Appendices

Innovation: The Bright Side of Common Ownership?

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A Proofs and Additional Theoretical Results

A.1 Strategic Substitutes

We can rewrite the system of first order conditions given in equations (6) and (7) in the following way

$$(\mathbf{a} + \mathbf{K} \circ \mathbf{a}')\, \mathbf{q} = (A - \bar{c}) \cdot \mathbf{1} + \mathbf{B}\mathbf{x}$$
$$(\mathbf{K} \circ \mathbf{B}')\, \mathbf{q} = \gamma \mathbf{x}$$

where $\circ$ is the Hadamard (element-by-element) product, $\mathbf{1}$ is an $n \times 1$ vector of ones, $\mathbf{a}$ is the product similarity matrix, $\mathbf{B}$ is the technology spillover matrix, and $\mathbf{K}$ is the common ownership matrix. The matrices $\mathbf{a}$, $\mathbf{B}$, and $\mathbf{K}$ are defined as follows:

$$\mathbf{a} = \begin{bmatrix} 1 & a_{12} & \cdots & a_{1n} \\ a_{21} & 1 & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{n1} & a_{n2} & \cdots & 1 \end{bmatrix}, \quad \mathbf{B} = \begin{bmatrix} 1 & \beta_{12} & \cdots & \beta_{1n} \\ \beta_{21} & 1 & \cdots & \beta_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \beta_{n1} & \beta_{n2} & \cdots & 1 \end{bmatrix}, \quad \mathbf{K} = \begin{bmatrix} 1 & \kappa_{12} & \cdots & \kappa_{1n} \\ \kappa_{21} & 1 & \cdots & \kappa_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \kappa_{n1} & \kappa_{n2} & \cdots & 1 \end{bmatrix}$$

Defining $\mathbf{K_a} = \mathbf{a} + \mathbf{K} \circ \mathbf{a}'$ and $\mathbf{K}_\beta = \mathbf{K} \circ \mathbf{B}'$ and plugging the second system of first-order conditions into the first yields the vector of equilibrium innovation $\mathbf{x}^*$ given by

$$\mathbf{x}^* = \begin{bmatrix} x_1^* \\ x_2^* \\ \vdots \\ x_n^* \end{bmatrix} = (A - \bar{c}) \left[\gamma \mathbf{K_a} \mathbf{K}_\beta{}^{-1} - \mathbf{B}\right]^{-1} \cdot \mathbf{1}. \tag{19}$$

Recall the best response functions for q_i and x_i given in equation (6) and (7)

$$q_i = \frac{1}{2}\left[A - \left(\bar{c} - x_i - \sum_{j \neq i}^{n} \beta_{ij} x_j\right) - \sum_{j \neq i}^{n} a_{ij} q_j - \sum_{j \neq i}^{n} \kappa_{ij} a_{ji} q_j\right]$$
$$x_i = \frac{1}{\gamma}\left(q_i + \sum_{j \neq i}^{n} \kappa_{ij} \beta_{ji} q_j\right)$$

We are interested in finding conditions under which $\frac{\partial x_i^*}{\partial \kappa_{ij}} > 0$

Rewriting (8) we have

$$(A - \bar{c}) \cdot \mathbf{1} = \left[\gamma \mathbf{K}_a \mathbf{K}_\beta^{-1} - \mathbf{B}\right] \mathbf{x} \tag{20}$$

First, assume that $\mathbf{B} = \mathbf{I}$ where I is the identity matrix. Thus, there are no technology spillovers as all off-diagonal elements β_{ij} of $\mathbf{B}$ are equal to zero. Therefore $\mathbf{K}_\beta = \mathbf{K} \circ \mathbf{B}' = I$. Hence (8) becomes

$$(A - \bar{c}) \cdot \mathbf{1} = [\gamma \mathbf{K}_a - I]\, x$$

This system is isomorphic to a Cournot Game and the following reaction function for each firm i:

$$x_i = \frac{1}{2\gamma - 1}\left[(A - \bar{c}) - \gamma \sum_{j \neq i} (a_{ij} + \kappa_{ij} a_{ji})\, x_j\right]$$

We are looking for a stable Nash equilibrium, so we have to impose some restrictions on the parameters. In particular, we need that

$$\left|\frac{\partial x_i}{\partial x_j}\right| < 1$$

which imposes the following restriction

$$\frac{\gamma}{2\gamma - 1}\left(a_{ij} + \kappa_{ij} a_{ji}\right) < 1.$$

With this condition it follows that $\frac{\partial x_i^*}{\partial \kappa_{ij}} < 0$. A graphic representation for the $n = 2$ duopoly case is given in Figure 3.

