202	4354	4507	4489	4627	4344	4502	4716	4629	4984	4983	5162	4929	4813	4667	4952
	MHHID	926	799	919	926	924	1060	989	1039	1225	1173	1231	1038	1043	925	1039	1296	1639	1817	1728	1572

Table 4. Panel A: Fraction of Firms in which Investor X is the Largest Shareholder, by Industry.

This table reports the average proportion of firms in two-digit SIC industries for which a given investor is the largest shareholder as of June 2013.

		2-digit SIC Industries								
	Firms with top shareholder	**01-09** Agriculture, Forestry, Fishing	**10-14** Mining	**15-17** Construction	**20-39** Manufact	**40-49** Transport Public Utilit	**50-51** Wholesale Trade	**52-59** Retail Trade	**60-67** Finance, Insurance, Real Estate	**70-89** Services
BlackRock	655	7.7%	12.9%	26.0%	16.6%	20.7%	12.5%	11.4%	16.9%	10.4%
Vanguard	222	0.0%	2.7%	0.0%	3.9%	4.8%	1.8%	5.2%	10.9%	2.4%
State Str	25	0.0%	0.0%	0.0%	1.1%	1.0%	0.0%	0.5%	0.3%	0.2%
Dimensional Fund Advisors	193	0.0%	2.7%	4.0%	5.4%	2.7%	5.4%	5.7%	5.8%	2.7%
The Northern Trust Co.	4	0.0%	0.7%	0.0%	0.1%	0.2%	0.0%	0.0%	0.0%	0.0%
Fidelity	347	7.7%	3.7%	10.0%	8.9%	4.1%	14.3%	18.0%	5.7%	10.9%
Mellon Asset Management	10	0.0%	0.3%	0.0%	0.4%	0.0%	0.0%	0.0%	0.2%	0.2%
Wellington	146	0.0%	2.7%	4.0%	2.4%	2.4%	1.8%	0.9%	7.3%	2.1%
T. Rowe Price	175	0.0%	3.4%	6.0%	4.0%	3.1%	2.7%	10.9%	2.5%	6.0%
JP Morgan	30	0.0%	1.0%	2.0%	0.7%	1.0%	1.8%	0.9%	0.2%	0.9%
Royce & Associates	97	15.4%	1.4%	2.0%	3.8%	1.0%	5.4%	3.8%	0.9%	1.2%
Renaissance Tech. Corp	67	0.0%	0.0%	2.0%	2.3%	2.2%	3.6%	0.5%	0.0%	2.7%
Invesco	20	0.0%	1.4%	2.0%	0.6%	0.2%	0.9%	0.5%	0.1%	0.5%
Capital Group	116	0.0%	4.4%	2.0%	3.6%	4.1%	0.0%	2.8%	1.5%	1.7%
Goldman Sachs	19	0.0%	1.0%	0.0%	0.3%	0.5%	0.9%	0.0%	0.5%	0.5%

Table 4. Panel B: Fraction of Firms in which Investor X is among the Largest Ten Shareholders, by Industry.

This table reports the average proportion of firms in two-digit SIC industries for which a given investor is among the largest ten shareholders as of June 2013.

		2-digit SIC Industries								
	Firms with top 10 shareholder (Universe of 4676 firms)	**01-09** Agriculture, Forestry, Fishing	**10-14** Mining	**15-17** Construction	**20-39** Manufact	**40-49** Transport Public Utilit	**50-51** Wholesale Trade	**52-59** Retail Trade	**60-67** Finance, Insurance, Real Estate	**70-89** Services
BlackRock	3025	54%	53%	80%	76%	68%	70%	86%	69%	72%
Vanguard	3038	46%	51%	74%	77%	61%	72%	85%	72%	74%
State Str	1625	38%	33%	34%	39%	39%	30%	58%	42%	30%
Dimensional Fund Advisors	1531	38%	24%	42%	38%	29%	43%	42%	41%	33%
The Northern Trust Co.	904	23%	17%	12%	22%	25%	26%	18%	27%	14%
Fidelity	1292	23%	26%	38%	31%	25%	37%	41%	27%	35%
Mellon Asset Management	655	8%	8%	14%	18%	19%	15%	22%	15%	10%
Wellington	787	8%	16%	26%	18%	13%	17%	20%	24%	17%
T. Rowe Price	753	0%	15%	22%	20%	17%	13%	25%	14%	19%
JP Morgan	539	8%	14%	12%	11%	17%	17%	19%	13%	11%
Royce & Associates	533	31%	7%	16%	20%	6%	22%	13%	6%	11%
Renaissance Tech. Corp	680	31%	11%	10%	20%	16%	16%	18%	10%	20%
Invesco	478	15%	8%	18%	11%	13%	5%	11%	12%	12%
Capital Group	451	8%	12%	10%	12%	14%	4%	12%	8%	11%
Goldman Sachs	371	0%	10%	10%	7%	13%	10%	4%	12%	6%

Table 4. Panel C: Fraction of Firms in which Investor X is among the Largest Ten Shareholders, over Time.

This table reports the average proportion of US Corporations for which a given investor is among the largest ten shareholders.

TOP 10 BLOCKHOLDERS	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
BlackRock	0%	0%	0%	0%	0%	0%	1%	1%	0%	0%	1%	3%	3%	8%	9%	9%	69%	72%	71%	69%
Vanguard	0%	0%	0%	10%	12%	17%	25%	30%	35%	32%	36%	37%	41%	45%	54%	65%	65%	66%	69%	68%
State Str	13%	8%	7%	8%	10%	10%	15%	19%	23%	32%	31%	20%	22%	23%	26%	33%	37%	37%	37%	36%
Dimensional Fund Advisors	29%	31%	32%	34%	34%	36%	36%	35%	38%	37%	31%	32%	33%	34%	39%	42%	39%	37%	36%	33%
The Northern Trust Co.	2%	2%	1%	1%	2%	10%	11%	14%	18%	22%	18%	13%	10%	8%	8%	16%	20%	17%	20%	20%
Fidelity	25%	26%	24%	23%	23%	21%	21%	23%	25%	28%	29%	26%	29%	28%	29%	30%	31%	30%	29%	30%
Mellon Asset Management	25%	24%	23%	24%	24%	21%	23%	22%	19%	17%	16%	15%	15%	12%	13%	16%	15%	15%	15%	14%
Wellington	10%	11%	11%	11%	12%	12%	12%	14%	16%	16%	17%	17%	20%	19%	19%	17%	19%	20%	19%	18%
T. Rowe Price	5%	5%	6%	7%	8%	8%	8%	9%	10%	10%	11%	11%	13%	14%	14%	16%	15%	17%	18%	17%
JP Morgan	7%	6%	6%	6%	7%	0%	5%	10%	8%	6%	5%	8%	8%	9%	8%	8%	9%	10%	12%	12%
Royce & Associates	6%	5%	4%	3%	3%	4%	4%	7%	10%	10%	11%	11%	11%	12%	12%	13%	13%	13%	13%	12%
Renaissance Tech. Corp	0%	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%	6%	17%	22%	21%	15%	13%	15%	15%
Invesco	5%	4%	4%	10%	13%	4%	9%	9%	9%	9%	8%	7%	6%	5%	9%	10%	12%	12%	11%	11%
Capital Group	8%	8%	9%	10%	11%	11%	13%	13%	13%	11%	12%	10%	12%	12%	12%	11%	11%	12%	11%	10%
Goldman Sachs	0%	0%	0%	2%	0%	6%	6%	6%	6%	7%	8%	11%	11%	14%	13%	12%	9%	9%	9%	8%

