Supplementary material

0.1 The incumbent firm

We now suppose that the incumbent firm is able to produce a unit of product A at no cost but has to incur the marginal cost $c+t$ to produce a unit of product B. The assumption is related to the cost advantage of the incumbent firm. Basically, each entrant has to incur the marginal cost c. Depending on its location choice, it has to incur an additional marginal cost in the opposite location, t or τ. Because of disclosure, the value of τ becomes smaller than t.

Suppose that k entrant firms locate at A and $n-(k+1)$ firms locate at B ($k = 0, 1, 2, n-1$) (note that the incumbent has already located at A). The profit of the incumbent firm (denoted as $\pi_I(k,\tau)$), the profit of the entrant firm locating at A (denoted as $\pi_A(k,\tau)$), and the profit of the firm locating at B (denoted as $\pi_B(k,\tau)$) are:

$$\begin{aligned}
\pi_I(k,\tau) &= \frac{(1+(n-1)c+((k+1)\times 0+(n-k-1)\tau)-(n+1)\times 0)^2}{(n+1)^2} \\
&\quad + \frac{(1+nc+((k+1)t+(n-k-1)\times 0)-(n+1)(c+t))^2}{(n+1)^2} \\
&= \frac{(1+(n-1)c+(n-k-1)\tau)^2}{(n+1)^2} + \frac{(1-c-(n-k)t)^2}{(n+1)^2}, \qquad (1)\\
\pi_A(k,\tau) &= \frac{(1+(n-1)c+((k+1)\times 0+(n-k-1)\tau)-(n+1)c)^2}{(n+1)^2} \\
&\quad + \frac{(1+nc+((k+1)t+(n-k-1)\times 0)-(n+1)(c+t))^2}{(n+1)^2} \\
&= \frac{(1-2c+(n-k-1)\tau)^2}{(n+1)^2} + \frac{(1-c-(n-k)t)^2}{(n+1)^2}, \qquad (2)\\
\pi_B(k,\tau) &= \frac{(1+(n-1)c+((k+1)\times 0+(n-k-1)\tau)-(n+1)(c+\tau))^2}{(n+1)^2} \\
&\quad + \frac{(1+nc+((k+1)t+(n-k-1)\times 0)-(n+1)c)^2}{(n+1)^2} \\
&= \frac{(1-2c-(k+2)\tau)^2}{(n+1)^2} + \frac{(1-c+(k+1)t)^2}{(n+1)^2}. \qquad (3)
\end{aligned}$$

We have to distinguish two cases: n is odd; n is even. First, we consider the case in which n is odd, and then the case in which n is even.

n is odd When n is odd, in any case, the number of firms in each of the markets is different. Given that $k=(n-1)/2-h$ entrant firms locate in market A in the nondisclosure case ($c \in [2(h-1), 2ht)$,

$(h = 1, 2, 3, \ldots)$), to induce an entrant firm that would locate in market A in the nondisclosure case to locate in market B, τ satisfies the following inequalities:

$$\pi_B\left(\frac{n-1}{2} - h - 1, \tau\right) - \pi_A\left(\frac{n-1}{2} - h, \tau\right) > 0$$
$$\pi_B\left(\frac{n-1}{2} - h - 2, \tau\right) - \pi_A\left(\frac{n-1}{2} - h - 1, \tau\right) < 0.$$

That is:

$$\begin{aligned}
& \pi_B\left(\frac{n-1}{2} - h - 1, \tau\right) - \pi_A\left(\frac{n-1}{2} - h, \tau\right) \\
= \; & \frac{(2-4c-(n-2h+1)\tau)^2}{4(n+1)^2} + \frac{(2-2c+(n-2h-1)t)^2}{4(n+1)^2} \\
& - \left(\frac{(2-4c+(n+2h-1)\tau)^2}{4(n+1)^2} + \frac{(2-2c-(n+2h+1)t)^2}{4(n+1)^2}\right) \\
= \; & -\frac{n((2h-1)\tau^2 + 2(1-2c)\tau - (2(1-c)-(2h+1)t)t)}{(n+1)^2} > 0. \\
& \pi_B\left(\frac{n-1}{2} - h - 2, \tau\right) - \pi_A\left(\frac{n-1}{2} - h - 1, \tau\right) \\
= \; & \frac{(2-4c-(n-2h-1)\tau)^2}{4(n+1)^2} + \frac{(2-2c+(n-2h-3)t)^2}{4(n+1)^2} \\
& - \left(\frac{(2-4c+(n+2h+1)\tau)^2}{4(n+1)^2} + \frac{(2-2c-(n+2h+3)t)^2}{4(n+1)^2}\right) \\
= \; & -\frac{n((2h+1)\tau^2 + 2(1-2c)\tau - (2(1-c)-(2h+3)t)t)}{(n+1)^2} < 0.
\end{aligned}$$

Solving the inequality, we have:

$$\begin{aligned}
& \frac{-(1-2c) + \sqrt{(1-2c)^2 + 2(2(h+1)-1)(1-c)t - (4(h+1)^2-1)t^2}}{2(h+1)-1} \\
& \qquad < \tau < \frac{-(1-2c) + \sqrt{(1-2c)^2 + 2(2h-1)(1-c)t - (4h^2-1)t^2}}{2h-1}.
\end{aligned}$$

We now consider the case in which the incumbent firm sets the level of τ at the upper bound:[1]

$$\tau_o \equiv \frac{-(1-2c) + \sqrt{(1-2c)^2 + 2(2h-1)(1-c)t - (4h^2-1)t^2}}{2h-1}. \tag{4}$$

We can easily show that this is smaller than t if and only if $c < 2ht$ (note that we now consider the range of c, $[2(h-1)t, 2ht)$). The profit in which the incumbent discloses its knowledge and sets τ_o

[1] Under the range of τ, setting the following τ_o induces the highest profit of the incumbent firm. We can easily show that $\sqrt{(1-2c)^2 + 2(2h-1)(1-c)t - (4h^2-1)t^2}$ in (4) is positive if the quantities supplied by the firms are positive.

and that in which it does not are:

$$\pi_I\left(\frac{n-1}{2}-(h+1),\tau_o\right) = \Big[(1+2h+n)\sqrt{(1-2c)^2+2(2h-1)(1-c)t-(4h^2-1)t^2} \quad (5)$$
$$-(n-2h+3-4(1+hn)c)\Big]^2 \Big/ 4(n+1)^2(2h-1)^2$$
$$+\frac{(2-2c-(n+2h+3)t)^2}{4(n+1)^2},$$
$$\pi_I\left(\frac{n-1}{2}-h,t\right) = \frac{(2+2(n-1)c+(n+2h-1)t)^2}{4(n+1)^2}+\frac{(2-2c-(n+2h+1)t)^2}{4(n+1)^2}. \quad (6)$$

If the difference between $\pi_I((n-1)/2-(h+1),\tau_o)$ in (5) and $\pi_I((n-1)/2-h,t)$ in (6) is positive, know-how disclosure enhances the profit of the incumbent firm. We now define $J_o(t,h)$ as follows:

$$J_o(t,h) \equiv \pi_I\left(\frac{n-1}{2}-(h+1),\tau_o\right)-\pi_I\left(\frac{n-1}{2}-h,t\right).$$

We now check the following three cases: (i) $h=1$ ($c \in (0,2t)$ or $t > c/2$), (ii) $h=2$ ($c \in [2t,4t)$ or $t \in (c/4, c/2]$), and (iii) h is larger than 2 ($c \in [2(h-1)t, 2ht)$ or $t \in (c/(2h), c/(2(h-1))]$). First, we consider the case in which $h=1$ ($c \in (0,2t)$ or $t > c/2$). Differentiating $J_o(t,1)$ with respect to t twice, we have (note that c and t are smaller than 1/2 (a necessary condition that the quantities supplied by the firms are positive)):

$$\frac{\partial^2 J_o(t,1)}{\partial t^2} = -\frac{(n+3)[((1-2c)^2+2(1-c)t-3t^2)^{3/2}-(4-30c+69c^2-52c^3)]}{2(n+1)((1-2c)^2+2(1-c)t-3t^2)^{3/2}} < 0.$$

Therefore, $J_o(t,1)$ is concave with respect to t. We now substitute $t=c/2$ (the lower bound of t) into $J_o(t,1)$, then we have:

$$J_o\left(\frac{c}{2},1\right) = \frac{3c^2}{2(n+1)} > 0.$$

We find that there exists $\bar{t}$ such that $J_o(t,1)=0$ and that for any $t \in [c/2,\bar{t})$, disclosure increases the profit of the incumbent firm because $J_o(t,1)$ is concave. We can summarize this in the following proposition.

