

# Online Appendix: Not for Publication

## A Omitted Proofs

### A.1 Symmetric Owners

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

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

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

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

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

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

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

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

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

and hence

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

$$\begin{aligned}\kappa &= \frac{2b^2 - (n-1)a^2 - (n-2)ab}{(n-1)ab} + \frac{r\sigma^2 \alpha^* + by^* \alpha^* \frac{1}{\chi}}{\sum_{j \neq i} \left[ -\frac{1}{\chi} \frac{2ab^2}{(2b+a)[2b-(n-1)a]} y^* + \frac{(\alpha^*)^2}{2\chi^2} \frac{ab^2}{(2b+a)[2b-(n-1)a]} \right]} \\ &= M_1 + M_2 M_3 (\alpha^*)\end{aligned}$$

where

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

and

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

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

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

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

discriminant  $\Delta$  of this quadratic function is given by

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

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

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

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

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

$$M_1 + M_2M_3 = 1$$

which reduces to

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

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

Second, we have

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

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

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

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

## A.2 Multiproduct Firms and Asymmetric Owners

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

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

where

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

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

Owner 1 solves

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

The first order condition is given by

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

Owner 2 solves

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

The first order condition is

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

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

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

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

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

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

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

where the difference of the two equations gives:

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

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

**Variant 1:**

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

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

**Variant 2:**

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

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

$$+ \kappa k_2^2 \alpha_1 - (4k_1 + 2\kappa k_2)\left( \frac{k_2}{2}\alpha_1 + k_3 \right) = 0$$

Several observations follow from these two variants.

1. Since the LHS of both equations in Variant 1 are positive, it follows that  $\alpha_1 < 2k_1$  and  $\alpha_2 < 2k_1 + \kappa k_2$ .
2. In the first (second) equation of Variant 1,  $\alpha_2$  ( $\alpha_1$ ) can be explicitly written as a function of  $\alpha_1$  ( $\alpha_2$ ). So, we could represent the first equation by Curve 1 and the second equation by Curve 2.
3. According to Variant 2, both curves cross  $\alpha_1 = \alpha_2$  once in the northeast quadrant. Denote the first intersection as  $\alpha^*$  and the second as  $\alpha^{**}$ . Then the following relationship holds:  $0 < \alpha^{**} < \alpha^* < 2k_1$ .

*Proof.* The intersections satisfy

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

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

or equivalently

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

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

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

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

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

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

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

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

1. Curve 1 crosses the  $\alpha_2$ -axis at  $(0, -\frac{k_3}{k_2})$  where  $-\frac{k_3}{k_2} > 2k_1$ .
2. On Curve 1, as  $\alpha_1$  approaches  $2k_1$  from the left,  $\alpha_2 \rightarrow -\infty$ .

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<sup>31</sup>Note that the second condition implies the first.

3. The function represented by Curve 1 either first increases and then decreases in  $\alpha_1$  over  $(0, 2k_1)$ , or it is always decreasing in  $\alpha_1$  over  $(0, 2k_1)$ . This can be shown by taking derivatives, and is omitted here.
4. Curve 2 crosses the  $\alpha_1$ -axis at  $(-\frac{k_3(4k_1+2\kappa k_2)}{2k_1k_2}, 0)$ , where  $-\frac{k_3(4k_1+2\kappa k_2)}{2k_1k_2} > 2k_1$ .
- (i) First, given  $k_3 > -2k_1k_2$ , we show the existence of a solution such that  $\alpha_1 > \alpha_2 > 0$ .

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

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

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

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

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

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

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

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

*Proof.* Suppose, to the contrary, there are two solutions satisfying  $\alpha_1 > \alpha_2 > 0$ . Let the first solution be  $(\bar{\alpha}_1, \bar{\alpha}_2)$  and the second be  $(\underline{\alpha}_1, \underline{\alpha}_2)$ . Without loss of generality,  $\bar{\alpha}_1 > \underline{\alpha}_1$ . Since

both of them need to satisfy equation (A.2), denote

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

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

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

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

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

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

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

condition of Owner 2 can be expressed as

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

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

### A.3 Strategic Substitutes

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

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

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

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

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

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

and that of the quantity specialist is given by

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

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

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

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

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

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

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

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

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

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

## B Theoretical Extensions and Discussion

### B.1 Form of Strategic Interaction

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

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

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

## B.2 Alternative Organizational and Contracting Assumptions

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

### B.2.1 Direct Investor Control of Prices

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

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

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

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

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

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

As before, the IC constraint of the top manager yields  $e_i = \frac{\alpha_i}{\chi}$ . Substituting the IR and IC

constraints into the objective function we obtain

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

where

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

Partially differentiating  $\phi_i$  with respect to  $\alpha_i$  yields

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

which can be rewritten as

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

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

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

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

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

The functional form of our cost-of-effort function (given by  $\frac{\chi}{2} q_i e_i^2$ ) ensures that the manager's effort choice  $e_i$  is always equal to  $\frac{\alpha_i}{\chi}$ . Because the optimal incentives for the pricing specialists

perfectly align the interests of pricing specialists and owners, there is no longer any need to inefficiently distort the managerial effort choice  $e_i$  downwards to indirectly raise prices  $p_{i,l}$ .