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

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 till 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 correlation between the measure of common ownership (MHHID) and WPS. Column 2 adds the measure of product market differentiation (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 (Hoberg & Phillips universe covers 1996 to 2013).

	Dependent Variable: log(Wealth-Performance Sensitivity$_{EGL}$)				
	(1)	(2)	(3)	(4)	(5)
Common Ownership (MHHID)	-0.265***	-0.597***	-0.242***	-0.327***	-0.0502
	(-3.463)	(-7.100)	(-3.749)	(-3.527)	(-0.732)
HHI		-0.243***	0.00543	-0.173*	0.0338
		(-2.793)	(0.0697)	(-1.894)	(0.492)
Size		0.0940***	0.276***	0.0868***	0.309***
		(5.371)	(9.063)	(4.726)	(9.653)
Log(Book to Market)		0.679***	0.598***	0.684***	0.563***
		(22.40)	(17.16)	(22.17)	(15.33)
Volatility		0.276	0.998**	0.0746	1.017**
		(0.650)	(2.403)	(0.175)	(2.374)
Leverage		-0.118	0.225**	-0.191*	0.199*
		(-1.103)	(2.121)	(-1.810)	(1.862)
Log(Tenure)		0.529***	0.559***	0.504***	0.552***
		(19.03)	(21.60)	(17.68)	(21.09)
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Firm FE	No	No	Yes	No	Yes
Observations	35,055	28,711	28,711	26,301	26,301
R-squared	0.089	0.243	0.257	0.240	0.265
Industry Definition	SIC-CRSP-4	SIC-CRSP-4	SIC-CRSP-4	HP400	HP400

Table 6. Wealth-performance sensitivities as a function of common ownership: alternative WPS measures.
This table presents coefficients from regressions of wealth-performance sensitivities on common ownership (MHHID). The difference to Table 5 is that we use alternative measures of wealth performance sensitivity. The universe covers all CEOs from 1993 till 2014. An industry is defined at the CRSP 4-digit SIC code as well as the Hoberg & Philips definition at the 400 level (Hoberg & Philips results cover from 1996 to 2013). Column 1 to 4 dependent variable is Jensen and Murphy (1990) measure while columns 5 to 8 use the Hall and Liebman (1998) measure (both in logs).

	log(Wealth-Performance Sensitivity$_{JM}$)				log(Wealth-Performance Sensitivity$_{HL}$)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Common Ownership (MHHID)	-0.442***	-0.168***	-0.297***	0.0141	-0.459***	-0.180***	-0.249***	0.0112
	(-5.541)	(-2.756)	(-3.667)	(0.242)	(-5.931)	(-3.030)	(-3.032)	(0.197)
HHI	-0.189**	0.000958	-0.186**	0.0432	-0.227***	-0.0312	-0.121	0.0392
	(-2.278)	(0.0137)	(-2.366)	(0.697)	(-2.865)	(-0.446)	(-1.556)	(0.637)
Size	-0.474***	-0.169***	-0.469***	-0.124***	0.640***	0.693***	0.643***	0.721***
	(-27.39)	(-5.684)	(-26.62)	(-3.986)	(38.58)	(26.50)	(37.93)	(26.46)
Log(Book to Market)	0.898***	0.717***	0.889***	0.677***	0.443***	0.517***	0.438***	0.493***
	(32.20)	(21.88)	(31.75)	(20.43)	(16.26)	(16.37)	(16.04)	(15.05)
Volatility	1.541***	0.699*	1.279***	0.754*	1.967***	1.297***	1.744***	1.268***
	(3.929)	(1.850)	(3.305)	(1.946)	(5.205)	(3.565)	(4.657)	(3.434)
Leverage	-0.410***	-0.378***	-0.471***	-0.387***	0.0594	0.146	-0.0152	0.120
	(-3.960)	(-3.991)	(-4.645)	(-4.133)	(0.552)	(1.359)	(-0.144)	(1.129)
Log(Tenure)	0.479***	0.475***	0.447***	0.460***	0.481***	0.505***	0.450***	0.492***
	(19.04)	(19.64)	(17.63)	(18.94)	(19.09)	(21.13)	(17.65)	(20.58)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FirmFE	No	Yes	No	Yes	No	Yes	No	Yes
Observations	28,711	28,711	26,301	26,301	28,711	28,711	26,301	26,301
R-squared	0.447	0.240	0.429	0.241	0.480	0.384	0.483	0.389
Industry Def	SIC-CRSP-4	SIC-CRSP-4	HP400	HP400	SIC-CRSP-4	SIC-CRSP-4	HP400	HP400

Table 7. Wealth-performance sensitivities as a function of common ownership: alternative common ownership measures.

This table presents regressions similar to those in Table 5; 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 till 2013. An industry is defined at the CRSP 4-digit SIC code as well as the Hoberg & Philips definition at the 400 level (Hoberg & Philips results cover from 1996 to 2013). Columns 2, 4, 6 and 8 include firm fixed effects.