Proposition 1 *Suppose that $c \in (0,2t)$ and that n is odd and larger than or equal to 5. There exists $\bar{t}$ such that $J_o(t,1)=0$. For any $t \in (c/2,\bar{t})$, the disclosure increases the profit of the incumbent firm.*

Second, we consider the case in which $h = 2$ ($c \in [2t, 4t)$ or $c/4 < t \leq c/2$). In this case, n is larger than or equal to 7. Differentiating $J_o(t, 2)$ with respect to t three times, we have:

$$\frac{\partial^3 J_o(t,2)}{\partial t^3} = -\frac{3(n+5)(8-26c+23c^2)(n-1-4(2n+1)c)(1-c-5t)}{2(n+1)^2((1-2c)^2+3(1-c)t-15t^2)^{5/2}}.$$

The sign of $\frac{\partial^3 J_o(t,2)}{\partial t^3}$ does not depend on the value of t because $(1-c-5t)$ is always positive.[2] For any t, the sign of $\frac{\partial^3 J_o(t,2)}{\partial t^3}$ is always negative or always positive. Therefore, if $(\partial^2 J_o(t,2))/(\partial t^2)$ is negative when $t = c/4$ and $t = c/2$, the sign of $(\partial^2 J_o(t,2))/(\partial t^2)$ is negative for any t.

(1) $t = c/4$: Substituting $t = c/4$ into $(\partial^2 J_o(t,2))/(\partial t^2)$, we have:

$$\left.\frac{\partial^2 J_o(t,2)}{\partial t^2}\right|_{t=c/4} = -\frac{4(n+5)(2(32-72c-8c^2+81c^3)+c(160-516c+449c^2)n)}{(n+1)^2(4-5c)^3} < 0.$$

because the coefficient of n and the constant term is positive for any $c < 4/9$ (when $1-c-5t > 0$ and $t > c/4$, $c < 4/9$.).

(2) $t = c/2$: Substituting $t = c/2$ into $(\partial^2 J_o(t,2))/(\partial t^2)$, we have:

$$\left.\frac{\partial^2 J_o(t,2)}{\partial t^2}\right|_{t=c/2} = -\frac{4(-H_a)(n+5)(8-26c+23c^2)}{3(n+1)^2(4-4c-11c^2)^{3/2}} - \frac{4(n+5)(n+2)}{3(n+1)^2} < 0.$$

because $(4-4c-11c^2)^{3/2}$ and $(8-26c+23c^2)$ are positive for any $c < 4/9$. Therefore, $J_o(t,2)$ is concave with respect to t. We now substitute $t = c/4$ (the lower bound of t) and $t = c/2$ (the upper bound of t) into $J_o(t,2)$, then we have:

$$\begin{aligned} J_o\left(\frac{c}{4}, 2\right) &= \frac{5c^2}{8(n+1)} > 0, \\ J_o\left(\frac{c}{2}, 2\right) &= \frac{(n+5)(2(n-1)-(7+17n)c)+(35+68n+5n^2)c^2}{36(n+1)^2} \\ &\quad -\frac{(n+5)(n-1-4(2n+1)c)\sqrt{4-4c-11c^2}}{36(n+1)^2}. \end{aligned}$$

If n and c are in the shaded area in Figure S1, $J_o(t,2)$ is positive for any $t \in [c/4, c/2)$, otherwise there exists $\bar{t}'$ such that $J_o(t,2) = 0$ and that for any $t \in [c/4, \bar{t}')$, disclosure increases the profit of the incumbent firm because $J_o(t,2)$ is concave. We can summarize this as follows:

Proposition 2 *Suppose that $c \in (2t, 4t)$ and that n is odd and larger than or equal to 7. If n and c satisfy $J_o(c/2, 2) > 0$, for any $t \in [c/4, c/2)$, the disclosure increases the profit of the incumbent firm,*

[2] In this case, the quantity supplied by the incumbent firm in market B is $(2-2c-(n+2h+3)t)/(2(n+1))$. If this is positive, $(1-c-5t)$ is also positive.

otherwise there exists $\bar{t}'$ such that $J_o(t, 2) = 0$, and for any $t \in (c/4, \bar{t}')$, the disclosure increases the profit of the incumbent firm.

Finally, we briefly discuss the case in which h is larger than two. After some calculus, we find that given that $k = (n-1)/2 - h$ entrant firms locate at A, $J_o(t, h)$ is minimized when $t = c/(2(h-1))$ or $t = c/(2h)$.[3] $J_o(c/(2h), h) = c^2(1 + 2h)/(2h^2(n + 1)) > 0$. Therefore, if $J_o(c/(2(h - 1)), h)$ is positive for any c, h, and n, in the given range of t ($[c/2h, c/(2(h-1))]$), disclosure enhances the profit of the incumbent firm. Note that h is related to the value of t. As the value of h increases, the value of t decreases.

We now show two examples of these values. From Figures S2 and S3, we find that as the value of h increases, the condition that the disclosure enhances the profit of the incumbent firm tends to hold. As mentioned earlier, as the value of h increases, the value of t decreases. That is, as the value of t becomes smaller, the condition tends to hold.

n **is even** Given that $k = n/2 - h$ entrant firms locate in market A in the nondisclosure case ($c \in [(2h-3)t, (2h-1)t)$, ($h = 1, 2, 3, \ldots$)), to induce an entrant firm that would locate in market A in the nondisclosure case to locate in market B, τ must satisfy the following inequalities:

$$\pi_B\left(\frac{n}{2} - h - 1, \tau\right) - \pi_A\left(\frac{n}{2} - h, \tau\right) > 0$$
$$\pi_B\left(\frac{n}{2} - h - 2, \tau\right) - \pi_A\left(\frac{n}{2} - h - 1, \tau\right) < 0,$$

that is:

$$\begin{aligned} &\pi_B\left(\frac{n}{2} - h - 1, \tau\right) - \pi_A\left(\frac{n}{2} - h, \tau\right) \\ = \quad &\frac{(2 - 4c - (n - 2h + 2)\tau)^2}{4(n+1)^2} + \frac{(2 - 2c + (n - 2h)t)^2}{4(n+1)^2} \end{aligned}$$

[3] We first differentiate $J_o(t, h)$ with respect to t three times. The sign of $(\partial^3 J_o(t, h))/(\partial t^3)$ does not depend on t but on the other parameters. This means that the sign $(\partial^3 J_o(t, h))/(\partial t^3)$ is always positive or always negative in the range of t, $[c/(2h), c/(2(h-1))]$. If the signs of $(\partial^2 J_o(t, h))/(\partial t^2)$ are negative at $t = c/(2h)$ and $t = c/(2(h-1))$, the sign of $(\partial^2 J_o(t, h))/(\partial t^2)$ is always negative for any $t \in [c/(2h), c/(2(h-1))]$. That is, $J_o(t, h)$ is concave with respect to t. Substituting $t = c/(2h)$ and $t = c/(2(h-1))$ into $(\partial^2 J_o(t, h))/(\partial t^2)$, we have the values of $(\partial^2 J_o(t, h))/(\partial t^2)$ at $t = c/(2h)$ and $t = c/(2(h-1))$. The numerators of the values are quadratic and concave functions with respect to n. Solving the quadratic equations $(\partial^2 J_o(t, h))/(\partial t^2)|_{t=c/(2h)} = 0$ and $(\partial^2 J_o(t, h))/(\partial t^2)|_{t=c/(2(h-1))} = 0$ with respect to n, we find that under both equations, the solutions are negative. Therefore, the values of $(\partial^2 J_o(t, h))/(\partial t^2)$ at $t = c/(2h)$ and $t = c/(2(h-1))$ are negative, that is, $J_o(t, h)$ is a concave function with respect to t.

$$
\begin{aligned}
& -\left(\frac{(2-4c+(n+2h-2)\tau)^2}{4(n+1)^2}+\frac{(2-2c-(n+2h)t)^2}{4(n+1)^2}\right) \\
= & -\frac{2n((h-1)\tau^2+(1-2c)\tau-(1-c-ht)t)}{(n+1)^2}>0. \\
& \pi_B\left(\frac{n}{2}-h-2,\tau\right)-\pi_A\left(\frac{n}{2}-h-1,\tau\right) \\
= & \frac{(2-4c-(n-2h)\tau)^2}{4(n+1)^2}+\frac{(2-2c+(n-2h-2)t)^2}{4(n+1)^2} \\
& -\left(\frac{(2-4c+(n+2h)\tau)^2}{4(n+1)^2}+\frac{(2-2c-(n+2h+2)t)^2}{4(n+1)^2}\right) \\
= & -\frac{2n(h\tau^2+(1-2c)\tau-(1-c+(h+1)t)t)}{(n+1)^2}<0.
\end{aligned}
$$

Solving the inequalities, we have:

$$
\frac{-(1-2c)+\sqrt{(1-2c)^2+4h(1-c-(h+1)t)t}}{2h}<\tau<W
$$

where

$$
W=\begin{cases} \dfrac{(1-c-t)t}{1-2c}, & \text{if } h=1, \\ \dfrac{-(1-2c)+\sqrt{(1-2c)^2+4(h-1)(1-c-ht)t}}{2(h-1)}, & \text{otherwise.} \end{cases}
$$

We now consider the case in which the incumbent sets the level of τ at the upper bound:

$$
\tau_e \equiv \begin{cases} \dfrac{(1-c-t)t}{1-2c}, & \text{if } h=1, \\ \dfrac{-(1-2c)+\sqrt{(1-2c)^2+4(h-1)(1-c-ht)t}}{2(h-1)}, & \text{otherwise.} \end{cases} \tag{7}
$$

