Acquisition-induced kill zones - Online appendix

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OA: Robustness Checks

In this section, we explore the robustness of our main model findings to several extensions of the assumptions in the base model. These connect to the discussion in Section 3.3 of the main text.

OA1: Non-Drastic Innovation

We first investigate the case with non-drastic innovation. That is, we assume that the profit of the incumbent if $y \in \{1, 2\}$ number of start-ups who obtain a superior substitute is $\lambda_y \pi_m$, where $0 \leq \lambda_2 \leq \lambda_1 < 1$. Our baseline model corresponds to the case with $\lambda_1 = \lambda_2 = 0$. To streamline the analysis, we further assume

Assumption 1. $\min\{\pi_D^I + \pi_m - \pi_M, p(\pi_D^I - \pi_D)\} \geq \lambda_1 \pi_m$

Assumption 1 can be interpreted as follows. First, $\pi_D^I + \pi_m - \pi_M \geq \lambda_1 \pi_m$, or equivalently, $\pi_D^I - \lambda_1 \pi_m \geq \pi_M - \pi_m$, captures a modified arrow replacement effect (Assumption 2 in the main text): the incumbent's incentive to innovate is greater when faced with potential competition by $E1$ than when faced with no competition. Meanwhile, $p(\pi_D^I - \pi_D) \geq \lambda_1 \pi_m$, or equivalently, $p\pi_D^I - \lambda_1 \pi_m \geq p\pi_D$, states that conditional on anticipating successful development by $E1$, I's expected gain from pursue development of its acquired project is greater than that of $E2$.

The main result is the following characterization of equilibrium under acquisitions.

Proposition 1. *Suppose Assumption 1 holds. Then, there exists a cutoff $\overline{x}_K(\lambda_1, \lambda_2) \in \mathbb{R}$, which is decreasing in (λ_1, λ_2), such that I acquires $E2$ if and only if $x \leq \overline{x}_K(\lambda_1, \lambda_2)$. Additionally, if $\overline{x}_K(\lambda_1, \lambda_2) \geq 0$, i.e., so I acquires $E2$ under some realizations of x,*

- *When $K \leq \min\{K_D^{E1}(0), K_D^I(\lambda_1)\}$, $E1$ chooses the type-0 project if and only if*

$$\begin{pmatrix} \int_0^1 x[\Pi - \pi_X(x) + p(\pi_D^E - \pi_D)]dF(x) \\ + \int_{\overline{x}_K(\lambda_1,\lambda_2)}^1 (1-x)p(\pi_D^E - \pi_D)]dF(x) \end{pmatrix} \geq 0, \tag{1}$$

  $E1$ always pursue development (of its project), I pursue development (of its acquired project) in response to $E1$ obtaining a superior substitute, and develops unconditionally if and only if $K \leq K_M^I$.

- *When $K_D^{E1}(0) < K \leq K_D^I(\lambda_1)$, then $E1$ chooses the type-X project, $E1$ pursue development if and only if x is sufficiently large, and I only counter-develops in response to $E1$ obtaining a superior substitute.*

- *When $K > K_D^I(\lambda_1)$, then $E1$ chooses the type-0 project, $E1$ pursue development if and only if x is sufficiently large, and I does not pursue development.*

Proposition 1 provides two main insights. First, an increase in (λ_1, λ_2) weakly lowers the probability in which I acquires $E2$. Furthermore, for sufficiently small (λ_1, λ_2), i.e., so innovation is sufficiently drastic, the equilibrium outcome remains unchanged from the main text. Thus, our main results are robust to sufficiently drastic innovation.

Second, I finds it profitable to acquire $E2$ if and only if the probability that $E1$ obtains a superior substitute is large, i.e., when x is small. Thus, by choosing the type-X project, $E1$ can limit the probability I acquires $E2$. As $E1$ prefers competing against $E2$ over I, this provides an additional incentive for $E1$ to choose the type-X project over the type-0 project. This can be seen as the condition under which $E1$ chooses a type-0 project under low development costs, (1), is harder to satisfy than the corresponding condition (9) in Proposition 2 of the main text.

Proof: To prove the claim, we proceed by backwards induction.