	Dependent Variable: log(Wealth-Performance Sensitivity$_{EGL}$)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Common Ownership (Top 5 Sh Overlap)	-0.278***	-0.0776*			-0.261***	-0.0483		
	(-4.540)	(-1.743)			(-4.130)	(-1.089)		
Common Ownership (Anton & Polk)			-0.284***	-0.190***			-0.346***	-0.150**
			(-3.193)	(-2.839)			(-3.855)	(-2.109)
HHI	0.105	0.125*	0.108	0.134*	-0.0358	0.0532	-0.0391	0.0465
	(1.306)	(1.767)	(1.394)	(1.952)	(-0.436)	(0.850)	(-0.479)	(0.745)
Size	0.0917***	0.285***	0.0869***	0.277***	0.0879***	0.312***	0.0832***	0.309***
	(5.189)	(9.163)	(4.938)	(9.010)	(4.722)	(9.603)	(4.508)	(9.573)
Log(Book to Market)	0.679***	0.587***	0.679***	0.594***	0.676***	0.559***	0.678***	0.563***
	(21.96)	(16.44)	(22.14)	(16.83)	(21.88)	(15.02)	(21.86)	(15.14)
Volatility	0.409	1.214***	0.306	1.063**	0.0249	1.055**	-0.0999	0.983**
	(0.941)	(2.895)	(0.706)	(2.563)	(0.0582)	(2.457)	(-0.233)	(2.291)
Leverage	-0.124	0.266**	-0.121	0.231**	-0.205*	0.211*	-0.204*	0.208*
	(-1.158)	(2.411)	(-1.119)	(2.147)	(-1.957)	(1.956)	(-1.930)	(1.932)
Log(Tenure)	0.534***	0.557***	0.535***	0.560***	0.511***	0.551***	0.512***	0.553***
	(18.86)	(21.56)	(19.14)	(21.81)	(17.77)	(21.16)	(17.88)	(21.26)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FirmFE	No	Yes	No	Yes	No	Yes	No	Yes
Observations	27,915	27,915	28,567	28,567	26,048	26,048	26,179	26,179
R-squared	0.239	0.254	0.240	0.255	0.240	0.264	0.240	0.264
Industry Def	SIC-CRSP-4	SIC-CRSP-4	SIC-CRSP-4	SIC-CRSP-4	HP400	HP400	HP400	HP400

Table 8. Top management "flow" pay as a function of own-firm and rival profits, market concentration, and common ownership.

This table presents the effects of product market differentiation (HHI) and common ownership (MHHID) on total compensation (TDC1) as described in equation (18). An industry is defined at the CRSP 4-digit SIC code. Column 1 presents the Aggarwal and Samwick (1999a) set-up – own and rival profits, and product market differentiation, and their interactions – complemented with industry and year fixed effects. Column 2 adds the measure of common ownership (MHHID) and the interactions with own and rival profits. Column 3 adds controls. Columns 4 and 5 run run specification 3 on the CEO and non-CEO subsample. Panel B reports the inverse compensation ratio test as described in equation (20): S is the change in the ratio of rival-firm pay-performance sensitivity over own pay-performance sensitivity (i.e. $\frac{\beta}{\alpha}$) relative to the cdf of common ownership (MHHID). All standard errors are clustered at the firm level.

PANEL A	Dependent Variable: Top Management Pay				
	(1)	(2)	(3)	(4)	(5)
Own * MHHID		-0.117**	-0.0918**	-0.178	-0.0823**
		(-2.057)	(-2.145)	(-1.525)	(-2.509)
Rival * MHHID		0.148**	0.106**	0.244*	0.108***
		(2.451)	(2.257)	(1.856)	(2.967)
MHHID		888.2***	99.80	467.1**	41.90
		(9.007)	(1.404)	(2.503)	(0.742)
Own * HHI	0.137***	0.0543	-0.0604	-0.132	-0.0477
	(4.473)	(1.117)	(-1.544)	(-1.214)	(-1.606)
Rival * HHI	-0.128***	-0.0322	0.0676	0.181	0.0677*
	(-3.345)	(-0.568)	(1.516)	(1.456)	(1.948)
HHI	-74.42	484.1***	-366.8***	-638.6***	-328.3***
	(-0.815)	(4.535)	(-4.830)	(-3.251)	(-5.438)
Own	0.226***	0.330***	0.230***	0.546***	0.183***
	(15.43)	(6.043)	(5.472)	(4.847)	(5.736)
Rival	0.325***	0.182***	-0.0183	-0.0755	-0.0283
	(18.65)	(3.089)	(-0.391)	(-0.581)	(-0.786)
Ceo			2,237***		
			(79.32)		
Log(Sales)			784.4***	1,817***	604.5***
			(44.56)	(42.23)	(44.84)
Volatility			3,733***	6,604***	2,955***
			(10.42)	(7.494)	(10.88)
Tenure			35.91***	-10.48	31.14***
			(9.613)	(-0.979)	(10.91)
Observations	192,110	192,110	183,133	33,053	150,080
R-squared	0.160	0.164	0.463	0.445	0.407
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

PANEL B					
Hypothesis test at the median (F(HHI)=0.5 and F(MHHID)=0.5)					
Inverse Comp. Ratio Test		0.242***	0.147***	0.306**	0.150***
P-Value		0.006	0.008	0.041	0.001

Table 9. Pay-performance regressions with alternative industry definitions.
This table shows robustness of the results from Table 8 across industry definitions. Column 1 is the reference specification (column 3 in Table 3). Column 2 refines the definition of the rival group as the size tertile within the 4-digit SIC code, as in Albuquerque (2009). Columns 3 and 4 use the alternative industry definition proposed by Hoberg and Phillips (2010) (HP) at the 400 level for the benchmark, and the size split specifications, respectively. Columns 5 and 6 present results at the more aggregated SIC3 and HP 300 levels. All specifications have industry and year fixed effects and a full set of controls. Panel B reports the inverse compensation ratio test as described in equation (20): S is the change in the ratio of rival-firm pay-performance sensitivity over own pay-performance sensitivity (i.e. $\frac{\beta}{\alpha}$) relative to the cdf of common ownership (MHHID). All standard errors are clustered at the firm level.