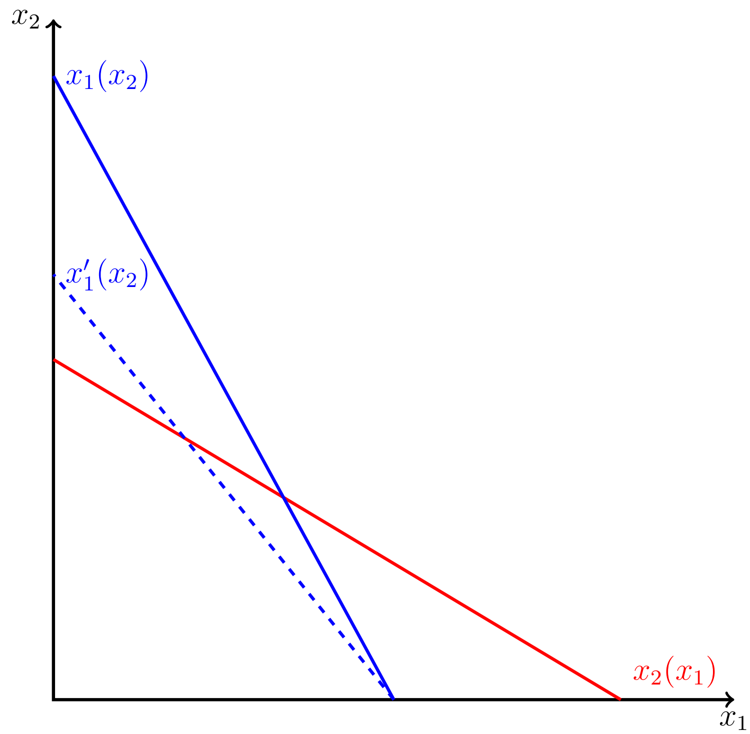

Figure 3. Innovation best response functions for $\mathbf{B} = I$ and $n = 2$

Now instead assume that $\mathbf{a} = \mathbf{I}$ such that there are no product market spillovers. The best response function for quantity (6) becomes

$$q_i = \frac{1}{2}\left[(A - \bar{c}) + x_i + \sum_{j \neq i}^{n} \beta_{ij} x_j\right]$$

which we can substitute into the best response function for innovation (7) to obtain

$$x_i = \frac{1}{\gamma}\left(\frac{1}{2}\left[(A - \bar{c}) + x_i + \sum_{j \neq i} \beta_{ij} x_j\right] + \sum_{j \neq i}^{n} \kappa_{ij} \beta_{ji} \frac{1}{2}\left[(A - \bar{c}) + x_j + \sum_{l \neq j} \beta_{jl} x_l\right]\right).$$

By reordering terms we obtain

$$2\gamma x_i = \left(1 + \sum_{j \neq i}^{n} \kappa_{ij}\beta_{ji}\right)(A - \bar{c}) + \left(1 + \sum_{j \neq i}^{n} \kappa_{ij}\beta_{ji}^2\right) x_i + \sum_{j \neq i}^{n} \left(\beta_{ij} + \kappa_{ij}\beta_{ji} + \sum_{l \neq \{i,j\}}^{n} \kappa_{il}\beta_{li}\beta_{lj}\right) x_j.$$

Therefore this system is isomorphic to a Cournot game with positive spillovers (instead of negative ones) with the following reaction function for firm i

$$x_i = \frac{\left(1 + \sum_{j \neq i}^{n} \kappa_{ij}\beta_{ji}\right)}{2\gamma - 1 - \left(\sum_{j \neq i}^{n} \kappa_{ij}\beta_{ji}^2\right)} + \sum_{j \neq i}^{n} \frac{\beta_{ij} + \kappa_{ij}\beta_{ji} + \sum_{l \neq \{i,j\}}^{n} \kappa_{il}\beta_{li}\beta_{lj}}{2\gamma - 1 - \left(\sum_{j \neq i}^{n} \kappa_{ij}\beta_{ji}^2\right)} x_j$$

We are looking for a stable Nash equilibrium, so we have to impose some restrictions on the parameters. In particular, we need that

$$\left|\frac{\partial x_i}{\partial x_j}\right| < 1$$

which imposes the following restriction

$$\frac{\beta_{ij} + \kappa_{ij}\beta_{ji} + \sum_{l \neq \{i,j\}} \kappa_{il}\beta_{li}\beta_{lj}}{2\gamma - 1 - \left(\sum_{j \neq i}^{n} \kappa_{ij}\beta_{ji}^2\right)} < 1$$

It then follows that $\frac{\partial x_i^*}{\partial \kappa_{ij}} > 0$. A graphic representation for the $n = 2$ duopoly case is given in Figure 4.

Now consider the general case for arbitrary $\mathbf{a}$ and $\mathbf{B}$. Define

$$\psi(\mathbf{a}, \mathbf{B}) = \frac{\partial x_i^*}{\partial \kappa_{ij}}(\mathbf{a}, \mathbf{B})$$