Stage 3: Post-acquisition subgame.

Stage 3B. Suppose that $E1$ obtains a superior substitute. Not pursuing development yields I with a payoff of $\lambda_1 \pi_m$. Pursuing development yields I a payoff of $p\pi_D^I + (1-p)\lambda_1\pi_m - K$. Hence, I pursue development if and only if

$$p(\pi_D^I - \lambda_1 \pi_m) := K_D^I(\lambda_1) \geq K$$

where $K_D^I(\lambda_1) \geq K_M^I$ by Assumption 1.

Meanwhile, if $E1$ does not obtain a superior substitute, then as in the main text, I pursues development iff $K \leq K_M^I$.

Stage 3A. The subgame plays out identically to that in the main text. Namely, if $E1$ expects I to counter-develop in response to obtaining a superior substitute, then $E1$ pursues development iff $K \leq K_D^{E1}(x)$. Otherwise, $E1$ always pursues development.

Stage 2: Acquisition stage. We now prove the existence of a cutoff $\overline{x}(\lambda_1, \lambda_2)$, strictly decreasing in (λ_1, λ_2), such that I acquires $E2$ if and only if $x \leq \overline{x}(\lambda_1, \lambda_2)$.

Recall, by Section 3.2.2 of the main text, that I acquires $E2$ if and only if I's profits with an acquisition exceed the sum of I and $E2$'s profits those without an acquisition. Given x, the latter is given by

$$p^2(1-x)\lambda_2\pi_m + ((1-p)p(1-x) + (1-p(1-x))p)\lambda_1\pi_m + (1-p)(1-p(1-x))\pi_m \tag{2}$$

Meanwhile, I's profit with acquisitions depends on the development cost. There are four cases to consider.

Case 1: $K < K_M^I$**.** I's profit following the acquisition is

$$p(1-x)(p\pi_D^I + (1-p)\lambda_1\pi_m) + (1-p(1-x))(p\pi_M + (1-p)\pi_m) - K$$

Hence, I's gain from the acquisition, i.e., subtracting (2) from the above, is given by

$$p^2(1-x)(\pi_D^I - \lambda_2\pi_m) + p(1-p(1-x))(\pi_M - \lambda_1\pi_m) - K$$

Thus, an acquisition occurs iff

$$\begin{aligned} &p^2(1-x)(\pi_D^I - \lambda_2\pi_m) + p(1-p(1-x))(\pi_M - \lambda_1\pi_m) - K \geq p(p(1-x)\pi_D + (1-p(1-x))\pi_M) - K \\ \iff\ &L_1(\lambda_1, \lambda_2, x) := p^2(1-x)(\pi_D^I - \pi_D) - (p(1-p(1-x))\lambda_1\pi_m + p^2(1-x)\lambda_2\pi_m) \geq 0 \end{aligned} \tag{3}$$

Observe that

$$\frac{\partial L_1}{\partial x} = -p^2(\pi_D^I - \pi_D) - p^2(\lambda_1 - \lambda_2)\pi_m < 0$$

which proves the existence of a cutoff $\overline{x}_K(\lambda_1, \lambda_2)$ with the required properties. We further observe that

$$\frac{\partial L_1}{\partial \lambda_1} = -p(1-p(1-x))\pi_m < 0, \quad \frac{\partial L_1}{\partial \lambda_2} = -p^2(1-x)\pi_m < 0$$

so the cutoff is strictly decreasing in (λ_1, λ_2).

Case 2: $K_M^I < K \leq \min\{K_D^{E1}(x), K_D^I(\lambda_1)\}$. I's profit following the acquisition is

$$p(1-x)(p\pi_D^I + (1-p)\lambda_1\pi_m - K) + (1-p(1-x))\pi_m$$

Hence, I's gain from the acquisition, i.e., subtracting (2) from the above, is given by

$$p^2(1-x)(\pi_D^I - \lambda_2\pi_m) + (1-\lambda_1)p(1-p(1-x))\pi_m - p(1-x)K$$

Hence, an acquisition occurs iff

$$p^2(1-x)(\pi_D^I - \lambda_2\pi_m) + (1-\lambda_1)p(1-p(1-x))\pi_m - p(1-x)K \geq p(p(1-x)\pi_D + (1-p(1-x))\pi_M) - K$$