We can easily show that τ_e is smaller than t if and only if $c<(2h-1)t$. The profit at which the incumbent discloses its knowledge and sets τ_e and that at which it does not are:

$$
\pi_I\left(\frac{n}{2}-(h+1),\tau_e\right) = \begin{cases} \Big[(n+2h)\sqrt{(1-2c)^2+4(h-1)((1-c)-ht)t} \\ \quad -(n-2h+4-2(2+(2h-1)n)c)\Big]^2\Big/16(h-1)^2(n+1)^2 \\ \quad +\dfrac{(2-2c-(n+2(h+1))t)^2}{4(n+1)^2}, \quad (h\neq 1), \\ \dfrac{(2(1-2c)(1+(n-1)c)+(n+2h)(1-c-t)t)^2}{4(1-2c)^2(n+1)^2}, \quad (h=1), \end{cases} \tag{8}
$$

$$
\pi_I\left(\frac{n}{2}-h,t\right) = \frac{(2+2(n-1)c+(n+2(h-1))t)^2}{4(n+1)^2}+\frac{(2-2c-(n+2h)t)^2}{4(n+1)^2}. \tag{9}
$$

If the difference between $\pi_I(n/2-(h+1),\tau_e)$ in (8) and $\pi_I(n/2-h,t)$ in (9) is positive, know-how disclosure enhances the profit of the incumbent firm. We now define $J_e(t,h)$ as follows:

$$
J_e(t,h)\equiv\pi_I\left(\frac{n}{2}-(h+1),\tau_e\right)-\pi_I\left(\frac{n}{2}-h,t\right).
$$

We now check the following cases: (i) $h = 1$ ($c \in (0, t)$ or $t > c$), (ii) $h = 2$ ($c \in [t, 3t)$ or $t \in (c/3, c]$), (iii) h is larger than 2.

First, we consider the case in which $h = 1$ ($c \in (0, t)$ or $t > c$). $J_e(t, 1)$ is:

$$J_e(t,1) = \frac{t\bar{J}}{4(1-2c)^2(n+1)^2},$$

where $\bar{J} \equiv 4c(1-2c)((1-c)(2+3n)+n^2c)+(n+2)(4-2(n+8)c+(5n+18)c^2)t^2-(2(1-c)-t)(n+2)^2t^2$. If $\bar{J}$ is positive, then $J_e(t, 1)$ is also positive. Differentiating $\bar{J}$ with respect to t twice, we have:[4]

$$\frac{\partial^2 \bar{J}}{\partial t^2} = -2(n+2)^2(2-2c-3t) < 0.$$

$\bar{J}$ is a concave function with respect to t. We now substitute $t = c$ (the lower bound of t) and $t = 2(1-c)/(n+6)$ (a necessary condition that the quantities supplied by the firms are positive) into $\bar{J}$, then we have:

$$\begin{aligned}
\bar{J}_{t=c} &= 16c(1-2c)^2(n+1) > 0, \\
\bar{J}_{t=2(1-c)/(n+6)} &= \frac{8(n+2)(5n+26) - 4(n^4+19n^3+107n^2+168n-84)c}{(n+1)^3} \\
&\quad - \frac{2(-2n^5-25n^4+940n^2+2928n+384)c^2}{(n+1)^3} \\
&\quad - \frac{2(4n^5+65n^4+292n^3-60n^2-2112n-512)c^3}{(n+1)^3}.
\end{aligned}$$

After some calculus, we can show that for any $c < 1/2$ (this is a necessary condition that the quantities supplied by the firms are positive) and n, $\bar{J}_{t=2(1-c)/(n+6)}$ is positive.[5]

Proposition 3 *Suppose that $c \in (0, t)$ and that n is even and larger than or equal to 4. The disclosure increases the profit of the incumbent firm.*

[4] In this case, the quantity supplied by the incumbent firm in market B is $(2-2c-(n+2h)t)/(2(n+1))$. If this is positive, $(2-2c-3t)$ is also positive.

[5] First, we differentiate $\bar{J}_{t=2(1-c)/(n+6)}$ with respect to c. This is a quadratic function with respect to c. Solving the quadratic equation $(\partial\bar{J}_{t=2(1-c)/(n+6)})/(\partial c) = 0$ with respect to c, we find that one solution (which we now denote as c_p) is positive and the other is negative. When $c = 0$, $(\partial\bar{J}_{t=2(1-c)/(n+6)})/(\partial c)$ is positive. Therefore, when $c \in [0, c_p]$, $\bar{J}_{t=2(1-c)/(n+6)}$ is increasing with respect to c, and when $c \in [c_p, 1/2]$, $\bar{J}_{t=2(1-c)/(n+6)}$ is decreasing with respect to c. If $\bar{J}_{t=2(1-c)/(n+6)}$ is positive when $c = 0$ and $c = 1/2$, then $\bar{J}_{t=2(1-c)/(n+6)}$ is positive for any $c < 1/2$. When $c = 0$, $\bar{J}_{t=2(1-c)/(n+6)}$ is $8(n+2)(5n+26)/(n+6)^3$. When $c = 1/2$, $\bar{J}_{t=2(1-c)/(n+6)}$ is $(n+2)^2(n+4)^2/4(n+6)^3$. Therefore, $\bar{J}_{t=2(1-c)/(n+6)}$ is positive.

Second, we consider the case in which $h = 2$ ($c \in [t, 3t)$ or $c/3 < t \leq c$). n is larger than or equal to 6. Differentiating $J_e(t, 2)$ with respect to t three times, we have:

$$\frac{\partial^3 J_e(t,2)}{\partial t^3} = -\frac{3(n+4)(8-10c+9c^2)(n-2(3n+2)c)(1-c-4t)}{(n+1)^2((1-2c)^2+4(1-c)t-8t^2)^{5/2}}.$$

The sign of $\frac{\partial^3 J_e(t,2)}{\partial t^3}$ does not depend on the value of t because $(1-c-4t)$ is always positive.[6] For any t, the sign of $\frac{\partial^3 J_e(t,2)}{\partial t^3}$ is always negative or always positive. Therefore, if $(\partial^2 J_e(t,2))/(\partial t^2)$ is negative when $t = c/3$ and $t = c$, the sign of $(\partial^2 J_e(t,2))/(\partial t^2)$ is negative for any t.

(1) $t = c/3$: Substituting $t = c/3$ into $(\partial^2 J_e(t,2))/(\partial t^2)$, we have:

$$\left.\frac{\partial^2 J_e(t,2)}{\partial t^2}\right|_{t=c/3} = -\frac{(n+4)(4(27-27c-126c^2+179c^3)+3c(144-477c+422c^2)n)}{2(n+1)^2(3-4c)^3} < 0,$$

because $(27-27c-126c^2+179c^3)$ and $(144-477c+422c^2)$ are positive for any $c < 1/2$.

(2) $t = c$: Substituting $t = c$ into $(\partial^2 J_e(t,2))/(\partial t^2)$, we have:

$$\left.\frac{\partial^2 J_e(t,2)}{\partial t^2}\right|_{t=c} = -\frac{(n+4)((3n+4)(1-8c^2)^{3/2}+(-H_b)(3-10c+9c^2)}{2(n+1)^2(1-8c^2)^{3/2}} < 0.$$

Therefore, $J_e(t, 2)$ is concave with respect to t. We now substitute $t = c/3$ (the lower bound of t) and $t = c$ (the upper bound of t) into $J_e(t, 2)$, then we have:

$$\begin{aligned} J_e\left(\frac{c}{3}, 2\right) &= \frac{8c^2}{9(n+1)} > 0, \\ J_e(c, 2) &= \frac{(n+4)(n-2(2+3n)c)(1-\sqrt{1-8c^2})-4n^2c^2}{8(n+1)^2}. \end{aligned}$$

If n and c are in the shaded area of Figure S4, $J_e(t, 2)$ is positive for any $t \in [c/3, c)$, otherwise there exists $\bar{t}''$ such that $J_e(t, 2) = 0$ and that for any $t \in [c/3, \bar{t}'')$, disclosure increases the profit of the incumbent firm because $J_e(t, 2)$ is concave. We can summarize this as the following proposition.

Proposition 4 *Suppose that $c \in (t, 3t)$ and that n is even and larger than or equal to 6. If $J_e(c, 2) > 0$, for any $t \in [c/3, c)$, the disclosure increases the profit of the incumbent firm. Otherwise, there exists $\bar{t}''$ such that $J_e(t, 2) = 0$, and for any $t \in (c/3, \bar{t}'')$, the disclosure increases the profit of the incumbent firm.*

[6] In this case, the quantity supplied by the incumbent firm in market B is $(2-2c-(n+2h)t)/(2(n+1))$. If this is positive, $(1-c-4t)$ is also positive.

Finally, we briefly discuss the case in which h is larger than two. After some calculus, we find that given $k = n/2 - h$ entrant firms locate at A, $J_e(t, h)$ is minimized when $t = c/(2h - 1)$ or $t = c/(2h - 3)$.[7] $J_e(c/(2h-1), h) = 4c^2h/((2h-1)^2(n+1)) > 0$. Therefore, if $J_e(c/(2h-3), h)$ is positive for any c, h, and n, in the given range of t ($[c/(2h-1), c/(2h-3)]$), disclosure enhances the profit of the incumbent firm. Note that h is related to the value of t. As the value of h increases, the value of t decreases.