From our previous discussion we know that

$$\psi(\mathbf{J}, I) < 0 \qquad \psi(I, \mathbf{J}) > 0$$

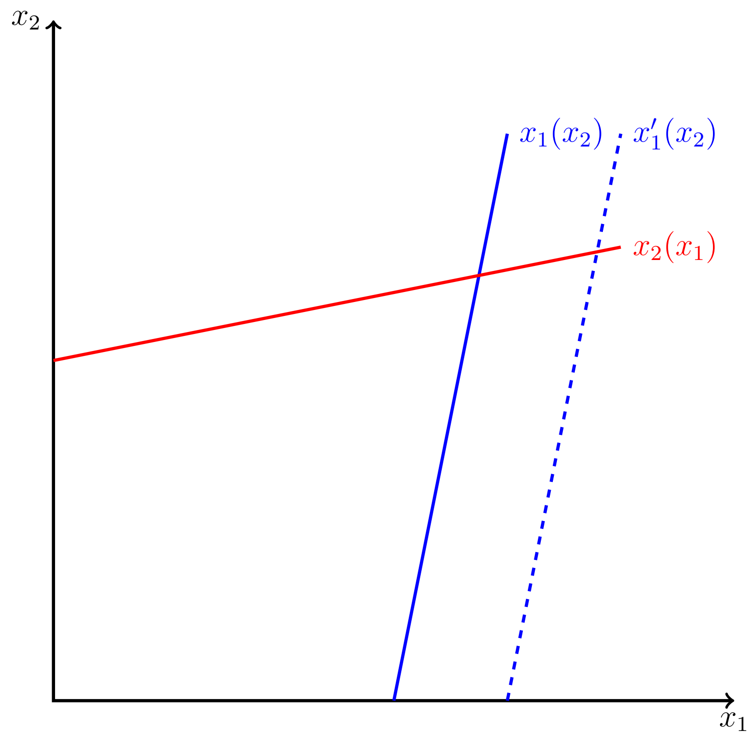

Figure 4. Innovation best response functions for $\mathbf{a} = I$ and $n = 2$

where $\mathbf{J} = \mathbf{1}\mathbf{1}'$. Since ψ is continuous and bounded then there exist $\tilde{\mathbf{a}}$ and $\tilde{\mathbf{B}}$ such that

$$\psi\left(\tilde{\mathbf{a}}, \tilde{\mathbf{B}}\right) = 0$$

Let $\Delta = \{\mathbf{a}, \mathbf{B} : \psi(\mathbf{a}, \mathbf{B}) = 0\}$ denote the set of all such matrices. Then $\psi\left(\tilde{\mathbf{a}}, \tilde{\mathbf{B}} + d\mathbf{B}\right) > 0$ for $d\mathbf{B} > 0$: at our initial point the business stealing effect and the technology spillover effects offset each other, but now the technology spillover is bigger.

Illustration of the Symmetric Case Because the equilibrium expression of our asymmetric model are very unwieldy and do not offer any guidance beyond the comparative statics stated in Proposition 1, we provide the expressions of a simplified symmetric case for illustrative purposes. We assume that the owners are symmetric such that owner i owns a majority stake in firm i as well as a residual symmetric share in all other firms. Therefore, we have $\kappa_{ij} = \kappa$. Furthermore, we assume that both the degree of product differentiation a_{ij} and technological spillovers β_{ij} are identical across firm pairs such that $a_{ij} = a$ and $\beta_{ij} = \beta$.

Solving for the symmetric equilibrium we obtain

$$q^* = \frac{A - \bar{c}}{2b + a(n-1)(1+\kappa) - \frac{\tau B}{\gamma}} \tag{21}$$

$$x^* = \frac{\tau}{\gamma} q^* \tag{22}$$

where $\tau = 1 + \kappa\beta(n-1)$ and $B = 1 + \beta(n-1)$.

Common ownership κ affects equilibrium innovation x^* in equation (22) in two ways: (i) through the "business stealing effect" on the equilibrium quantity q^* and (ii) through the "technology spillover effect" captured by τ.

From equation (21) one can see that whether the net effect of common ownership κ on equilibrium output q^* is positive or negative depends on the relative importance of product market spillovers a and technological spillovers β. Moreover, it is immediate from equations (21) and (22) that common ownership can only have a positive effect on output if it has a positive effect on innovation. The following proposition formalizes this insight, and makes it quantitatively precise.

Corollary 1. *Denote β' as the (positive) solution to $1+\beta(n-1)-\frac{a\gamma}{\beta}=0$. The comparative statics of equilibrium quantity q^* and innovation x^* with respect to common ownership κ are characterized by 3 regions.*

(i) If $\beta \leq \frac{a}{2+a(n-1)}$, then $\frac{\partial q^*}{\partial \kappa} < 0$ and $\frac{\partial x^*}{\partial \kappa} \leq 0$.

(ii) If $\frac{a}{2+a(n-1)} < \beta \leq \beta'$, then $\frac{\partial q^*}{\partial \kappa} \leq 0$ and $\frac{\partial x^*}{\partial \kappa} > 0$.

(iii) If $\beta > \beta'$, then $\frac{\partial q^*}{\partial \kappa} > 0$ and $\frac{\partial x^*}{\partial \kappa} > 0$.

Equilibrium innovation x^* is proportional to equilibrium quantity q^* and is also increasing in τ which itself is increasing in κ. Thus, if quantity q^* is increasing in the degree of common ownership κ then innovation x^* will also be increasing in common ownership. Compared to equilibrium quantity q^*, equilibrium innovation x^* receives an additional kick through τ because of the technological spillovers which common ownership internalizes. As a result, common ownership will increase equilibrium innovation for some parameter values for which common ownership will decrease equilibrium quantity.

Although our model provides predictions about the equilibrium quantity, our primary empirical focus is on how the equilibrium level of innovation x^* varies with the level of common ownership κ. Therefore, the first two parts of Corollary 1 which determine the threshold above which common ownership increases innovation, are instructive. In particular, product market and technology spillovers jointly determine the sign of the common ownership effect on innovation as the following corollary illustrates.