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

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

### B.2.2 Centralized Pricing Decisions by Top Managers

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

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

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

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

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

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

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

functions

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

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

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

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

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

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

risk aversion or low profit shock variance, the first effect is larger than the second and common ownership increases markups.

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

### B.2.3 Relative Performance Evaluation for Top Managers

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

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

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

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

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

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

The proof (and intuition) for this result is a straightforward application of the informativeness principle (Holmstrom, 1979). First, because pricing specialists rather than top managers control product market prices  $p_{i,l}$  in our model, a common owner can only indirectly affect  $p_{i,l}$  through

changing the manager's incentive slopes  $\alpha_i$  and  $\omega_{ij}$ . Second, the weights  $\omega_{ij}$  do not affect the top manager's effort  $e_i$  which is equal to  $\alpha_i$  because  $e_i$  only changes  $c_i$ , but does not directly affect  $\pi_j$ ,<sup>32</sup> and the pricing specialists choose price simultaneously with the top manager. However, the weights  $\omega_{ij}$  impose additional wage risk on the manager equal to  $\frac{r}{2}\omega_{ij}^2\sigma^2$ . Finally, except for the additive noise terms, the product market competition game between firms is deterministic. Therefore, despite the strategic interactions between firms, observing  $\pi_j$  in addition to  $\pi_i$  does not provide any additional information about managerial effort  $e_i$  to the principal. As a result, the optimal managerial incentive schemes set  $\omega_{ij}^* = 0$  for all  $ij$  firm pairs and are therefore identical to those obtained in Proposition 1 and 2. Thus, our model shows that common ownership does not necessarily provide a rationale for the limited use of relative performance evaluation observed in practice (Oyer, 2004; Jenter and Kanaan, 2015).

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

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

where the variance of the wage is equal to

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

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

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

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

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<sup>32</sup>This is in contrast to the prices  $p_{i,l}$  which are chosen at the same time as  $e_i$  but which do directly affect  $\pi_j$ .

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

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

The optimal incentive weights  $\omega_{ij}^*$  for firm  $i$  are therefore given by

$$\vec{\omega}_i = \hat{\rho}_i^{-1} \vec{v}_i \alpha_i. \quad (21)$$

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

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

[Antón et al. \(2016\)](#) and [Liang \(2016\)](#) empirically document that a specific industry-level measure of common ownership, namely MHHID, is negatively related to the strength of managerial relative pay-for-performance sensitivity, whereas [Kwon \(2016\)](#) offers contradictory evidence. The approach of these papers is problematic for two reasons. First, they focus on pay-for-performance sensitivity, but [Edmans et al. \(2017\)](#) argue that “any empirical measure of executive incentives

must take into account the incentives provided by changes in the value of the executive’s equity holdings—i.e., measure wealth-performance sensitivities, rather than pay-performance sensitivities” and that “focusing only on changes in salary, bonuses, and new equity grants misses the majority of incentives.” Second, [Backus et al. \(2021b\)](#) and [Backus et al. \(2021a\)](#) show theoretically and empirically that MHHID is a flawed industry-level measure of common ownership. Instead, they propose the use of firm-level profit weights (“kappas”) which we employ as our primary measure of common ownership.

#### B.2.4 Managerial Rents under Weak Governance

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

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

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

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

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

### B.3 Welfare under Direct and Indirect Investor Control

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

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

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

yielding the equilibrium outcomes

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

where

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

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<sup>33</sup>We are particularly grateful to Meg Meyer for detailed suggestions and comments on this section.

### B.3.1 Direct Investor Control

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

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

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

$$\begin{aligned}\frac{\partial\phi_i}{\partial p_i} &= A - 2bp_i + a \sum_{j \neq i} p_j + b(\bar{c} - e_i) + \kappa a \sum_{j \neq i} (p_j - \bar{c} + e_j) \\ \frac{d\phi_i}{de_i} &= \frac{\partial\pi_i}{\partial e_i} = q_i - \chi e_i\end{aligned}$$

and yield the equilibrium outcomes

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

### B.3.2 Indirect Investor Control

To mirror the decision structure of our model, assume now that investors set  $e_i$  to maximize  $\phi_i$ , but the pricing specialists set  $p_i$  to maximize  $\pi_i$ . The first order conditions of this indirect

control case (denoted by  $\phi\pi$ ) are

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

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

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

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

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

Thus, we have

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

which yields

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

Finally, we obtain

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

where

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

### B.3.3 Comparison

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

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

## B.4 Timing and Observability

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

### B.4.1 Timing of Pricing Decisions

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

stemming from the impact of  $e_i$  on  $\pi_i$  via the change in  $p_i$  is 0.