We now show two examples of these values. From Figures S5 and S6, we find that as the value of h increases, the condition that disclosure enhances the profit of the incumbent firm tends to hold. As mentioned earlier, as the value of h increases, the value of t decreases. That is, as the value of t becomes smaller, the condition tends to hold.

0.2 Entrant firms

We now consider the changes in the profits of the entrant firms. There are two types of entrants: those who locate in market A and those who locate in market B.

Suppose that k entrant firms locate at A and $n-(k+1)$ firms locate at B ($k = 0, 1, 2, n-1$) (note that the incumbent has already located at A). The profit of the incumbent firm (denoted as $\pi_I(k, \tau)$), the profit of the entrant firm locating at A (denoted as $\pi_A(k, \tau)$), and the profit of the firm locating at B (denoted as $\pi_B(k, \tau)$) are:

$$\begin{aligned}\pi_A(k,\tau) &= \frac{(1-2c+(n-k-1)\tau)^2}{(n+1)^2} + \frac{(1-c-(n-k)t)^2}{(n+1)^2},\\ \pi_B(k,\tau) &= \frac{(1-2c-(k+2)\tau)^2}{(n+1)^2} + \frac{(1-c+(k+1)t)^2}{(n+1)^2}.\end{aligned}$$

We have to distinguish two cases: n is odd; n is even. First, we consider the case in which n is odd, and then that in which n is even.

[7] We first differentiate $J_e(t, h)$ with respect to t three times. The sign of $(\partial^3 J_e(t,h))/(\partial t^3)$ does not depend on t but on the other parameters. This means that the sign $(\partial^3 J_e(t,h))/(\partial t^3)$ is always positive or always negative on the range of t $[c/(2h-1), c/(2h-3)]$. If the signs of $(\partial^2 J_e(t,h))/(\partial t^2)$ are negative at $t = c/(2h-1)$ and $t = c/(2h-3)$, the sign of $(\partial^2 J_e(t,h))/(\partial t^2)$ is always negative for any $t \in [c/(2h-1), c/(2h-3)]$. That is, $J_e(t, h)$ is concave with respect to t. Substituting $t = c/(2h-1)$ and $t = c/(2h-3)$ into $(\partial^2 J_e(t,h))/(\partial t^2)$, we have the values of $(\partial^2 J_e(t,h))/(\partial t^2)$ at $t = c/(2h-1)$ and $t = c/(2h-3)$. The numerators of the values are quadratic and concave functions with respect to n. Solving the quadratic equations $(\partial^2 J_e(t,h))/(\partial t^2)|_{t=c/(2h-1)} = 0$ and $(\partial^2 J_e(t,h))/(\partial t^2)|_{t=c/(2h-3)} = 0$ with respect to n, we find that for both equations the solutions are negative. Therefore, the values of $(\partial^2 J_e(t,h))/(\partial t^2)$ at $t = c/(2h-1)$ and $t = c/(2h-3)$ are negative, that is, $J_e(t, h)$ is a concave function with respect to t.

0.2.1 Entrant firms locating in market A

We now discuss the profits of the firms locating in market A.

n is odd When n is odd, in any case, the number of firms in each market is different. Given that $k = (n-1)/2 - h$ $(h = 1, 2, 3, \ldots)$ entrant firms locate in market A in the nondisclosure case $(c \in [2(h-1), 2ht))$, to induce an entrant firm that would locate in market A in the nondisclosure case to locate in market B, the incumbent sets τ at τ_o (which is defined in (4)):

$$\tau_o = \frac{-(1-2c) + \sqrt{(1-2c)^2 + 2(2h-1)(1-c)t - (4h^2-1)t^2}}{2h-1}.$$

The profit in the cases when the incumbent discloses its knowledge and sets τ_o and when it does not is:

$$\begin{aligned}\pi_A\left(\frac{n-1}{2} - (h+1), \tau_o\right) &= \Big[(1+2h+n)\sqrt{(1-2c)^2 + 2(2h-1)(1-c)t - (4h^2-1)t^2} \quad (10)\\ &\quad -(n-2h+3)(1-2c)\Big]^2 \Big/ 4(2h-1)^2(n+1)^2\\ &\quad + \frac{(2-2c-(n+2h+3)t)^2}{4(n+1)^2},\\ \pi_A\left(\frac{n-1}{2} - h, t\right) &= \frac{(2-4c+(n+2h-1)t)^2}{4(n+1)^2} + \frac{(2-2c-(n+2h+1)t)^2}{4(n+1)^2}. \quad (11)\end{aligned}$$

If the difference between $\pi_A((n-1)/2-(h+1), \tau_o)$ in (10) and $\pi_A((n-1)/2-h, t)$ in (11) is positive, the know-how disclosure enhances the profits of entrant firms who locate in market A. We now define $J_o^A(t, h)$ as follows:

$$J_o^A(t,h) \equiv \pi_A\left(\frac{n-1}{2} - (h+1), \tau_o\right) - \pi_A\left(\frac{n-1}{2} - h, t\right).$$

We now check the three cases: (i) $h = 1$ $(c \in (0, 2t)$ or $t > c/2)$, (ii) $h = 2$ $(c \in [2t, 4t)$ or $t \in (c/4, c/2])$, and (iii) h is larger than 2 $(c \in [2(h-1)t, 2ht)$ or $t \in (c/(2h), c/(2(h-1))])$.

First, we consider the case in which $h = 1$ $(c \in (0, 2t)$ or $t > c/2)$. Differentiating $J_o^A(t, 1)$ with respect to t twice, we have (note that c and t are smaller than 1/2):

$$\frac{\partial^2 J_o^A(t,1)}{\partial t^2} = -\frac{(n+3)(((1-2c)^2 + 2(1-c)t - 3t^2)^{3/2} - (1-2c)(4-14c+13c^2))}{2(n+1)((1-2c)^2 + 2(1-c)t - 3t^2)^{3/2}} < 0.$$

Therefore, $J_o^A(t,1)$ is concave with respect to t. We now substitute $t = c/2$ (the lower bound of t) into $J_o^A(t,1)$, then we have:

$$J_o^A\left(\frac{c}{2},1\right) = \frac{c^2}{2(n+1)} > 0.$$

We find that there exists $\tilde{t}$ such that $J_o^A(t,1) = 0$ and that for any $t \in [c/2, \bar{t})$, disclosure increases the profit of the incumbent firm because $J_o^A(t,1)$ is concave. We can summarize this as the following proposition.

Proposition 5 *Suppose that $c \in (0, 2t)$. There exists $\tilde{t}$ such that $J_o^A(t,1) = 0$. For any $t \in (c/2, \tilde{t})$, the disclosure increases the profit of the incumbent firm.*

Second, we consider the case in which $h = 2$ ($c \in [2t, 4t)$ or $c/4 < t \leq c/2$). Differentiating $J_o^A(t,2)$ with respect to t three times, we have:

$$\begin{aligned}
\frac{\partial^3 J_o^A(t,2)}{\partial t^3} &= -\frac{3(1-2c)(n+5)(8-26c+23c^2)(n-1)(1-c-5t)}{2(n+1)^2((1-2c)^2+3(1-c)t-15t^2)^{5/2}} < 0, \\
\frac{\partial^2 J_o^A(t,2)}{\partial t^2} &= \frac{(n+5)[(1-2c)(8-26c+23c^2)(n-1)]}{6(n+1)^2((1-2c)^2+3(1-c)t-15t^2)^{3/2}} - \frac{8(n+5)(n+2)}{6(n+1)^2}.
\end{aligned}$$

We now show that the sign of $(\partial^2 J_o^A(t,2))/(\partial t^2)$ is negative in all cases. Substituting $t = c/4$ (the lower bound of t) into $(\partial^2 J_o^A(t,2))/(\partial t^2)$, we have:

$$\left.\frac{\partial^2 J_o^A(t,2)}{\partial t^2}\right|_{t=c/4} = -\frac{4(n+5)(2(32-136c+200c^2-103c^3)+c(32-100c+81c^2)n)}{(n+1)^2(4-5c)^3} < 0,$$
$$\text{for any } c < 1/2.$$

Because $\frac{\partial^3 J_o^A(t,2)}{\partial t^3}$ is negative, $(\partial^2 J_o^A(t,2))/(\partial t^2)$ is negative, that is, $J_o^A(t,2)$ is concave with respect to t. We now substitute $t = c/4$ (the lower bound of t) and $t = c/2$ (the upper bound of t) into $J_o^A(t,2)$, then we have:

$$\begin{aligned}
J_o^A\left(\frac{c}{4},2\right) &= \frac{c^2}{8(n+1)} > 0, \\
J_o^A\left(\frac{c}{2},2\right) &= \frac{(n+5)(2-5c)(n+5)-(31+4n+n^2)c^2}{36(n+1)^2} \\
&\quad - \frac{(n+5)(n-1)(1-2c)\sqrt{4-4c-11c^2}}{36(n+1)^2} < 0.
\end{aligned}$$

There exists $\tilde{t}'$ such that $J_o^A(t,2) = 0$ and that for any $t \in [c/4, \tilde{t}')$, disclosure increases the profit of the incumbent firm because $J_o^A(t,2)$ is concave. We can summarize this as the following proposition.