Corollary 2. *Common ownership κ can decrease or increase innovation.*

(i) If and only if product market spillovers are sufficiently large, $a > \frac{2\beta}{1-\beta(n-1)}$, common ownership κ decreases equilibrium innovation x^*. Otherwise, common ownership κ increases equilibrium innovation x^*.

(ii) If and only if technology spillovers are sufficiently large, $\beta > \frac{a}{2+a(n-1)}$, common ownership κ increases equilibrium innovation x^*. Otherwise, common ownership κ decreases equilibrium innovation x^*.

Corollary 2 shows that without knowledge of product differentiation and technological characteristics common ownership has an ambiguous effect on innovation.[24] Depending on the relative strengths of (i) the business stealing and (ii) the technology spillover effect common ownership can either decrease or increase equilibrium innovation. However, the corollary also makes precise predictions under what conditions common ownership has a negative or a positive effect on innovation. Common ownership should decrease innovation if a is sufficiently large relative to β, whereas common ownership should increase innovation if the opposite is the case. In other words, we expect common ownership to decrease (increase) innovation when product market spillovers are sufficiently large (small) and technology spillovers are sufficiently small (large).

Corollary 3. *The effect of common ownership κ on innovation x^* is decreasing in product homogeneity a, $\frac{\partial^2 x^*}{\partial\kappa\partial a} < 0$, and increasing in technology proximity β, $\frac{\partial^2 x^*}{\partial\kappa\partial\beta} > 0$.*

Corollary 3 shows that product market and technology spillovers modify the relationship of common ownership on innovation in opposite ways. Whereas product market spillovers reinforce

[24] This insight helps explain the variation in empirical findings to date on the relation between common ownership and corporate innovation. These designs have not made the distinctions our model predicts to be crucial.

the negative effect of common ownership on innovation, technology spillovers strengthen its positive effects.

A.2 Strategic Complements

Consider the following change to our baseline model. Instead of competing in quantities q_i, firms compete in prices p_i. The proof for this case is essentially identical to the case of strategic substitutes. The innovation reaction function of any firm i is linear and downward-sloping with respect to innovation of any firm j.

Assume again, for illustrative purposes, that product market and technological spillovers are identical across the n firms in the economy. Given the representative consumer's preferences the demand function facing firm i is given by

$$q_i(\mathbf{p}) = \omega - \rho p_i + \delta \sum_{j \neq i} p_j \tag{23}$$

where $\mathbf{p} = (p_1, ..., p_n)$ is the vector of all product market prices, $\omega = \frac{A}{1+(n-1)a}$, $\rho = \frac{1+(n-2)a}{[1+(n-1)a](1-a)}$, and $\delta = \frac{a}{[1+(n-1)a](b-a)}$. By assuming $1 > a > 0$ we have $\rho > (n-1)\delta > 0$. Thus, a firm's price choice has a greater impact on the demand for its own product than its competitive rivals' actions in that particular market.

The profits of firm i are given by

$$\pi_i = (p_i - c_i)\left(\omega - \rho p_i + \delta \sum_{j \neq i} p_j\right) - \frac{\gamma}{2} x_i^2. \tag{24}$$

The objective function of the owner of firm i is as in equation (5) given by

$$\phi_i = \pi_i + \sum_{j \neq i} \kappa_{ij} \pi_j \tag{25}$$

where we again, for illustrative purposes, assume that $\kappa_{ij} = \kappa$ is identical across firms.

Firm i's first-order conditions with respect to quantity p_i and innovation x_i can be rearranged to yield the following best-response functions:

$$p_i = \frac{1}{2\rho}\left[\omega + \rho c_i + \delta \sum_{j\neq i}^{n} p_j + \kappa\delta \sum_{j\neq i}^{n}(p_j - c_j)\right] \tag{26}$$

$$x_i = \frac{1}{\gamma}\left(q_i + \kappa\beta \sum_{j\neq i}^{n} q_j\right) \tag{27}$$

where $q_i = \omega - \rho p_i + \delta \sum_{j\neq i} p_j$ and $c_i = \bar{c} - x_i - \beta \sum_{j\neq i}^{n} x_j$. We solve for the symmetric equilibrium price p^* and equilibrium innovation x^* of the n firms in the economy which are given by

$$p^* = \frac{\gamma[\omega + \bar{c}(\rho - \kappa\Delta)] + \omega B(\rho - \kappa\Delta)\tau}{\gamma[2\rho - (1+\kappa)\Delta] + B(\rho - \kappa\Delta)\tau(\rho - \Delta)} \tag{28}$$

$$x^* = \frac{\tau}{\gamma}[\omega - p^*(\rho - \Delta)] \tag{29}$$

where $\tau = 1 + \kappa\beta(n-1)$, $B = 1 + \beta(n-1)$, and $\Delta = \delta(n-1)$.

As in the case of strategic substitutes, equilibrium innovation x^* increases (decreases) with common ownership κ, if technology spillovers β are sufficiently large (small) relative to product market spillovers a. A sufficient condition for $\frac{\partial x^*}{\partial \kappa} > 0$ is $\beta > \frac{\delta(\rho-\Delta)}{\rho(2\rho-\Delta)}$.