PANEL A	Dependent Variable: Top Management Pay					
	(1)	(2)	(3)	(4)	(5)	(6)
Own * MHHID	-0.0918**	-0.111***	-0.0978**	-0.153***	-0.0792**	-0.0800*
	(-2.145)	(-2.678)	(-2.140)	(-3.193)	(-2.066)	(-1.825)
Rival * MHHID	0.106**	0.0987**	0.0181	0.0778	0.0204	0.00341
	(2.257)	(2.346)	(0.324)	(1.413)	(0.446)	(0.0697)
MHHID	99.80	366.7***	432.4***	619.9***	201.0***	418.2***
	(1.404)	(5.676)	(5.791)	(9.431)	(3.070)	(5.870)
Own * HHI	-0.0604	-0.0889**	-0.0122	-0.0541	-0.0141	-0.0207
	(-1.544)	(-2.266)	(-0.337)	(-1.421)	(-0.400)	(-0.545)
Rival * HHI	0.0676	0.0687	0.00797	0.0575	-0.0249	0.00427
	(1.516)	(1.626)	(0.149)	(1.092)	(-0.545)	(0.0857)
HHI	-366.8***	-212.8***	146.9*	199.1***	-324.5***	46.76
	(-4.830)	(-3.175)	(1.895)	(2.980)	(-4.264)	(0.688)
Own	0.230***	0.262***	0.214***	0.276***	0.203***	0.205***
	(5.472)	(6.086)	(4.958)	(5.705)	(5.711)	(4.794)
Rival	-0.0183	-0.0336	0.116**	0.0399	0.0936**	0.118**
	(-0.391)	(-0.751)	(2.110)	(0.682)	(2.117)	(2.427)
Ceo	2,237***	2,236***	2,274***	2,275***	2,253***	2,271***
	(79.32)	(79.29)	(77.24)	(77.31)	(80.84)	(77.34)
Log(Sales)	784.4***	779.0***	779.7***	762.3***	771.3***	783.1***
	(44.56)	(43.62)	(44.16)	(41.62)	(45.17)	(44.26)
Volatility	3,733***	3,772***	3,691***	3,733***	3,690***	3,675***
	(10.42)	(10.52)	(10.44)	(10.51)	(10.72)	(10.55)
Tenure	35.91***	35.46***	32.87***	32.22***	35.09***	33.18***
	(9.613)	(9.535)	(8.789)	(8.663)	(9.725)	(8.918)
Observations	183,133	182,601	166,027	165,915	194,192	166,541
R-squared	0.463	0.464	0.458	0.459	0.463	0.458
Industry Def	SIC4	SIC4-Size	HP400	HP400-Size	SIC3	HP300
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

PANEL B						
Hypothesis test at the median (F(HHI)=0.5 and F(MHHID)=0.5)						
Inverse Comp. Ratio Test	0.147***	0.133***	0.978	0.173***	0.066	0.067
P-Value	0.008	0.003	0.172	0.005	0.238	0.305

Table 10. Pay-performance regressions with percentage changes (log specification) and firm-fixed effects.
This table presents specifications similar to those in Table 9, but in logs, and with firm-fixed effects. Standard errors are clustered at the firm level.

PANEL A	Dependent: Log(TDC1), Performance: returns (not profits)			
	SIC-4	SIC-4	Hoberg-Philips	Hoberg-Philips
Own * MHHID	-0.112**	-0.0874**	-0.114**	-0.0766**
	(-2.471)	(-2.558)	(-2.497)	(-2.226)
Rival * MHHID	0.0888*	0.0437	0.0207	0.0139
	(1.839)	(1.230)	(0.347)	(0.297)
MHHID	0.0392	0.0381**	0.187***	0.0698***
	(1.374)	(2.085)	(5.807)	(3.491)
Own * HHI	-0.106**	-0.0546*	-0.0467	-0.0624*
	(-2.525)	(-1.696)	(-1.097)	(-1.951)
Rival * HHI	0.0947**	0.0360	0.0780	0.0613
	(2.155)	(1.061)	(1.330)	(1.296)
HHI	-0.158***	-0.0186	0.0253	0.00829
	(-5.292)	(-0.774)	(0.760)	(0.391)
Own	0.284***	0.195***	0.268***	0.196***
	(7.004)	(6.337)	(6.292)	(6.174)
Rival	-0.103**	-0.0549	-0.0584	-0.0506
	(-2.327)	(-1.642)	(-1.013)	(-1.117)
Ceo	0.829***	0.377***	0.833***	0.374***
	(117.5)	(38.03)	(113.0)	(36.38)
Log(Sales)	0.412***	0.286***	0.410***	0.292***
	(75.31)	(24.89)	(71.14)	(23.43)
Volatility	1.233***	0.403***	1.220***	0.505***
	(8.383)	(2.926)	(8.180)	(3.451)
Tenure	0.0550***	0.0255***	0.0533***	0.0205**
	(9.899)	(3.176)	(9.353)	(2.480)
Observations	184,079	184,079	166,037	166,037
R-squared	0.514	0.166	0.502	0.139
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Executive-Firm FE	No	Yes	No	Yes

Table 11. Pay-performance regressions with alternative common ownership measure.

This table presents specifications similar to those in Table 9, whereas the common ownership measure varies. Instead of using actual market shares to compute the O'Brien and Salop (2000) MHHID, we use the ratio of one divided by the number of firms in the industry. Standard errors are clustered at the firm level.

	(1) SIC4-Size	(2) SIC4-Size	(3) SIC4-Size	(4) SIC4-Size	(5) HP4-Size	(6) HP4-Size	(7) HP4-Size	(8) HP4-Size
Own * MHHID	-0.125***	-0.0767**	-0.223**	-0.0596**	-0.110**	-0.106***	-0.197*	-0.0820**
	(-2.705)	(-2.109)	(-2.166)	(-2.115)	(-2.110)	(-2.579)	(-1.706)	(-2.564)
Rival * MHHID	0.137***	0.0912**	0.181*	0.0848***	0.109*	0.0543	0.248*	0.0651*
	(2.692)	(2.424)	(1.741)	(2.770)	(1.744)	(1.098)	(1.755)	(1.650)
MHHID	1,352***	394.9***	963.2***	297.8***	1,663***	424.3***	1,192***	318.3***
	(17.36)	(7.193)	(6.485)	(6.939)	(21.25)	(7.185)	(7.754)	(6.795)
Own * HHI	0.0427	-0.0471	-0.126	-0.0281	0.0721*	0.00549	0.0121	0.00235
	(1.260)	(-1.621)	(-1.539)	(-1.273)	(1.696)	(0.179)	(0.126)	(0.0951)
Rival * HHI	-0.0538	0.0392	0.127	0.0348	-0.117*	0.0176	-0.00861	0.0265
	(-1.239)	(1.190)	(1.404)	(1.334)	(-1.925)	(0.395)	(-0.0657)	(0.743)
HHI	306.4***	-313.2***	-729.9***	-263.3***	750.9***	-11.51	-48.74	-13.08
	(3.762)	(-5.451)	(-4.904)	(-5.772)	(8.766)	(-0.188)	(-0.297)	(-0.270)
Own	0.345***	0.222***	0.596***	0.166***	0.268***	0.214***	0.481***	0.163***
	(8.157)	(6.472)	(6.265)	(6.335)	(5.702)	(5.842)	(4.635)	(5.717)
Rival	0.153***	-0.0181	-0.0620	-0.0178	0.348***	0.0762	0.105	0.0472
	(3.143)	(-0.488)	(-0.613)	(-0.596)	(5.677)	(1.585)	(0.774)	(1.236)
Ceo		2,236***				2,275***		
		(79.29)				(77.29)		
Log(Sale)		779.2***	1,810***	600.3***		774.4***	1,815***	592.5***
		(44.28)	(42.15)	(44.69)		(42.77)	(41.24)	(42.86)
Volatility		3,759***	6,622***	2,981***		3,740***	6,573***	2,980***
		(10.45)	(7.481)	(10.93)		(10.48)	(7.450)	(10.99)
Tenure		35.44***	-11.29	30.76***		32.52***	-22.20**	30.26***
		(9.535)	(-1.057)	(10.86)		(8.717)	(-2.092)	(10.60)
Observations	191,557	182,601	32,952	149,649	165,915	165,915	29,986	135,929
R-squared	0.169	0.464	0.446	0.408	0.173	0.458	0.444	0.399
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