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

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

#### B.4.2 Observability of Managerial Contracts

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

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

## B.5 Vertical Relationships

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

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

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

## B.6 Endogenous Market Shares

The endogeneity of market shares is an important feature of our theoretical framework. As we will show, not only does it provide a causal interpretation for previous empirical findings, but it also identifies shortcomings in the interpretation of existing empirical work. In our model, the

only cause of market-level variation in prices, output, market shares, and concentration is the firm-level variation in common ownership.

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

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

## B.7 Product Market Differentiation

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

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

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

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

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

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

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

## B.8 Product Market Concentration

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

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

## C Additional Empirical Results

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

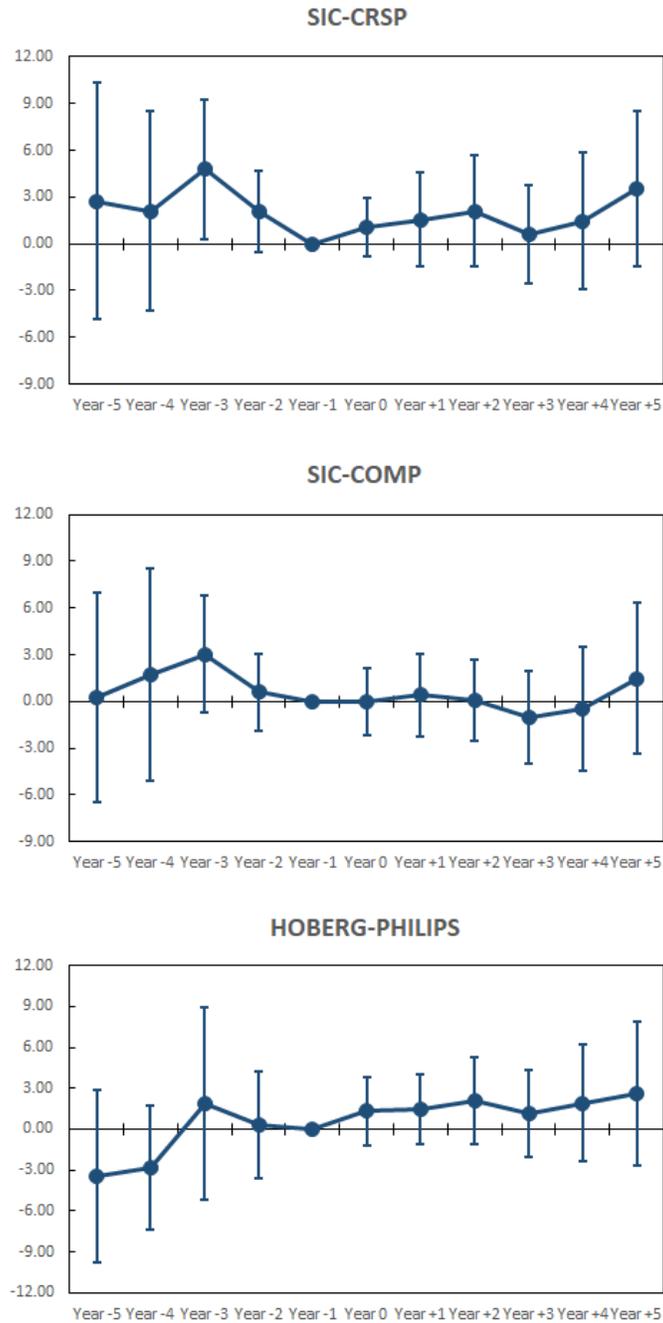
**Table C10.** Change in common ownership following index addition of a competitor.

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

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

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



**Figure C1. Estimated coefficients of S&P500 inclusions (rather than competitor index inclusions) on WPS.**

The graph plots the estimated coefficient on year fixed effects in the regression on WPS. We drop the year previous to the inclusion, and thus the effect is normalized to zero for that year. We control for volatility, natural log of market equity, leverage, HHI, and natural log of tenure, each evaluated in the year previous to the inclusion, and interacted with year fixed effects. We also include firm and year fixed effects, and double-cluster standard errors at the firm and year levels.