B Additional Empirical Results

Table B1. Innovation and Common Ownership with Value Weighted Kappas.

The table reports the baseline regressions for Jaffe (columns 1-3) and Mahalanobis (columns 4-6) proximity measures, where firm-level κs calculated value-weighting the pairwise κs across different pairs for each firm.

Proximity Measures	Jaffe			Mahalanobis		
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	*R&D*	*TCW*	*TSM*	*R&D*	*TCW*	*TSM*
CO	-0.000698	-0.00436	-0.00248	-0.000657	-0.00458	-0.00269
	(0.000666)	(0.00571)	(0.00513)	(0.000661)	(0.00569)	(0.00509)
ln(*COSPILLTECH*)	0.00515**	0.0721***	0.101***	0.00508**	0.104***	0.108***
	(0.00226)	(0.0257)	(0.0298)	(0.00240)	(0.0287)	(0.0314)
ln(*COSPILLHP*)	-0.00451**	-0.0670**	-0.104***	-0.00452*	-0.0988***	-0.112***
	(0.00222)	(0.0265)	(0.0308)	(0.00232)	(0.0295)	(0.0323)
ln(*SPILLTECH*)	-0.00648**	-0.0725**	-0.108***	-0.00619	-0.104***	-0.129***
	(0.00299)	(0.0304)	(0.0344)	(0.00380)	(0.0354)	(0.0388)
ln(*SPILLHP*)	0.00667***	0.155***	0.213***	0.00668***	0.187***	0.222***
	(0.00245)	(0.0298)	(0.0352)	(0.00259)	(0.0328)	(0.0368)
Institutional Ownership	-0.0314***	0.0571	0.411***	-0.0313***	0.0556	0.413***
	(0.00415)	(0.0370)	(0.0393)	(0.00415)	(0.0370)	(0.0393)
Observations	31,169	28,060	28,060	31,186	28,076	28,076
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes

Table B2. Innovation and Common Ownership when Kappas are averaged across the four quarters of the year.

The table reports the baseline tables when κs are averaged across the four quarters of the year, instead of taking the snapshot of December of each year.

Proximity Measures	Jaffe			Mahalanobis		
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	*R&D*	*TCW*	*TSM*	*R&D*	*TCW*	*TSM*
CO	-0.00182*	-0.0185*	-0.0160*	-0.00173*	-0.0182*	-0.0163*
	(0.000934)	(0.0103)	(0.00889)	(0.000924)	(0.0103)	(0.00885)
ln(*COSPILLTECH*)	0.00480**	0.0664**	0.0687**	0.00383	0.0900***	0.0833***
	(0.00222)	(0.0281)	(0.0308)	(0.00249)	(0.0288)	(0.0323)
ln(*COSPILLHP*)	-0.00353	-0.0563*	-0.0723**	-0.00261	-0.0800***	-0.0865**
	(0.00230)	(0.0290)	(0.0321)	(0.00253)	(0.0299)	(0.0337)
ln(*SPILLTECH*)	-0.00605**	-0.0640**	-0.0711**	-0.00481	-0.0869**	-0.0997**
	(0.00289)	(0.0321)	(0.0344)	(0.00375)	(0.0352)	(0.0388)
ln(*SPILLHP*)	0.00517**	0.144***	0.179***	0.00426	0.168***	0.194***
	(0.00250)	(0.0318)	(0.0359)	(0.00273)	(0.0327)	(0.0375)
Institutional Ownership	-0.0316***	0.0540	0.411***	-0.0315***	0.0528	0.411***
	(0.00411)	(0.0371)	(0.0395)	(0.00412)	(0.0371)	(0.0395)
Observations	31,431	28,308	28,308	31,436	28,313	28,313
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes

Table B3. Innovation and Common Ownership when pairwise Kappas are lower than 1 (before the aggregation). The table reports the baseline tables where we restrict pair-wise κs (before aggregating at the firm level) to be lower or equal to 1.

Proximity Measures		Jaffe			Mahalanobis	
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	*R&D*	*TCW*	*TSM*	*R&D*	*TCW*	*TSM*
CO	-0.000958	-0.444***	-0.592***	0.000132	-0.455***	-0.601***
	(0.0110)	(0.101)	(0.117)	(0.0110)	(0.101)	(0.116)
ln(*COSPILLTECH*)	0.00513**	0.0657***	0.0992***	0.00507**	0.0999***	0.108***
	(0.00226)	(0.0254)	(0.0298)	(0.00240)	(0.0281)	(0.0315)
ln(*COSPILLHP*)	-0.00465**	-0.0337	-0.0657**	-0.00473*	-0.0671**	-0.0744**
	(0.00232)	(0.0265)	(0.0312)	(0.00242)	(0.0291)	(0.0325)
ln(*SPILLTECH*)	-0.00646**	-0.0676**	-0.109***	-0.00616	-0.102***	-0.132***
	(0.00298)	(0.0300)	(0.0345)	(0.00378)	(0.0350)	(0.0390)
ln(*SPILLHP*)	0.00678***	0.116***	0.167***	0.00686**	0.149***	0.176***
	(0.00255)	(0.0302)	(0.0358)	(0.00269)	(0.0327)	(0.0372)
Institutional Ownership	-0.0305***	0.00326	0.339***	-0.0304***	0.000228	0.340***
	(0.00415)	(0.0382)	(0.0410)	(0.00415)	(0.0382)	(0.0411)
Observations	31,169	28,060	28,060	31,186	28,076	28,076
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes

Table B4. Innovation and Common Ownership when firm-level Kappas are lower than 1 (after the aggregation). The table reports the baseline tables where we restrict firm-level κs (after the pairwise aggregation) to be lower or equal to 1.