PANEL B

Hypothesis test at the median: F(HHI)=0.5 and F(MHHID)=0.5								
Inverse Comp Ratio	0.217***	0.114***	0.230**	0.105***	0.261***	0.127**	0.362**	0.127***
P-Value	0.001	0.004	0.033	0.002	0.010	0.029	0.029	0.008

Table 12. Wealth-performance sensitivities as a function of common ownership: IV, first-stage.
This table presents the first stage of the WPS IV analysis. Following the methodology in Anton and Polk (2014) we predict the values for MHHID with the ratio of common ownership that comes from scandalous funds with respect to total common ownership as of September 2003. Columns 1 and 2 correspond to SIC4 and columns 3 and 4 to Hoberg and Phillips (2010) (HP 400 level) industry definitions, respectively. We include all controls present in the second stage. All standard errors are clustered at the firm level.

VARIABLES	(1) MHHID	(2) MHHID	(3) MHHID	(4) MHHID
Ratio	0.0481**	0.284*	0.117***	0.129
	(2.053)	(1.817)	(4.330)	(0.783)
MHHID03	0.618***	0.925***	0.664***	0.498***
	(36.31)	(19.14)	(48.24)	(7.433)
HHI	-0.269***	-0.466***	-0.219***	-0.260***
	(-16.49)	(-5.297)	(-17.81)	(-5.302)
vol	-0.100	-0.389	0.0434	-0.727***
	(-1.557)	(-1.418)	(0.890)	(-3.509)
log_mef	0.00488**	0.0690***	0.00647***	0.0101
	(2.204)	(3.915)	(3.814)	(0.917)
leverage	0.0250*	-0.0432	0.000327	-9.58e-05
	(1.772)	(-0.742)	(0.0305)	(-0.00211)
log_tenure	0.00119	0.0128	0.00209	0.0122*
	(0.253)	(1.205)	(0.585)	(1.707)
Observations	3,132	3,132	3,299	3,299
R-squared	0.675	0.156	0.747	0.240
Industry Def	sich_crsp4	sich_crsp4	icode40004	icode40004
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
FirmFE	No	Yes	No	Yes
Number of gvkey		1,687		1,781

Table 13. Wealth-performance sensitivities as a function of common ownership: IV, second-stage.
This table uses the fitted values for MHHID from the previous table to estimate the impact of the 2003 mutual fund scandal on the Edmans, Gabaix and Landier (2009) EGL measure of wealth performance sensitivity. All standard errors are clustered at the firm level.

VARIABLES	(1) EGL	(2) EGL	(3) EGL	(4) EGL
MHHID	-0.839***	-0.504**	-0.745***	-0.858
	(-2.831)	(-2.190)	(-3.075)	(-1.417)
HHI	-0.464**	-0.610	-0.170	-0.435
	(-2.062)	(-1.467)	(-0.903)	(-1.394)
vol	0.545	-4.189***	0.597	-3.685**
	(0.834)	(-2.842)	(0.950)	(-2.470)
log_mef	0.166***	0.489***	0.157***	0.457***
	(6.497)	(5.397)	(6.261)	(5.272)
leverage	-0.455**	0.526	-0.466***	0.465
	(-2.419)	(0.992)	(-2.661)	(0.921)
log_tenure	0.773***	1.042***	0.768***	1.057***
	(16.14)	(10.98)	(16.49)	(11.04)
Observations	3,098	3,098	3,266	3,266
R-squared	0.199		0.199	
Industry Def	sich_crsp4	sich_crsp4	icode40004	icode40004
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Firm FE	No	Yes	No	Yes
Number of gvkey		1,677		1,770

Table 14. Panel A. Panel-IV: First stage regressions.

This table presents the first stage of the RPE IV analysis. Following the methodology in Anton and Polk (2014) we predict the values for MHHID and the interactions of MHHID with Own and Rival profits with the ratio of common ownership that comes from scandalous fund with respect to total common ownership as of September 2003 interacted with the respective profit measure. Columns 1 to 3 correspond to SIC4 and columns 4 to 6 to Hoberg and Phillips (2010) (HP) industry definitions, respectively. We include all controls present in the second stage. All standard errors are clustered at the firm level.