Proposition 6 *Suppose that $c \in (2t, 4t)$. There exists $\tilde{t}'$ such that $J_o^A(t, 2) = 0$. For any $t \in (c/4, \tilde{t}')$, the disclosure increases the profit of the incumbent firm.*

Finally, we briefly discuss the case in which h is larger than two. After some calculus, we find that, given that $k = (n-1)/2 - h$ entrant firms locate at A, $J_o(t, h)$ is minimized when $t = c/(2(h-1))$.[8] $J_o^A(c/(2h), h) = c^2/(2h^2(n+1)) > 0$. Therefore, we have the following result: *Suppose that $c \in (2(h-1)t, 2ht)$ and n is odd. There exists $\tilde{t}_g'$ such that $J_o^A(t, h) = 0$. For any $t \in (c/(2h), \tilde{t}_g')$, the disclosure increases the profit of the incumbent firm.*

n **is even** Given that $k = n/2 - h$ entrant firms locate in market A in the nondisclosure case ($c \in [(2h-3)t, (2h-1)t)$) (when $h = 1$, the range is $(0, t)$), to induce an entrant firm who would locate in market A in the nondisclosure case to locate in market B, τ satisfies the following inequalities, the incumbent sets τ at τ_e:

$$\tau_e = \begin{cases} \dfrac{(1-c-t)t}{1-2c} & \text{if } h = 1, \\ \dfrac{-(1-2c) + \sqrt{(1-2c)^2 + 4(h-1)(1-c-ht)t}}{2(h-1)}, & \text{otherwise.} \end{cases}$$

The profit when the incumbent discloses its knowledge and sets τ_e and that when it does not do so is:

$$\pi_A\left(\frac{n}{2} - (h+1), \tau_e\right) = \begin{cases} \Big[(n+2h)\sqrt{(1-2c)^2 + 4(h-1)((1-c) - ht)t} \\ \quad -(n-2h+4)(1-2c)\Big]^2 \Big/ 16(h-1)^2(n+1)^2 \\ \quad + \dfrac{(2-2c-(n+2(h+1))t)^2}{4(n+1)^2}, \ (h \neq 1) \\ \dfrac{(2-6c+5c^2-2(1-c)t+t^2)(4(1-2c)^2+(n+2)^2t^2)}{4(1-2c)^2(n+1)^2}, \ (h=1), \end{cases} \tag{12}$$

$$\pi_A\left(\frac{n}{2} - h, t\right) = \frac{(2-4c+(n+2(h-1))t)^2}{4(n+1)^2} + \frac{(2-2c-(n+2h)t)^2}{4(n+1)^2}. \tag{13}$$

[8] We first differentiate $J_o^A(t, h)$ with respect to t three times. The sign of $(\partial^3 J_o^A(t, h))/(\partial t^3)$ does not depend on t but on the other parameters. This means that the sign $(\partial^3 J_o^A(t, h))/(\partial t^3)$ is always positive or always negative on the range of t $[c/(2h), c/(2(h-1))]$. If the signs of $(\partial^2 J_o^A(t, h))/(\partial t^2)$ are negative at $t = c/(2h)$ and $t = c/(2(h-1))$, the sign of $(\partial^2 J_o^A(t, h))/(\partial t^2)$ is always negative for any $t \in [c/(2h), c/(2(h-1))]$. That is, $J_o^A(t, h)$ is concave with respect to t. Substituting $t = c/(2h)$ and $t = c/(2(h-1))$ into $(\partial^2 J_o^A(t, h))/(\partial t^2)$, we have the values of $(\partial^2 J_o^A(t, h))/(\partial t^2)$ at $t = c/(2h)$ and $t = c/(2(h-1))$. The numerators of the values are quadratic and concave functions with respect to n. Solving the quadratic equations $(\partial^2 J_o^A(t, h))/(\partial t^2)|_{t=c/(2h)} = 0$ and $(\partial^2 J_o^A(t, h))/(\partial t^2)|_{t=c/(2(h-1))} = 0$ with respect to n, we find that under the both equations the solutions are negative. Therefore, the values of $(\partial^2 J_o^A(t, h))/(\partial t^2)$ at $t = c/(2h)$ and $t = c/(2(h-1))$ are negative, that is, $J_o^A(t, h)$ is concave function with respect to t.

If the difference between $\pi_I(n/2-(h+1),\tau_e)$ in (12) and $\pi_I(n/2-h,t)$ in (13) is positive, know-how disclosure enhances the profit of entrant firms locating in market A. We now define $J_e^A(t,h)$ as follows:

$$J_e^A(t,h) \equiv \pi_A\left(\frac{n}{2}-(h+1),\tau_e\right)-\pi_A\left(\frac{n}{2}-h,t\right).$$

We now check the three cases: (i) $h=1$ ($c\in(0,t)$ or $t>c$), (ii) $h=2$ ($c\in[t,3t)$ or $t\in(c/3,c]$), and (iii) h is larger than 2 ($c\in[(2h-3)t,(2h-1)t)$ or $t\in(c/(2h-1),c/(2h-3)]$).

First, we consider the case in which $h=1$ ($c\in(0,t)$ or $t>c$). $J_e^A(t,1)$ is:

$$J_e^A(t,1)=\frac{t\tilde{J}}{4(1-2c)^2(n+1)^2},$$

where $\tilde{J}\equiv 4c(1-2c)^2n+(n+2)(4+2(n-6)c-(3n-10)c^2)t-(2(1-c)-t)(n+2)^2t^2$. If $\tilde{J}$ is positive, then $J_e^A(t,1)$ is also positive. Differentiating $\tilde{J}$ with respect to t twice, we have:

$$\frac{\partial^2\tilde{J}}{\partial t^2}=-2(n+2)^2(2-2c-3t)<0.$$

$\tilde{J}$ is a concave function with respect to t. We now substitute $t=c$ (the lower bound of t) and $t=2(1-c)/(n+6)$ (a necessary condition that the quantities supplied by the firms are positive) into $\tilde{J}$, then we have:

$$\begin{aligned}\tilde{J}_{t=c} &= 8c(1-2c)^2(n+1)>0,\\ \tilde{J}_{t=2(1-c)/(n+6)} &= \frac{16(1-c)(13-44c+40c^2)+48(3-2c-22c^2+30c^3)n}{(n+6)^3}\\ &\quad+\frac{4(5+55c-241c^2+235c^3)n^2+12c(5-17c+15c^2)n^3}{(n+6)^3}\\ &\quad+\frac{c(4-13c+11c^2)n^4}{(n+6)^3}.\end{aligned}$$

After some calculus (we can show that the coefficients of n's are positive), we find that for any $c<1/2$ (this is a necessary condition that the quantities supplied by the firms are positive) and n, $\tilde{J}_{t=2(1-c)/(n+6)}$ is positive.

Proposition 7 *Suppose that $c\in(0,t)$ and that n is even. The disclosure increases the profits of the entrant firms locating in A.*

Second, we consider the case in which $h = 2$ ($c \in [t, 3t)$ or $c/3 < t \leq c$). Differentiating $J_e^A(t, 2)$ with respect to t three times, we have:

$$\frac{\partial^3 J_e^A(t,2)}{\partial t^3} = -\frac{3(1-2c)(3-10c+9c^2)n(n+4)(1-c-4t)}{(n+1)^2((1-2c)^2+4(1-c)t-8t^2)^{5/2}} < 0.$$

We now show that the sign of $(\partial^2 J_e^A(t,2))/(\partial t^2)$ is negative for any t. Substituting $t = c/3$ into $(\partial^2 J_e^A(t,2))/(\partial t^2)$, and then for any $c < 1/2$ we have:

$$\left.\frac{\partial^2 J_e^A(t,2)}{\partial t^2}\right|_{t=c/3} = -\frac{(n+4)(4(3-4c)^3+3c(36-117c+98c^2)n)}{2(n+1)^2(3-4c)^3} < 0.$$

Therefore, $J_e^A(t, 2)$ is concave with respect to t. We now substitute $t = c/3$ (the lower bound of t) and $t = c$ (the upper bound of t) into $J_e(t, 2)$, then we have:

$$\begin{aligned}
J_e^A\left(\frac{c}{3}, 2\right) &= \frac{2c^2}{9(n+1)} > 0, \\
J_e^A(c, 2) &= \frac{n(n+4)(1-2c) - 4(n+2)^2c^2 - n(n+4)(1-2c)\sqrt{1-8c^2}}{8(n+1)^2} < 0.
\end{aligned}$$

There exists $\tilde{t}''$ such that $J_e^A(t, 2) = 0$ and that for any $t \in [c/3, \tilde{t}'')$, the disclosure increases the profit of the incumbent firm because $J_e^A(t, 2)$ is concave. We can summarize this as the following proposition.