Proximity Measures		Jaffe			Mahalanobis	
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	*R&D*	*TCW*	*TSM*	*R&D*	*TCW*	*TSM*
CO	0.00622	-0.198**	-0.351***	0.00696	-0.204**	-0.354***
	(0.00763)	(0.0916)	(0.0874)	(0.00759)	(0.0913)	(0.0872)
ln(*COSPILLTECH*)	0.00461**	0.0687***	0.0877***	0.00456*	0.100***	0.0956***
	(0.00228)	(0.0267)	(0.0304)	(0.00242)	(0.0295)	(0.0320)
ln(*COSPILLHP*)	-0.00425*	-0.0441	-0.0607*	-0.00431*	-0.0750**	-0.0682**
	(0.00230)	(0.0282)	(0.0319)	(0.00240)	(0.0310)	(0.0332)
ln(*SPILLTECH*)	-0.00471*	-0.0738**	-0.100***	-0.00401	-0.106***	-0.124***
	(0.00260)	(0.0313)	(0.0351)	(0.00311)	(0.0362)	(0.0395)
ln(*SPILLHP*)	0.00649***	0.127***	0.160***	0.00655**	0.158***	0.168***
	(0.00252)	(0.0319)	(0.0366)	(0.00264)	(0.0346)	(0.0380)
Institutional Ownership	-0.0349***	0.00260	0.338***	-0.0348***	-0.000257	0.339***
	(0.00445)	(0.0383)	(0.0435)	(0.00445)	(0.0383)	(0.0435)
Observations	30,611	27,539	27,539	30,626	27,553	27,553
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes

Table B5. Innovation and Common Ownership using only first classification patent.

The table reports the baseline results when we compute the TECH matrices using only the first classification patent.

Proximity Measures	Jaffe			Mahalanobis		
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	*R&D*	*TCW*	*TSM*	*R&D*	*TCW*	*TSM*
CO	-0.000551	-0.00794	-0.0102*	-0.000450	-0.00777	-0.0103*
	(0.000790)	(0.00688)	(0.00590)	(0.000781)	(0.00690)	(0.00586)
ln(*COSPILLTECH*)	0.00458**	0.0508**	0.0810***	0.00344	0.0964***	0.103***
	(0.00190)	(0.0257)	(0.0277)	(0.00219)	(0.0277)	(0.0306)
ln(*COSPILLHP*)	-0.00395**	-0.0447*	-0.0825***	-0.00296	-0.0905***	-0.105***
	(0.00186)	(0.0257)	(0.0284)	(0.00214)	(0.0283)	(0.0316)
ln(*SPILLTECH*)	-0.00388	-0.0474	-0.0806***	-0.00217	-0.0972***	-0.113***
	(0.00236)	(0.0290)	(0.0308)	(0.00318)	(0.0328)	(0.0360)
ln(SPILLSIHP)	0.00593***	0.132***	0.191***	0.00493**	0.179***	0.214***
	(0.00214)	(0.0295)	(0.0331)	(0.00241)	(0.0318)	(0.0362)
Institutional Ownership	-0.0312***	0.0564	0.406***	-0.0309***	0.0536	0.407***
	(0.00414)	(0.0370)	(0.0393)	(0.00414)	(0.0371)	(0.0394)
Observations	31,147	28,048	28,048	31,185	28,074	28,074
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes

Table B6. Innovation and Common Ownership using no-rolling patent window (similar to Bloom et al.).

The table reports the baseline results when we compute the TECH matrices using a full matrix of patent correlation using all years, instead of using a rolling window to avoid look ahead bias.

Proximity Measures	Jaffe			Mahalanobis		
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	*R&D*	*TCW*	*TSM*	*R&D*	*TCW*	*TSM*
CO	-0.000536	-0.00788	-0.00991*	-0.000470	-0.00793	-0.00993*
	(0.000789)	(0.00688)	(0.00594)	(0.000782)	(0.00687)	(0.00593)
ln(*COSPILLTECH*)	0.00482*	0.0819***	0.112***	0.00488*	0.0911***	0.113***
	(0.00246)	(0.0272)	(0.0314)	(0.00255)	(0.0299)	(0.0328)
ln(*COSPILLHP*)	-0.00424*	-0.0759***	-0.114***	-0.00440*	-0.0851***	-0.115***
	(0.00239)	(0.0277)	(0.0319)	(0.00244)	(0.0302)	(0.0334)
ln(*SPILLTECH*)	-0.0179***	-0.00687	-0.0277	-0.0218**	-0.0129	-0.0216
	(0.00672)	(0.0341)	(0.0376)	(0.0106)	(0.0396)	(0.0419)
ln(*SPILLHP*)	0.00716***	0.152***	0.209***	0.00718***	0.165***	0.214***
	(0.00259)	(0.0307)	(0.0361)	(0.00265)	(0.0331)	(0.0376)
Institutional Ownership	-0.0311***	0.0467	0.397***	-0.0309***	0.0495	0.401***
	(0.00413)	(0.0371)	(0.0395)	(0.00413)	(0.0371)	(0.0395)
Observations	31,182	28,071	28,071	31,187	28,077	28,077
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes

Table B7. Subsample of Highest Innovation and Greatest Spillovers.