That is, if

$$\begin{aligned} L_2(\lambda_1, \lambda_2, x) :=& p^2(1-x)(\pi_D^I - \pi_D) + (1-p(1-x))(K - p(\pi_M - \pi_m)) \\ & - (p(1-p(1-x))\lambda_1\pi_m + p^2(1-x)\lambda_2\pi_m) \geq 0 \end{aligned} \tag{4}$$

Now notice that if $\lambda_1 \leq \frac{K - p(\pi_M - \pi_m)}{p\pi_m}$, then $L_2(\lambda_1, \lambda_2, 1) \geq 0$ while

$$\begin{aligned} L_2(\lambda_1, \lambda_2, 0) &= p^2(\pi_D^I - \pi_D) + (1-p)(K - p(\pi_M - \pi_m)) - p(1-p)\lambda_1\pi_m - p^2\lambda_2\pi_m \\ &\geq p^2\pi_D^I - \pi_D - p\lambda_1\pi_m \geq 0, \end{aligned}$$

where the first inequality holds as $K - p(\pi_M - \pi_m) \geq \lambda_1 p\pi_m$ and $p^2(\lambda_1 - \lambda_2)\pi_m < 0$. Since $L_2(\lambda_1, \lambda_2, x)$ is linear in x, it follows that $L_2(\lambda_1, \lambda_2, x) \geq 0$ for all $x \in [0,1]$, so we can set the cutoff at $\overline{x}(\lambda_1, \lambda_2) = \infty$. Meanwhile, if $\lambda_1 > \frac{K-p(\pi_M-\pi_m)}{p\pi_m}$, then

$$\begin{aligned}\frac{\partial L_2}{\partial x} &= -p[p(\pi_D^I - \pi_D) - K + p(\pi_M - \pi_m)] - p^2(\lambda_1 - \lambda_2)\pi_m \\ &\leq -p[p(\pi_D^I - \pi_D) - (p(\pi_M - (1-\lambda_1)\pi_m)) + p(\pi_M - \pi_m)] \\ &< -p^2((\pi_D^I - \pi_D) - \lambda_1\pi_m) \leq 0\end{aligned}$$

where the last inequality follows from Assumption 1. This proves the existence of a cutoff $\overline{x}(\lambda_1, \lambda_2)$ with the required properties. Finally, to see that this cutoff is decreasing in (λ_1, λ_2), it suffices to show that the cutoff is decreasing on the region with $\lambda_1 > \frac{K-p(\pi_M-\pi_m)}{p\pi_m}$. This holds as

$$\frac{\partial L_2}{\partial \lambda_1} = -p(1-p(1-x))\pi_m < 0, \quad \frac{\partial L_2}{\partial \lambda_2} = -p^2(1-x)\pi_m < 0.$$

Case 3: $K_D^{E1}(x) < K \leq K_D^I(\lambda_1)$. I's profit following the acquisition is π_m. Hence, I's gain from the acquisition, i.e., subtracting (2) from π_m, is given by

$$p^2(1-x)(1-\lambda_2)\pi_m + ((1-p)p(1-x) + (1-p(1-x))p)(1-\lambda_1)\pi_m$$

Thus, I acquires $E2$ if and only if

$$\begin{aligned}L_3(\lambda_1, \lambda_2, x) := K &+ p^2(1-x)((1-\lambda_2)\pi_m - \pi_D) \\ &+ p(1-p(1-x))((1-\lambda_1)\pi_m - \pi_M) + p(1-p)(1-x)(1-\lambda_1)\pi_m \geq 0. \qquad (5)\end{aligned}$$

From here, we notice that

$$\begin{aligned}&\frac{\partial L_3}{\partial \lambda_1} = -((1-p)p(1-x) + (1-p(1-x))p)\pi_m < 0, \quad \frac{\partial L_3}{\partial \lambda_2} = -p^2(1-x)\pi_m < 0 \\ &\frac{\partial L_3}{\partial x} = -p^2[\pi_M - \pi_D + (\lambda_1 - \lambda_2)\pi_m] - p(1-p)(1-\lambda_1)\pi_m < 0\end{aligned}$$

so following the logic of Case 1 yields the existence of a cutoff $\overline{x}_K(\lambda_1, \lambda_2)$ with the desired properties.