Proposition 8 *Suppose that $c \in (t, 3t)$ and that n is even. There exists $\tilde{t}''$ such that $J_e^A(t, 2) = 0$. For any $t \in (c/3, \tilde{t}'')$, the disclosure increases the profit of the incumbent firm.*

Finally, we briefly discuss the case in which h is larger than two. After some calculus, we find that given $k = n/2 - h$ entrant firms locate at A, $J_e(t, h)$ is minimized when $t = c/(2(h-1))$.[9] $J_e^A(c/(2h-1), h) = 2c^2/((2h-1)^2(n+1)) > 0$. Therefore, we have the following result: *Suppose that $c \in ((2h-3)t, (2h-1)t)$ and n is even. There exists $\tilde{t}_g''$ such that $J_e^A(t, h) = 0$. For any $t \in (c/(2h-1), \tilde{t}_g'')$, the disclosure increases the profit of the incumbent firm.*

0.2.2 Entrant firms locating in market B

We now discuss the profits of the firms locating in market B.

[9] The procedure to prove it is similar to that in the odd case.

n is odd When n is odd, in any case, the number of firms in each market is different. Given that $k = (n-1)/2 - h$ ($h = 1, 2, 3, \ldots$) entrant firms locate in market A in the nondisclosure case ($c \in [2(h-1), 2ht)$), to induce an entrant firm who would locate in market A in the nondisclosure case to locate in market B, the incumbent sets τ at τ_o:

$$\tau_o = \frac{-(1-2c) + \sqrt{(1-2c)^2 + 2(2h-1)(1-c)t - (4h^2-1)t^2}}{2h-1}.$$

We can easily show that this is smaller than t if and only if $c < 2ht$. The profit in which the incumbent discloses its knowledge and sets τ_o and that in which it does not are:

$$\begin{aligned} \pi_B\left(\frac{n-1}{2} - (h+1), \tau_o\right) &= \Big[(1-2h+n)\sqrt{(1-2c)^2 + 2(2h-1)(1-c)t - (4h^2-1)t^2} \qquad (14) \\ &\quad -(n+2h-1)(1-2c)\Big]^2 \Big/ 4(2h-1)^2(n+1)^2 \\ &\quad + \frac{(2-2c+(n-2h-1)t)^2}{4(n+1)^2}, \\ \pi_B\left(\frac{n-1}{2} - h, t\right) &= \frac{(2-4c-(n-2h-3)t)^2}{4(n+1)^2} + \frac{(2-2c+(n-2h+1)t)^2}{4(n+1)^2}. \qquad (15) \end{aligned}$$

If the difference between $\pi_B((n-1)/2-(h+1), \tau_o)$ in (14) and $\pi_B((n-1)/2-h, t)$ in (15) is negative, know-how disclosure diminishes the profits of the entrant firms who locate in market B. We now define $J_o^B(t,h)$ as follows:

$$J_o^B(t,h) \equiv \pi_B\left(\frac{n-1}{2} - (h+1)\right) - \pi_B\left(\frac{n-1}{2} - h\right).$$

We now check the cases (i) $h = 1$ ($c \in (0, 2t)$ or $t > c/2$), (ii) $h = 2$ ($c \in [2t, 4t)$ or $t \in (c/4, c/2]$), and (iii) h is larger than 2 ($c \in [2(h-1)t, 2ht)$ or $t \in (c/(2h), c/(2(h-1))]$).

First, we consider the case in which $h = 1$ ($c \in (0, 2t)$ or $t > c/2$). Differentiating $J_o^B(t,1)$ with respect to t twice, we have (note that c and t is smaller than $1/2$ and $t > c/2$):

$$\frac{\partial^2 J_o^B(t,1)}{\partial t^2} = -\frac{(n-1)(4((1-2c)^2 + 2(1-c)t - 3t^2)^{3/2} - (1-2c)(4-14c+13c^2))}{2(n+1)((1-2c)^2 + 2(1-c)t - 3t^2)^{3/2}} < 0.$$

We now substitute $t = c/2$ (the lower bound of t) into $J_o^B(t)$ and $\frac{\partial J_o^B(t)}{\partial t}$, then we have:

$$\begin{aligned} \frac{\partial J_o^B(t,1)}{\partial t}\Big|_{\frac{c}{2}} &= -\frac{c(4+(n-7)c)}{2(2-3c)(n+1)} < 0, \\ J_o^B\left(\frac{c}{2}, 1\right) &= -\frac{c^2}{2(n+1)} < 0. \end{aligned}$$

Because $\partial^2 J_o^B/\partial t^2 < 0$, $\partial J_o^B/\partial t$ is negative and then $J_o^B(t,1)$ is negative for any $t (> c/2)$.

Proposition 9 *Suppose that $c \in (0, 2t)$ and that n is odd. The disclosure decreases the profit of the entrant firms locating at B.*

Second, we consider the case in which $h = 2$ ($c \in [2t, 4t)$ or $c/4 < t \leq c/2$). We now relabel $J_o^B(t, 2)$ as $J_o^B(c, 2)$. That is, we now treat J_o^B as a function with respect to c. Differentiating $J_o^B(c, 2)$ with respect to c three times, we have:

$$\begin{aligned}
\frac{\partial^3 J_o^B(c,2)}{\partial c^3} &= -\frac{3(n^2-9)(3-2c-10t)(4-23t)t^2}{2(n+1)^2((1-2c)^2+3(1-c)t-15t^2)^{5/2}} < 0, \\
\frac{\partial^2 J_o^B(c,2)}{\partial c^2} &= \frac{-(n^2-9)(8+72t-117t^2-180t^3)}{18(n+1)^2((1-2c)^2+3(1-c)t-15t^2)^{3/2}} \\
&\quad + \frac{(n^2-9)[6(8+36t-51t^2)c-48(2+3t)c^2+64c^3]}{18(n+1)^2((1-2c)^2+3(1-c)t-15t^2)^{3/2}} - \frac{4(n^2-9)}{9(n+1)^2}.
\end{aligned}$$

We now show that the sign of $(\partial^2 J_o^B(c,2))/(\partial c^2)$ is positive for any c. Substituting $c = 4t$ (the upper bound of c) into $(\partial^2 J_o^B(c,2))/(\partial c^2)$, we have:

$$\left.\frac{\partial^2 J_o^B(c,2)}{\partial c^2}\right|_{c=4t} = \frac{9(n^2-9)t^2(5-28t)}{18(n+1)^2(1-5t)^3} > 0, \text{ for any } t < 2/(9+n).$$

Note that $t < 2/(9+n)$ is a necessary condition that the quantity supplied by the firms are positive. $(\partial^2 J_o^B(c,2))/(\partial c^2)$ is positive, that is, $J_o^B(c, 2)$ is convex with respect to c. We now substitute $c = 4t$ (the upper bound of c) and $c = 2t$ (the lower bound of c) into $J_o^B(c, 2)$, then we have:

$$\begin{aligned}
J_o^B(4t, 2) &= -\frac{2t^2}{n+1} < 0, \\
J_o^B(2t, 2) &= \frac{(n^2-9)(1-5t) - 2(n^2+27)t^2 - (n^2-9)(1-4t)\sqrt{1-2t-11t^2}}{18(n+1)^2} < 0.
\end{aligned}$$

For any $t \in [c/4, c/2)$, disclosure decreases the profit of the entrant firms.

Proposition 9' *Suppose that $c \in (2t, 4t)$ and that n is odd. The disclosure decreases the profit of the entrant firms locating at B.*

Finally, we briefly discuss the case in which h is larger than two. After some calculus, we find that given $k = (n-1)/2 - h$ entrant firms locate at A, $J_o^B(c, h)$ is a convex function with respect to c.[10] $J_o^B(2(h-1)t, h)$ and $J_o^B(2ht, h)$ are negative. Therefore, we have the following proposition.

[10] We first differentiate $J_o^B(c, h)$ with respect to c three times. The sign of $(\partial^3 J_o^B(c,h))/(\partial c^3)$ depends not on t but on the other parameters. This means that the sign $(\partial^3 J_o^B(c,h))/(\partial c^3)$ is always positive or always negative in the range of c

Proposition 9" *Suppose that $c \in (2(h-1)t, 2ht)$ and n is odd. The disclosure decreases the profits of entrant firms locating in market B.*

n is even Given that $k = n/2 - h$ entrant firms locate in market A in the nondisclosure case ($c \in [(2h-3)t, (2h-1)t)$), to induce an entrant firm that would locate in market A in the nondisclosure case to locate in market B, the incumbent sets τ at τ_e:

$$\tau_e = \begin{cases} \dfrac{(1-c-t)t}{1-2c} & \text{if } h = 1, \\ \dfrac{-(1-2c)+\sqrt{(1-2c)^2+4(h-1)(1-c-ht)t}}{2(h-1)}, & \text{otherwise.} \end{cases}$$