Dep. Variables	(1) MHHID	(2) Own*MHHID	(3) Rival*MHHID	(4) MHHID	(5) Own*MHHID	(6) Rival*MHHID
ScandalRatio	-0.0618***	15.56	-10.17	0.237***	-26.98*	0.366
	(-8.263)	(1.131)	(-0.790)	-21.2	(-1.731)	(0.0271)
MHHID03	0.407***	-47.19***	-43.30***	0.489***	-38.96***	-32.29***
	(73.50)	(-4.633)	(-4.542)	(93.76)	(-5.354)	(-5.119)
Own * ScandalRatio	1.87e-05***	-0.0200**	0.0806***	-4.74e-05***	-0.0666***	-0.0539***
	(3.879)	(-2.254)	(9.715)	(-5.468)	(-5.502)	(-5.146)
Own * MHHID03	8.88e-07	0.478***	0.0438***	-5.97e-06	0.574***	0.00778
	(0.258)	(75.46)	(7.382)	(-1.488)	(102.7)	(1.606)
Rival * ScandalRatio	5.08e-06	0.0787***	-0.0279***	-4.47e-05***	-0.0260*	-0.0201
	(0.948)	(7.987)	(-3.024)	(-4.237)	(-1.766)	(-1.574)
Rival * MHHID03	3.76e-06	0.0298***	0.443***	-1.91e-05***	-0.00707	0.516***
	(1.004)	(4.315)	(68.69)	(-3.943)	(-1.045)	(88.07)
Own * HHI	-5.68e-06*	-0.364***	0.0645***	8.49e-06***	-0.265***	0.0636***
	(-1.825)	(-63.65)	(12.04)	(2.576)	(-57.56)	(15.97)
Rival * HHI	1.49e-05***	0.0706***	-0.381***	-1.80e-05***	0.0405***	-0.363***
	(4.253)	(10.93)	(-63.11)	(-4.256)	(6.852)	(-70.91)
HHI	-0.435***	-58.99***	-21.93**	-0.348***	-35.36***	-20.01***
	(-82.70)	(-6.099)	(-2.422)	(-71.81)	(-5.239)	(-3.421)
Own	-2.00e-06	0.511***	-0.0617***	1.06e-05**	0.477***	-0.0164***
	(-0.539)	(75.00)	(-9.676)	(2.337)	(75.25)	(-2.980)
Rival	-8.42e-06**	-0.0505***	0.548***	2.84e-05***	-0.00925	0.539***
	(-2.036)	(-6.644)	(77.01)	(5.152)	(-1.202)	(80.76)
CEO	0.00134	1.395	0.214	-0.00225	-2.958	-1.279
	(0.510)	(0.289)	(0.0474)	(-0.942)	(-0.888)	(-0.443)
Log(Sales)	0.0212***	8.858***	8.523***	0.0266***	6.059***	3.138***
	(24.99)	(5.692)	(5.850)	(32.22)	(5.264)	(3.145)
Volatility	-0.161***	127.7***	101.2***	0.00686	-56.83**	26.83
	(-8.392)	(3.620)	(3.064)	(0.393)	(-2.334)	(1.271)
Tenure	-0.000178	-0.117	0.0754	0.000940***	0.888***	0.724**
	(-0.671)	(-0.240)	(0.165)	(3.889)	(2.632)	(2.476)
Observations	26,976	26,976	26,976	29,098	29,098	29,098
R-squared	0.654	0.959	0.954	0.652	0.981	0.977
Industry Def	SIC4-Size	SIC4-Size	SIC4-Size	HP400-Size	HP400-Size	HP400-Size
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes

Table 14. Panel B. Panel-IV: Underidentification and weak instrument tests.

This table shows results of tests for underidentification and weak identification for each endogenous regressor separately, using the method of Sanderson and Windmeijer (2016). We also report the Kleibergen and Paap (2006) Wald test for the full model. First-stage test statistics are cluster-robust.

	Underidentification		Weak Instr.)
Variable	SW Chi-Sq (4)	P-val	SW F(4, 1872)
MHHID	583.78	0.000	145.43
MHHID * Own	156.85	0.000	39.08
MHHID * Rival	120.54	0.000	30.03

Table 15. Panel-IV: Second stage regressions.

This table uses the fitted values for MHHID and their interactions with Own and Rival profits from the previous table to estimate the impact of the 2003 mutual fund scandal on total compensation. Rivals are defined both with the four-digit CRSP SIC code (columns 1 and 2) and Hoberg and Phillips (2010) (HP) 400 index (columns 3 and 4), respectively. The result of interest is reported in Panel B: the inverse compensation ratio as described in equation (20). S is the change in the ratio of rival-firm pay-performance sensitivity over own pay-performance sensitivity (i.e. $\frac{\beta}{\alpha}$) relative to the cdf of common ownership (MHHID). All standard errors are clustered at the firm level.

PANEL A	Dependent Variable: Top Management Pay			
	(1)	(2)	(3)	(4)
Own * MHHID	-0.427**	-0.336**	-0.178	-0.232
	(-2.158)	(-2.126)	(-0.980)	(-1.576)
Rival * MHHID	0.339	0.268	0.553*	0.416*
	(1.356)	(1.346)	(1.836)	(1.853)
MHHID	1,140***	874.5***	897.2***	829.5***
	(3.878)	(3.720)	(3.644)	(4.189)
Own * HHI	-0.244	-0.181	-0.0955	-0.132
	(-1.592)	(-1.451)	(-0.658)	(-1.202)
Rival * HHI	0.153	0.132	0.324	0.271
	(0.762)	(0.835)	(1.350)	(1.509)
HHI	416.8**	308.3*	591.0***	525.8***
	(1.998)	(1.837)	(3.554)	(3.962)
Own	0.582***	0.452***	0.331*	0.354**
	(3.001)	(2.900)	(1.711)	(2.283)
Rival	-0.155	-0.129	-0.320	-0.235
	(-0.617)	(-0.643)	(-0.991)	(-0.979)
Ceo	2,362***		2,402***	
	(52.63)		(55.12)	
Log(Sales)	762.1***	590.6***	717.4***	543.9***
	(26.80)	(26.13)	(23.86)	(23.03)
Volatility	3,939***	3,110***	3,641***	2,882***
	(8.205)	(7.970)	(7.424)	(7.200)
Tenure	28.24***	29.64***	27.94***	30.23***
	(4.976)	(6.634)	(5.163)	(7.076)
Observations	24,989	20,416	26,937	22,001
R-squared	0.511	0.461	0.513	0.461
Industry Def	SIC4-Size	SIC4-Size	HP400-Size	HP400-Size
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes

PANEL B				
Hypothesis test at the median (F(HHI)=0.5 and F(MHHID)=0.5)				
Inverse Comp. Ratio Test	0.497**	0.392**	0.661**	0.561***
P-Value	0.044	0.044	0.023	0.005

Internet Appendix A: Additional Theoretical Results

A Common Ownership and Relative Performance Evaluation

The following stylized model of product market competition and common ownership analyzes the impact on relative performance evaluation building on the setup of Aggarwal and Samwick (1999a). The main difference is that we extend their model to allow for common ownership.

A1 Setup

A1.1 Product Market Competition

Two firms are labeled 1 and 2. The model has two stages. At stage 1, the owners (she) of the firms write contracts with the managers (he). At stage 2, the managers engage in differentiated Cournot (Bertrand) competition. We assume that a manager's action choice at stage 2 is noncontractible. However, profits are contractible. The two firms face symmetric inverse demand functions given by

$$P_i(q_i, q_j) = A - bq_i - aq_j, \tag{21}$$

where $i, j \in 1, 2$ and $b > a > 0$. Thus, the manager's action choice has a greater impact on the demand for his own product than does his rival's action.[21]

The firms have symmetric marginal costs c. The profits of firm i are therefore given by

$$\pi_i = q_i(A - bq_i - aq_j - c). \tag{22}$$

[21] Although we assume linear demands and two firms, the results of our model generalize to nonlinear demand functions and industries with more than two firms.