This table shows the results of a subsample of firms that have greater potential of spillovers, and highest innovation activity. There may be many firms with little to no innovation activity, and also the potential "spillable" set of firms is limited. To show that our results are robust to this subsample of firms we conduct the same analysis using a subset of the companies with highest innovation activity and highest potential spillovers. To do this we have computed the average innovation input and output, and the average spillovers for each industry in our sample. We then rank industries by each of those variables (R&D, TCW, TSM, SPILLTECH and SPILLHP). We take the top 5 industries in each of those lists, and keep the companies that are present in all 5 groups. We conduct the same analysis using only companies in those industries, which reduces our sample to 4,869 observations (compared to the 31,169 in R&D equations, and 28,060 in patent equations). Firms are from this subset of industries: Within the Pharmaceuticals sector, we have codes 2836 (Biological Products, excluding Diagnostic), 2835 (Diagnostic Substances), and 2834 (Pharmaceutical Preparations). The Electronic & Other Electrical Equipment category includes 3575 (Computer Terminals), 3570 (Computer and Office Equipment), 3600 (Electronic & Other Electrical Equipment & Components), and 3576 (Computer Communications Equipment). Services are represented by 8731 (Commercial Physical and Biological Research) and 8721 (Accounting, Auditing, and Bookkeeping). The Miscellaneous category contains the non-specific code 9997 for Nonclassifiable Establishments. Communications is represented by 4812 (Radiotelephone Communications). Retail Trade encompasses 5961 (Catalog and Mail-Order Houses). The Transportation & Public Utilities sector includes 4888 (Marine Terminals) and 4220 (Public Warehousing and Storage). Lastly, the Finance, Insurance, & Real Estate industry features codes 6799 (Investors, NEC), 6500 (Real Estate), and 6552 (Land Subdividers and Developers, Except Cemeteries).

Proximity Measures	Jaffe			Mahalanobis		
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	*R&D*	*TCW*	*TSM*	*R&D*	*TCW*	*TSM*
CO	-0.00329**	0.00317	-0.0216	-0.00318*	0.00369	-0.0212
	(0.00165)	(0.0131)	(0.0158)	(0.00163)	(0.0130)	(0.0157)
ln(*COSPILLTECH*)	0.0112	0.105**	0.210***	0.0149	0.134***	0.191**
	(0.00917)	(0.0428)	(0.0654)	(0.00923)	(0.0491)	(0.0813)
ln(*COSPILLHP*)	-0.00876	-0.105**	-0.222***	-0.0129	-0.137***	-0.205**
	(0.00969)	(0.0454)	(0.0682)	(0.00971)	(0.0522)	(0.0837)
ln(*SPILLTECH*)	-0.0209*	-0.175***	-0.268***	-0.0240	-0.191**	-0.255**
	(0.0124)	(0.0678)	(0.0898)	(0.0158)	(0.0896)	(0.118)
ln(*SPILLHP*)	0.0158	0.131**	0.330***	0.0196*	0.159**	0.310***
	(0.0119)	(0.0631)	(0.0895)	(0.0119)	(0.0694)	(0.105)
Institutional Ownership	-0.0712***	0.160**	0.438***	-0.0720***	0.153**	0.441***
	(0.0164)	(0.0705)	(0.0897)	(0.0165)	(0.0710)	(0.0901)
Observations	4,869	4,876	4,876	4,873	4,877	4,877
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes

Table B8. Innovation and Common Ownership with IHHI as additional regressor.

The table reports the baseline table with IHHI as an additional regressor. IHHI is the institutional Herfindahl Index, computed as the sum of squares of institutional ownership stakes.

Proximity Measures		Jaffe			Mahalanobis	
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent Variable	*R&D*	*TCW*	*TSM*	*R&D*	*TCW*	*TSM*
CO	-0.000410	-0.0106	-0.0150**	-0.000343	-0.0107	-0.0154**
	(0.000788)	(0.00710)	(0.00620)	(0.000778)	(0.00709)	(0.00614)
ln(*COSPILLTECH*)	0.00499**	0.0750***	0.107***	0.00492**	0.109***	0.117***
	(0.00227)	(0.0258)	(0.0298)	(0.00242)	(0.0287)	(0.0315)
ln(*COSPILLHP*)	-0.00484**	-0.0586**	-0.0906***	-0.00484**	-0.0916***	-0.0995***
	(0.00223)	(0.0263)	(0.0304)	(0.00234)	(0.0293)	(0.0319)
ln(*SPILLTECH*)	-0.00633**	-0.0758**	-0.114***	-0.00604	-0.109***	-0.138***
	(0.00302)	(0.0304)	(0.0345)	(0.00384)	(0.0355)	(0.0390)
ln(*SPILLHP*)	0.00700***	0.148***	0.201***	0.00699***	0.181***	0.210***
	(0.00246)	(0.0296)	(0.0348)	(0.00260)	(0.0326)	(0.0364)
Institutional Ownership	-0.0307***	0.0478	0.394***	-0.0307***	0.0462	0.396***
	(0.00414)	(0.0372)	(0.0392)	(0.00414)	(0.0372)	(0.0392)
IHHI	-0.00726	0.197**	0.312***	-0.00693	0.207**	0.328***
	(0.00549)	(0.0825)	(0.0833)	(0.00550)	(0.0825)	(0.0838)
Observations	31,169	28,060	28,060	31,186	28,076	28,076
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
FirmFE	Yes	Yes	Yes	Yes	Yes	Yes