Case 4: $K > K_D^I(\lambda_1)$. I's profit following the acquisition is

$$p(1-x)\lambda_1\pi_m + (1-p(1-x))\pi_m$$

Hence, I's gain from the acquisition, i.e., subtracting (2) from the above, is given by

$$p^2(1-x)(1-\lambda_2)\pi_m + p(1-\lambda_1)\pi_m$$

Thus, I acquires $E2$ if and only if

$$L_4(\lambda_1,\lambda_2,x) := K + p^2(1-x)((1-\lambda_2)\pi_m - \pi_D) + p((1-\lambda_1)\pi_m - (1-p(1-x))\pi_M) \geq 0. \tag{6}$$

From here, we notice that

$$\frac{\partial L_4}{\partial \lambda_1} = -p\pi_m < 0, \quad \frac{\partial L_4}{\partial \lambda_2} = -p^2(1-x)\pi_m < 0$$
$$\frac{\partial L_4}{\partial x} = -p(p(1-\lambda_2)\pi_m - \pi_D) + \pi_M) < 0$$

so following the logic of Case 1 yields the existence of a cutoff $\overline{x}_K(\lambda_1,\lambda_2)$ with the desired properties.

Stage 1: project choice stage. We now fully characterize $E1$'s project choice. Note that if $\overline{x}(\lambda_1,\lambda_2) < 0$, then I never acquires $E2$, so $E1$'s project choice is identical to that in the main text. Thus, we focus on the case with $\overline{x}(\lambda_1,\lambda_2) \geq 0$ throughout.

Cases 1 and 2: $\boldsymbol{K \leq K_M^I}$ **and** $\boldsymbol{K_M^I < K \leq \min\{K_D^{E1}(0), K_D^I(\lambda_1)\}}$**.** Suppose $E1$ chooses the type-0 project. Because $\overline{x}(\lambda_1,\lambda_2) \geq 0$, acquisitions always occur. Following the discussion of Stages 2-3 implies that $E1$'s payoff is $K_D^{E1}(0) - K = p\Pi + p(\pi_D^E - \pi_D) - K$. Meanwhile, if $E1$ chooses the type-X project, then $E1$ obtains a payoff of $K_D^{E1}(x) - K = p(x\pi_X(x) + (1-x)[\Pi + p(\pi_D^E - \pi_D)]) - K$ when $x \leq \overline{x}_K(\lambda_1,\lambda_2)$, and $p(x\pi_X(x) + (1-x)\Pi) - K$ otherwise. Comparing the two, if follows that $E1$ chooses the type-0 project if and only if (1) holds. The remaining equilibrium behaviour for firms follows from the discussion of Stages 2 and 3.

Case 3: $\boldsymbol{K_D^{E1}(0) < K \leq K_D^I(\lambda_1)}$ Suppose $E1$ chooses the type-0 project. Because $\overline{x}(\lambda_1, \lambda_2) \geq 0$, acquisitions always occur, and so, following the discussion of Stages 2-3, $E1$ never pursues development and so obtains a profit of zero. Meanwhile, if $E1$ chooses the type-X project, then for any realization of x sufficiently close to one, $E1$'s expected profit is close to $p\pi_X(x) - K > 0$, regardless of whether I acquires $E2$ and I's subsequent counter-development. Because the CDF over x, F, is continuous, so x close to 1 is drawn with strictly positive probability, it follows that $E1$'s expected profit from choosing the type-X project is strictly positive. Thus, $E1$ chooses the type-X project.

Case 4: $\boldsymbol{K > K_D^I(\lambda_1)}$ Suppose $E1$ chooses the type-0 project. Because $\overline{x}(\lambda_1, \lambda_2) \geq 0$, acquisitions always occur, and so, following the discussion of Stages 2-3, $E1$ always pursues development and I never pursues development, so $E1$'s profit so $p\pi_M - K$. As discussed in text, this is the largest possible expected profit $E1$ can get under any project regardless of other firms' development decisions. Thus, $E1$ chooses the type-0 project. □

OA2: Simultaneous Development

Next, we consider when both I and $E1$ make their development decisions simultaneously in stage 3. To simplify exposition, we assume $\pi_X(x) = \pi_X$ is constant.