A1.2 Managers

The following linear contract is offered to the manager of firm i:

$$w_i = k_i + \alpha_i \pi_i + \beta_i \pi_j. \tag{23}$$

In this setup, α_i is the incentive slope on own firm profits, β_i is the incentive slope on rival firm profits (RPE), and k_i is the fixed payment used to satisfy the individual rationality constraint which is pinned down by the manager's outside option $w_i^{'}$. Two risk-neutral managers, 1 and 2, set the quantity (price) for their respective firm in accordance with the incentives given by their contracts.

Thus, each manager i sets quantity (price) to maximize one of the following two objective functions:

$$\max_{q_i} \alpha_i (q_i - c)(A - bq_i - aq_j) + \beta_i (q_j - c)(A - bq_j - aq_i) \tag{24}$$

$$\max_{p_i} \alpha_i (p_i - c)(B - dp_i + ep_j) + \beta_i (p_j - c)(A - dp_j + ep_i), \tag{25}$$

where the coefficients for Bertrand competition are

$$B = \frac{A}{b+a}, \quad d = \frac{b}{(b+a)(b-a)}, \quad e = \frac{a}{(b+a)(b-a)}. \tag{26}$$

The managers' reaction functions for Cournot (Bertrand) competition are given by

$$R_i^{'}(q_j) = \frac{A-c}{2b} + \frac{aq_j(\alpha_i + \beta_i)}{2\alpha_i b} \tag{27}$$

$$R_i^{'}(p_j) = \frac{B + dc + ep_j}{2b} + \frac{\beta_i e(p_j - c)}{2\alpha_i d}, \tag{28}$$

and hence the optimal quantity (price) choices are

$$q_i^* = \frac{\alpha_j(A-c)(\alpha_i a - 2\alpha_i b + \beta_i a)}{-4\alpha_j b^2\alpha_i + \alpha_i a^2\beta_j + \alpha_i a^2\alpha_j + \beta_i a^2\beta_j + \beta_i a^2\alpha_j} \tag{29}$$

$$p_i^* = \frac{-\alpha_j B(\alpha_i a + 2d\alpha_i + \beta_i e) - \alpha_j dc(2d\alpha_i + \alpha_i e - \beta_i e) + e^2 c\beta_j(\alpha_i + \beta_i)}{-4\alpha_i d^2\alpha_j + \alpha_i e^2\alpha_j + \alpha_i e^2\beta_j + \beta_i e^2\alpha_j + \beta_i e^2\beta_j}. \tag{30}$$

First, note that if $\beta_1 = \beta_2 = 0$, we obtain the standard differentiated Cournot (Bertrand) equilibrium for any $\alpha_i > 0$. This is because without any RPE each manager just maximizes his own firm's profits the way an undiversified owner-manager would. Second, for the manager's action choice, only the relative magnitude (or "compensation ratio") of α_i and β_i matters because no effort incentive problem exists and the base pay k_i perfectly offsets any profit-based payments. Thus, a continuum of optimal contracts exists for each firm's manager which is only pinned down by the ratio $\frac{\alpha_i}{\beta_i}$. In this model, RPE exists purely for strategic reasons. RPE produces no gain due to better signal extraction from correlated noise shocks because no hidden action problem and risk aversion exist. In a previous version of the present paper we also extended our model to allow for RPE due to managerial risk aversion. Finally, w_i is irrelevant in the maximization problem stated here because without risk aversion and a binding individual rationality constraint, no welfare loss results from imposing risk on the agent.

A1.3 Owners

There are two owners, A and B. To simplify the exposition, we assume that they are symmetric such that A owns a share $x \geq 1/2$ of firm 1 and $1-x$ of firm 2 and B owns $1-x$ of firm 1 and x of firm 2. Given the symmetric ownership shares $1-x$ measures the degree of common ownership in the industry. Each majority owner sets an incentive contract (k_i, α_i, β_i) for her manager i such that it maximizes the profit shares of the owner at both firms.[22] The optimal incentive contract for manager i should internalize the effect on profits of firm j to the extent that the majority owner

[22]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.

of firm i also owns shares of firm j. Hence, the relevant maximization problem for the majority owner of firm i is

$$\max_{k_i, \alpha_i, \beta_i} x(\pi_i - w_i) + (1-x)(\pi_j - w_j) \tag{31}$$

$$\text{subject to} \quad w_i \geq w_i^{'} \quad \text{and} \quad q_i^* \in \arg\max_{q_i} w_i \quad \text{or} \quad p_i^* \in \arg\max_{p_i} w_i. \tag{32}$$

A2 Results

The optimal incentives as a function of product market conditions and ownership for a symmetric equilibrium are given by

$$\text{Cournot:} \quad \beta^* = \frac{-a + 2(a+b)x - \sqrt{a^2 + 4b^2x^2 + 4ab(-2+3x)}}{2a(1-x)}\alpha^* \tag{33}$$

$$\text{Bertrand:} \quad \beta^* = \frac{-e - 2(d-e)x + \sqrt{e^2 + 4ed(2-3x) + 4d^2x^2}}{2e(1-x)}\alpha^*. \tag{34}$$

The following proposition establishes the theoretical result regarding relative performance evaluation.

Proposition 2. *Under both forms of competition, the optimal inverse compensation ratio* $\frac{\beta^*}{\alpha^*}$ *is increasing in* $1-x$ *for* $1/2 \leq x \leq 1$.

The intuition for this result is straightforward. As $1-x$ increases, that is, as common ownership increases, each owner cares relatively more about the profits of the other firm in the industry. Thus, each owner would prefer softer competition between the two firms that she owns. As a result, she sets incentives for the manager of her majority-owned firm to induce less competitive strategic behavior. She does so by increasing β_i or decreasing α_i. Note further that the value of x has no impact on the product market shares and the HHI because the underlying cost and demand structures remain unchanged. However, common ownership changes with the value x and it attains its maximum at $x = 1/2$. Accordingly, in our empirical tests, we will hold market shares constant and vary only the degree of common ownership.

Finally, it is important to emphasize that this result unambiguously holds independent of the form of competition which tends to be the exception in models of strategic product market interaction.[23] Regardless of whether the action variable has strategic substitutability or complementarity (i.e., the two firms are not completely separate monopolists, $a > 0$) common ownership always increases the inverse compensation ratio.