Table B9. Innovation and Common Ownership with Lags of Independent Variables.
The table reports the baseline tables with different lags for the independent variables.

PANEL A: USING JAFFE PROXIMITY MEASURES

VARIABLES	(1) Ind Vars t-1	(2) Ind Vars t-2	(3) Ind Vars t-3	(4) Ind Vars t-4	(5) Ind Vars t-5
Dependent variable log(1+R&D/Assets) in t					
CO	-0.000527	-0.000215	-0.000439	-0.00116**	-0.00157**
	(0.000789)	(0.000990)	(0.000545)	(0.000542)	(0.000642)
ln(*COSPILLTECH*)	0.00513**	0.00422*	0.00362	0.00557***	0.00316
	(0.00226)	(0.00226)	(0.00248)	(0.00200)	(0.00203)
ln(*COSPILLHP*)	-0.00457**	-0.00441**	-0.00327	-0.00432**	-0.00197
	(0.00222)	(0.00220)	(0.00244)	(0.00196)	(0.00201)
Dependent variable TCW in t					
CO	-0.00796	-0.0223***	-0.00345	0.00548	0.00603
	(0.00691)	(0.00839)	(0.0133)	(0.0173)	(0.0194)
ln(*COSPILLTECH*)	0.0717***	0.0534*	0.103**	0.0965**	0.0380
	(0.0257)	(0.0324)	(0.0410)	(0.0427)	(0.0521)
ln(*COSPILLHP*)	-0.0659**	-0.0351	-0.0761*	-0.0760*	-0.00150
	(0.0264)	(0.0334)	(0.0416)	(0.0453)	(0.0519)
Dependent variable TSM in t					
CO	-0.0104*	-0.0119	0.0376	0.00333	0.00889
	(0.00591)	(0.00922)	(0.0360)	(0.0130)	(0.0258)
ln(*COSPILLTECH*)	0.101***	0.147***	0.193***	0.0489	-0.0473
	(0.0298)	(0.0383)	(0.0490)	(0.0811)	(0.109)
ln(*COSPILLHP*)	-0.102***	-0.130***	-0.179***	-0.0218	0.0817
	(0.0307)	(0.0405)	(0.0511)	(0.0835)	(0.113)

PANEL B: USING MAHALANOBIS PROXIMITY MEASURES

VARIABLES	(1) Ind Vars t-1	(2) Ind Vars t-2	(3) Ind Vars t-3	(4) Ind Vars t-4	(5) Ind Vars t-5
Dependent variable log(1+R&D/Assets) in t					
CO	-0.000451	-0.000201	-0.000416	-0.00114**	-0.00154**
	(0.000780)	(0.000979)	(0.000538)	(0.000535)	(0.000635)
ln(*COSPILLTECH*)	0.00506**	0.00320	0.00113	0.00366*	0.00183
	(0.00240)	(0.00244)	(0.00261)	(0.00209)	(0.00221)
ln(*COSPILLHP*)	-0.00459**	-0.00339	-0.000891	-0.00243	-0.000643
	(0.00233)	(0.00236)	(0.00257)	(0.00203)	(0.00219)
Dependent variable TCW in t					
CO	-0.00795	-0.0217***	-0.00391	0.00479	0.00524
	(0.00691)	(0.00833)	(0.0134)	(0.0173)	(0.0194)
ln(*COSPILLTECH*)	0.104***	0.0700**	0.148***	0.124***	0.0807
	(0.0287)	(0.0354)	(0.0416)	(0.0461)	(0.0523)
ln(*COSPILLHP*)	-0.0978***	-0.0518	-0.120***	-0.103**	-0.0436
	(0.0295)	(0.0365)	(0.0425)	(0.0488)	(0.0539)
Dependent variable TSM in t					
CO	-0.0106*	-0.0121	0.0365	0.00262	0.00779
	(0.00587)	(0.00916)	(0.0357)	(0.0130)	(0.0256)
ln(*COSPILLTECH*)	0.108***	0.159***	0.235***	0.108	0.0256
	(0.0314)	(0.0405)	(0.0534)	(0.0733)	(0.0922)
ln(*COSPILLHP*)	-0.110***	-0.143***	-0.220***	-0.0806	0.00934
	(0.0322)	(0.0431)	(0.0557)	(0.0761)	(0.0954)