We can easily show that this is smaller than t if and only if $c < (2h-1)t$. The profit when the incumbent discloses its knowledge and sets τ at the above-mentioned level and that when it does not is:

$$\pi_B\left(\frac{n}{2}-(h+1), \tau_e\right) = \begin{cases} \Big[(n-2h+2)\sqrt{(1-2c)^2+4(h-1)((1-c)-ht)t} \\ \quad -(n+2h-2)(1-2c)\Big]^2 \Big/ 16(h-1)^2(n+1)^2 \\ \quad +\dfrac{(2-2c+(n-2h))t)^2}{4(n+1)^2}, \ (h \neq 1), \\ \dfrac{(2(1-2c)^2-(1-c)nt+nt^2)^2}{4(1-2c)^2(n+1)^2} + \dfrac{(2(1-c)+(n-2)t)^2}{4(n+1)^2}, \ (h=1), \end{cases} \tag{16}$$

$$\pi_B\left(\frac{n}{2}-h\right) = \frac{(2-4c-(n-2(h-2))t)^2}{4(n+1)^2} + \frac{(2-2c+(n-2h+2)t)^2}{4(n+1)^2}. \tag{17}$$

If the difference between $\pi_B(n/2-(h+1), \tau_e)$ in (16) and $\pi_B(n/2-h, t)$ in (17) is negative, the know-how disclosure decreases the profit of the entrant firms locating at B. We now define $J_e^B(t,h)$ as follows:

$$J_e^A(t,h) \equiv \pi_B\left(\frac{n}{2}-(h+1), \tau_e\right) - \pi_B\left(\frac{n}{2}-h, t\right).$$

We now check the cases (i) $h = 1$ ($c \in (0,t)$ or $t > c$), (ii) $h = 2$ ($c \in [t, 3t)$ or $t \in (c/3, c]$), and (iii) h is larger than 2 ($c \in [(2h-3)t, (2h-1)t)$ or $t \in (c/(2h-1), c/(2h-3)]$).

$[2(h-1)t, 2ht]$. If the signs of $(\partial^2 J_o^B(c,h))/(\partial c^2)$ are positive at $c = 2(h-1)t$ and $t = 2ht$, the sign of $(\partial^2 J_o^B(c,h))/(\partial c^2)$ is always positive for any $c \in [2(h-1)t, 2ht]$. That is, $J_o^B(c,h)$ is convex with respect to c. Substituting $c = 2(h-1)t$ and $c = 2ht$ into $(\partial^2 J_o^B(c,h))/(\partial c^2)$, we have the values of $(\partial^2 J_o^B(c,h))/(\partial c^2)$ at $c = 2(h-1)t$ and $c = 2ht$. The numerators of the values contain the following quadratic form $B(t,h,c)(n-2h+2)(n+2h-2) > 0$ ($B(t,h,c)$ is a function of t and h and the value of B depends on c). Therefore, the values of $(\partial^2 J_o^B(c,h))/(\partial c^2)$ at $c = 2(h-1)t$ and $c = 2ht$ are positive, that is, $J_o^B(t,h)$ is a convex function with respect to c.

First, we consider the case in which $h = 1$ ($c \in (0, t)$ or $t > c$). $J_e^B(t, 1)$ is:

$$J_e^B(t,1) = \frac{t\hat{J}}{4(1-2c)^2(n+1)^2},$$

where $\hat{J} \equiv -4c(1-2c)^2(n+2) - n(4-2(n+8)c + (3n+16)c^2)t - 2(1-c)n^2t^2 + n^2t^3$. If $\hat{J}$ is negative, then $J_e^B(t, 1)$ is also negative. Differentiating $\hat{J}$ with respect to t twice, we have:

$$\frac{\partial^2 \hat{J}}{\partial t^2} = -2n^2(2-2c-3t) < 0. \tag{18}$$

$\hat{J}$ is a concave function with respect to t. We now substitute $t = c$ (the lower bound of t) into $\hat{J}$ and $\partial\hat{J}/\partial t$, then we have:

$$\begin{aligned}\hat{J}_{t=c} &= -\frac{2c^2}{1+n} < 0,\\ \frac{\partial \hat{J}}{\partial t}_{t=c} &= -2(1-2c)n(2-4c+cn) < 0.\end{aligned}$$

$\partial\hat{J}/\partial t$ is negative for any t and then $\hat{J}$ is negative.

Proposition 10 *Suppose that $c \in (0, t)$ and that n is even. The disclosure decreases the profits of the entrant firms locating in B.*

Second, we consider the case in which $h = 2$ ($c \in [t, 3t)$ or $c/3 < t \leq c$). We now relabel $J_e^B(t, 2)$ as $J_e^B(c, 2)$. Differentiating $J_e^B(c, 2)$ with respect to c three times, we have:

$$\frac{\partial^3 J_e^B(c,2)}{\partial c^3} = -\frac{3(n^2-4)(3-2c-8t)(2-9t)t^2}{(n+1)^2((1-2c)^2+4(1-c)t-8t^2)^{5/2}} > 0.$$

We now show that the sign of $(\partial^2 J_e^B(c, 2))/(\partial c^2)$ is positive in any case. Substituting $c = t$ into $(\partial^2 J_e^B(c, 2))/(\partial c^2)$, and then for any $t < 1/5$ we have:

$$\left.\frac{\partial^2 J_e^B(c,2)}{\partial c^2}\right|_{c=t} = -\frac{(n^2-4)(-2+29t^2-34t^3+2(1-8t^2)^{3/2})}{2(n+1)^2(1-8t^2)^{3/2}} > 0.$$

Therefore, $J_e^B(c, 2)$ is convex with respect to c. We now substitute $c = t$ (the lower bound of c) and $c = 3t$ (the upper bound of c) into $J_e^B(c, 2)$, then we have:

$$\begin{aligned}J_e^B(t,2) &= \frac{(n^2-4)(1-2t)(1-\sqrt{1-8t^2})-4n^2t^2}{8(n+1)^2} < 0,\\ J_e^B(3t,2) &= -\frac{2t^2}{n+1} < 0.\end{aligned}$$

Proposition 10' *Suppose that $c \in [t, 3t)$ and that n is even. The disclosure decreases the profits of entrant firms locating at B.*

Finally, we briefly discuss the case in which h is larger than two. After some calculus, we find that given $k = n/2 - h$ entrant firms locate at A, $J_e^B(c, h)$ is a convex function with respect to c.[11] $J_e^B((2h-3)t, h)$ and $J_e^B((2h-1)t, h)$ are negative. Therefore, we have the following proposition.

Proposition 10" *Suppose that $c \in [(2h-3)t, (2h-1)t)$ and n is even. The disclosure decreases the profits of entrant firms locating in market B.*

0.3 Interdependent demand

In this subsection, we calculate a case in which the products in markets A and B are interdependent. To consider this case, we set the inverse demand functions in the markets as follows:

$$p_A = 1 - Q_A - \gamma Q_B, \quad p_B = 1 - Q_B - \gamma Q_A,$$

where Q_i $(i = A, B)$ is the total quantity supplied by the firms in market i $(i = A, B)$, and γ is the degree of product differentiation between the products. In the basic setting, we have assumed that $\gamma = 0$, that is, the products are independent.

We now suppose that there exist an incumbent firm and four entrant firms, that is, 5 firms exist. In this case, the incumbent firm and one entrant firm locate in market A, and the rest of the entrant firms are located in market B.

Before the incumbent firm discloses its know-how, one entrant firm locates in A and three entrant firms locate in B. We can easily show that the location pattern appears as an equilibrium outcome if $c < 2t$. The profit of the incumbent firm (denoted as $\pi_I(1,t)$), the profit of the entrant firm locating at A (denoted as $\pi_A(1,t)$), and the profit of the firm locating at B (denoted as $\pi_B(1,t)$) are:

$$\begin{aligned}
\pi_I(1,t) &= \frac{(1+4c+3t)(1+4c+3t-(1-c-4t)\gamma)}{36(1-\gamma^2)} \\
&\quad + \frac{(1-c-4t)(1-c-4t-(1+4c+3t)\gamma)}{36(1-\gamma^2)}, \\
\pi_A(1,t) &= \frac{(1-2c+3t)(1-2c+3t-(1-c-4t)\gamma)}{36(1-\gamma^2)}
\end{aligned}$$

[11] The procedure to prove this is similar to that in the odd case.

$$
\begin{aligned}
&\quad + \frac{(1-c-4t)(1-c-4t-(1-2c+3t)\gamma)}{36(1-\gamma^2)}, \\
\pi_B(1,t) &= \frac{(1-2c-3t)(1-2c-3t-(1-c+2t)\gamma)}{36(1-\gamma^2)} \\
&\quad + \frac{(1-c+2t)(1-c+2t-(1-2c-3t)\gamma)}{36(1-\gamma^2)}.
\end{aligned}
$$

We now suppose that the entrant firm locating in A moves to market B because of the disclosure. In this case, the incumbent firm locates in market A, and all the entrant firms locate in market B. The profit of the incumbent firm and the profit of the entrant firms are:

$$
\begin{aligned}
\pi_I(0,\tau) &= \frac{(1+4c+4\tau)(1+4c+4\tau-(1-c-5t)\gamma)}{36(1-\gamma^2)} \\
&\quad + \frac{(1-c-5t)(1-c-5t-(1+4c+4\tau)\gamma)}{36(1-\gamma^2)}, \\
\pi_B(0,\tau) &= \frac{(1-2c-2\tau)(1-2c-2\tau-(1-c+t)\gamma)}{36(1-\gamma^2)} \\
&\quad + \frac{(1-c+t)(1-c+t-(1-2c-2\tau)\gamma)}{36(1-\gamma^2)}.
\end{aligned}
$$