B Moral Hazard, Risk Aversion, and Multi-tasking

The following model extension illustrates the robustness of the result on relative performance evaluation. Consider the following multi-tasking moral hazard model. Two firms, each employing a risk-averse manager with exponential utility and a reservation wage of 0 who receives a linear compensation scheme given by

$$w_i = k_i + \alpha_i \pi_i + \beta_i \pi_j, \tag{35}$$

where the profits of firm i are given by

$$\pi_i = e_{1,i} + h e_{2,j} + \nu, \tag{36}$$

and where ν is a common shock that is normally distributed with mean 0 and variance σ^2.

Each manager i can exert two types of effort: productive effort $e_{1,i}$ which increases own firm profits, or competitive effort $e_{2,i}$ which influences the rival firm's profits. The impact of competitive effort can either be positive or negative depending on the sign of h. If $h = 0$, the two firms are essentially two separate monopolists. Thus, competitive effort $e_{2,i}$ can be thought of as a reduced-form way of modeling competitive product market interaction between the two firms. Note that competitive effort $e_{2,i}$ can take both positive and negative values. For simplicity, we assume that

[23] For example, Aggarwal and Samwick (1999a) show that the predicted effect on executive compensation of their main variable of interest switches signs when competition changes from Cournot to Bertrand.

the cost for both types of effort is quadratic.

There are two owners, A and B. As before, we assume that they are symmetric such that A owns a share $x \geq 1/2$ of firm 1 and $1-x$ of firm 2, and B owns $1-x$ of firm 1 and x of firm 2. Each majority owner sets an incentive contract (k_i, α_i, β_i) for her manager i such that it maximizes the profit shares of the owner at both firms subject to individual rationality and incentive compatibility constraints.

The incentive compatibility constraints resulting from the agent i's wage bill given by equation (35) yield the optimal effort levels for both types of effort:

$$e_{1,i} = \alpha_i \quad \text{and} \quad e_{2,i} = h\beta_i. \tag{37}$$

We can rewrite the manager's utility in terms of his certainty equivalent. After substituting for the binding individual rationality and the two incentive compatibility constraints in (37), the maximization problem of the majority owner of firm i becomes

$$\begin{aligned} \max_{\alpha_i, \beta_i} \quad & x[\alpha_i + h\alpha_j - \frac{1}{2}\alpha_i^2 - \frac{1}{2}(h\beta_i)^2 - \frac{r}{2}(\alpha_i + \beta_i)^2\sigma^2] \\ +(1-x)&[\alpha_j + h\alpha_i - \frac{1}{2}\alpha_j^2 - \frac{1}{2}(h\beta_j)^2 - \frac{r}{2}(\alpha_j + \beta_j)^2\sigma^2]. \end{aligned} \tag{38}$$

Thus, the first order conditions for α_i and β_i are given by

$$1 - \alpha_i - r\sigma^2(\alpha_i + \beta_i)^2 = 0 \tag{39}$$

$$x(-h^2\beta_i^2 - r\sigma^2(\alpha_i + \beta_i)^2) + xh^2 = 0. \tag{40}$$

Because the two firms are symmetric we can drop the i subscript. Solving this system of equations yields the optimal incentive slopes:

$$\alpha^* = 1 - \frac{1}{x}\frac{h^2 r\sigma^2}{h^2 r\sigma^2 + h^2 + r\sigma^2} \tag{41}$$

$$\beta^* = -1 + \frac{1}{x}\frac{h^2 r\sigma^2 + h^2}{h^2 r\sigma^2 + h^2 + r\sigma^2}. \tag{42}$$

It is straightforward to show that $0 < \alpha^* < 1$ and $\alpha^* > \beta^*$. Furthermore, in terms of absolute value, the incentives on own profits are always stronger than on rival profits; that is, $\alpha^* > |\beta^*|$. Most importantly, this model also yields our main prediction that the own-profit incentive slope α^* is decreasing while the rival-profit incentive slope β^* is increasing in the degree of common ownership $1 - x$.

Proposition 3. *The optimal incentive slope on own profits α^* is decreasing and the optimal incentive slope on rival profits β^* is increasing in $1 - x$ for $1/2 \leq x \leq 1$.*

In addition, the model has all the natural features of moral hazard with linear contracts. The optimal incentive slope for α^* is distorted away from the first-best of 1 because of two factors: the manager's risk aversion r and the impact of competitive effort on the other firm h. When the manager has no influence on the profits of the other firm ($h = 0$), the first best ($\alpha^* = 1$) can be achieved through a strong RPE by setting $\beta^* = -1$, thereby completely filtering out all noise ν in the firm's profits. The higher the impact on the other firm h, the degree of risk aversion r, and the variance σ^2, the more strongly the two incentive slopes are distorted away from the first best.

The model also allows us to analytically solve for the optimal level of base pay k^* by substituting the agent's equilibrium competitive efforts into the binding IR constraint of the manager. In particular, the optimal k^* is given by

$$k^* = \frac{1}{2}(\alpha^*)^2 + \frac{1}{2}h^2(\beta^*)^2 + \frac{1}{2}r\sigma^2(\alpha^* + \beta^*)^2 - (\alpha^* + \beta*)(\alpha^* + h^2\beta^*). \tag{43}$$

Substituting the optimal values of α^* and β^* and differentiating with respect to x yields the following predicted effect of common ownership on managerial base pay.

Proposition 4. *The optimal base pay k^* is increasing in $1 - x$ for $1/2 \leq x \leq 1$ if $|h|$ and r are sufficiently large.*

In other words, unconditional base pay increases in the degree of common ownership. The owner trades off two conflicting aims of RPE: providing risk insurance from the common shock to the manager and incentivizing managerial choices that affect the rival firm. If the manager has no influence on the profits of the other firm (e.g., $h = 0$), then the second consideration is absent. Hence, it is always optimal for the owner to use strong RPE by setting $\beta^* = -\alpha^*$, thereby completely filtering out all the common noise in the firm's profits and providing perfect insurance to the manager. However, if the manager's actions also affect the rival firm, it will no longer be optimal to set $\beta^* = -\alpha^*$ because doing so would lead to excessively competitive behavior on behalf of the manager. But this incomplete filtering of common noise now exposes the risk-averse manager to some compensation risk. Given that the manager is risk-averse, meeting his outside option now requires paying a higher base wage k^*.

Finally, note that the model also predicts that the equilibrium incentive slope on rival-firm profits β^* can be positive for sufficiently high levels of common ownership. In particular, $\beta^* > 0$ if and only if $x < \frac{h^2 r\sigma^2 + h^2}{h^2 r\sigma^2 + h^2 + r\sigma^2}$.