We now show the condition that the entrant firm locating in market A under the nondisclosure case moves to market B following the disclosure. The condition is:

$$
\begin{aligned}
&\pi_B(0,\tau) - \pi_A(1,t) \geq 0 \;\Leftrightarrow\; \tau \leq J_\gamma - (1-2c-(1-c-2t)\gamma), \\
&\quad \text{where } J_\gamma \equiv \sqrt{(1-2c-(1-c-2t)\gamma)^2 + t(2-2c-3t-2(1-2c)\gamma)}.
\end{aligned}
$$

We now define the upper bound of τ as τ_γ:

$$\tau_\gamma \equiv J_\gamma - (1-2c-(1-c-2t)\gamma).$$

The difference between $\pi_I(0,\tau_\gamma)$ and $\pi_I(1,t)$ is:

$$
\begin{aligned}
&\frac{4(1-2c)(1-4c)-(4-9c)t+8t^2-(8(1-c)(1-3c)-(8-29c)t+4t^2)\gamma}{6(1-\gamma^2)} \\
&+ \frac{4(1-c-t)(1-c-2t)\gamma^2 - 2(1-4c-(1-c-t)\gamma)J_\gamma}{6(1-\gamma^2)}.
\end{aligned}
$$

We now consider the relation between the degree of product differentiation and the profitability of know-how disclosure. Differentiating τ_γ with respect to γ, we have:

$$\frac{\partial \tau_\gamma}{\partial \gamma} = \frac{(1-c-2t)J_\gamma - \{(1-2c)(1-c-t)-(1-c-2t)^2\gamma\}}{J_\gamma}.$$

After some calculus, we find that this is negative.[12] As the degree of differentiation decreases, the incumbent firm sets the level of τ lower.

[12] Because $c < 2t$ and t is smaller than $1/4$ (the former condition is that one of the entrant firms locates in market A under the nondisclosure case, and the latter condition is a necessary condition that the quantities supplied by the firms are positive), $(1-2c)(1-c-t)-(1-c-2t)^2\gamma$ is positive for any $\gamma \in (-1,1)$. Because $\{(1-2c)(1-c-t)-(1-c-2t)^2\gamma\}^2 - ((1-c-2t)J_\gamma)^2 = (2t-c)t(2-3c-2t)(2-2c-3t) > 0$, $\frac{\partial \tau_\gamma}{\partial \gamma}$ is negative.

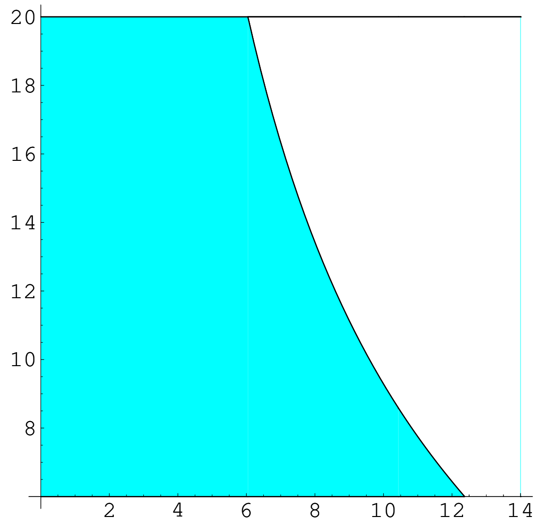

Figure S1: Know-how disclosure is profitable for the incumbent firm (n is odd)

(Horizontal: $100c$, Vertical: n, the shaded area: the profitable area for the incumbent)

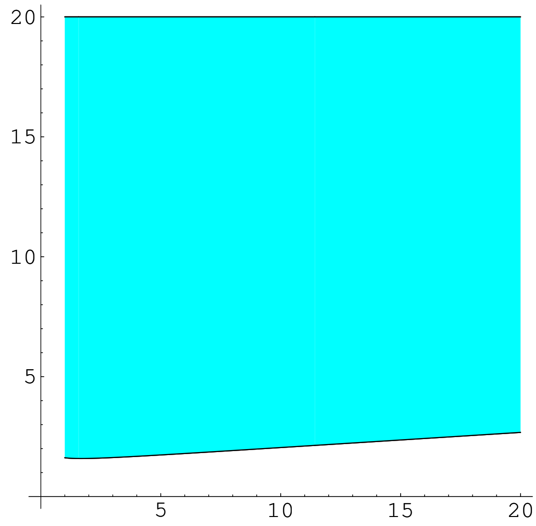

Figure S2: Know-how disclosure is profitable for the incumbent firm (n is odd, $c = 0.1$)

(Horizontal: n, Vertical: h, the shaded area: the profitable area for the incumbent)

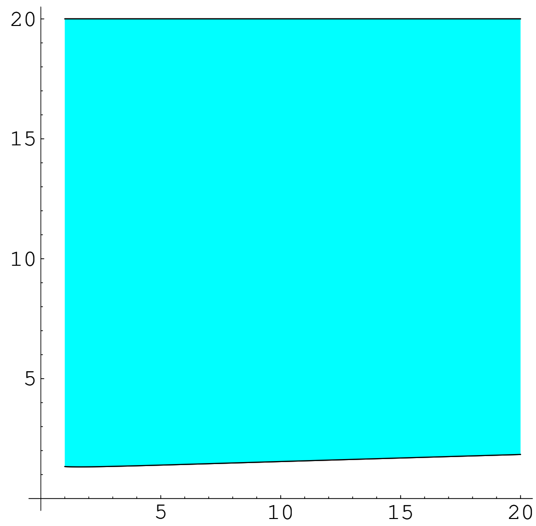

Figure S3: Know-how disclosure is profitable for the incumbent firm (n is odd, $c = 0.05$)

(Horizontal: n, Vertical: h, the shaded area: the profitable area for the incumbent)

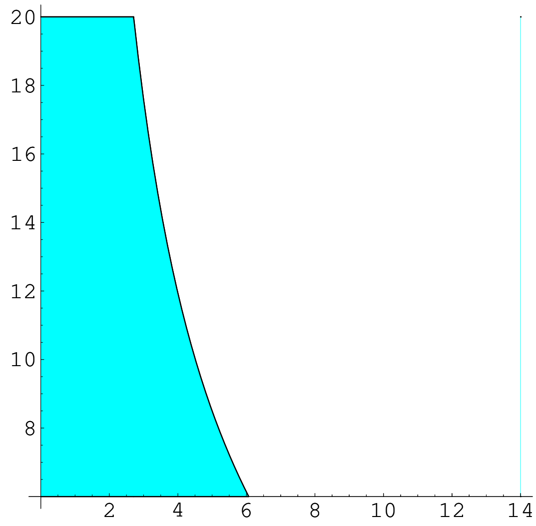

Figure S4: Know-how disclosure is profitable for the incumbent firm (n is even)

(Horizontal: $100c$, Vertical: n, the shaded area: the profitable area for the incumbent)

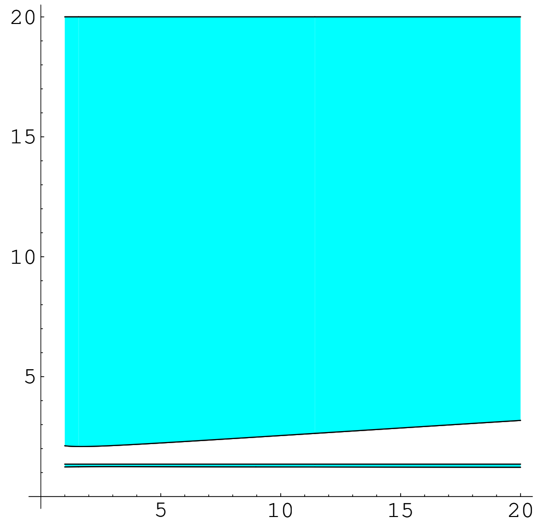

Figure S5: Know-how disclosure is profitable for the incumbent firm (n is even, $c = 0.1$)

(Horizontal: n, Vertical: h, the shaded area: the profitable area for the incumbent)

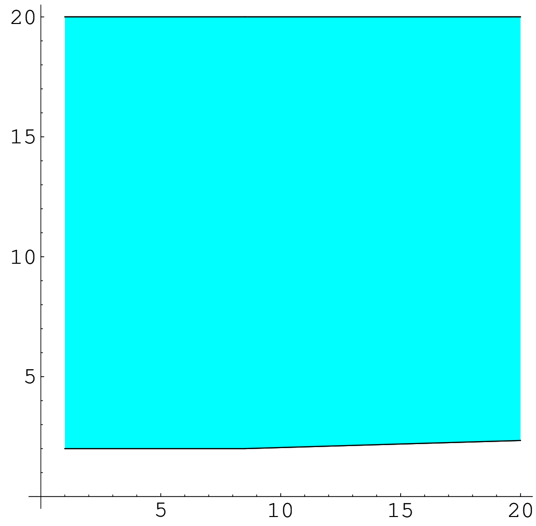

Figure S6: Know-how disclosure is profitable for the incumbent firm (n is even, $c = 0.05$)

(Horizontal: n, Vertical: h, the shaded area: the profitable area for the incumbent)