The main result is the following characterization of equilibrium behaviour.

Proposition 2. *Suppose I and $E1$ make their development decisions simultaneously in stage 3. Then, the equilibrium outcome of our game is as follows:*

1. *When $K_M^I \geq K$, $E1$ chooses the type-0 project if and only if*

$$\int_0^1 x\left[\Pi - \pi_X + p(\pi_D^E - \pi_D)\right] dF(x) \geq 0.$$

   I acquires $E2$, and both I and $E1$ always pursue development (of their projects).

2. *When $K_M^I < K \leq \min\{K_D^{E1}(0), pK_D^I + (1-p)K_M^I\}$, $E1$ chooses the type-0 project*

if and only if

$$\int_0^{\overline{x}(K)} x\Big[\Pi - \pi_X + p(\pi_D^E - \pi_D)\Big] dF(x) + \int_{\overline{x}(K)}^1 \Big[\Pi - (x\pi_X + (1-x)\pi_M)\Big] dF(x), \tag{7}$$

where

$$\overline{x}(K) := \frac{p(p\pi_D^I + (1-p)(\pi_M - \pi_m)) - K}{p^2(\pi_D^I - (\pi_M - \pi_m))} \in (0,1)$$

is decreasing in K and converges to 1 as $K \to K_M^I$. I acquires $E2$, $E1$ always pursues development, and I pursues development if and only if $x \leq \overline{x}(K)$, and does not pursue development otherwise.

3. *When $K_D^{E1}(0) < K \leq pK_D^I + (1-p)K_M^I$, $E1$ always chooses the type-X project and I acquires $E2$. Furthermore,*

   - *When $x \leq \min\{\underline{x}(K), \overline{x}(K)\}$, I and $E1$ pursue development with probabilities q_I^* and q_{E1}^* respectively, where*

     $$q_{E1}^* = \frac{K - p(\pi_M - \pi_m)}{p^2(1-x)[\pi_D^I - (\pi_M - \pi_m)]}, \quad q_I^* = \frac{p(x\pi_X + (1-x)\pi_M) - K}{p^2(1-x)(\pi_M - \pi_D^E)},$$

     and $\underline{x}(K) := \frac{K - p(p\pi_D^E + (1-p)\pi_M)}{p(\pi_X - (p\pi_D^E + (1-p)\pi_M))} \in [0,1)$.
   - *When $\underline{x}(K) < x \leq \overline{x}(K)$, both I and $E1$ always pursue development.*
   - *When $x > \overline{x}(K)$, $E1$ always pursues development, which I never pursues development.*

4. *When $K > pK_D^I + (1-p)K_M^I$, $E1$ always chooses the type-0 project. I acquires $E2$, $E1$ always pursues development, and I never pursues development.*

Proof. To prove the claim, we proceed by backwards induction.

Stage 3: Suppose I and $E1$ develop with probabilities q_I and q_{E1} respectively. Then, players' payoffs are given by

$$\text{I's payoff:}\quad q_I\Bigg(q_{E1}[p^2(1-x)\pi_D^I + (1-p(1-x))(p\pi_M + (1-p)\pi_m)] + (1-q_{E1})[p\pi_M + (1-p)\pi_m] - K\Bigg)$$
$$+ (1-q_I)\Bigg(q_{E1}[(1-p(1-x))\pi_m)] + (1-q_{E1})[\pi_m]\Bigg);$$
$$\text{E1's payoff:}\quad q_{E1}\Bigg(q_I[p(x\pi_X + (1-x)(p\pi_D^E + (1-p)\pi_M))] + (1-q_I)[p(x\pi_X + (1-x)\pi_M)] - K\Bigg).$$

Hence, fix $q_{E1} \in [0,1]$. I develops iff

$$q_{E1}\Bigg[p^2(1-x)\pi_D^I + p(1-p(1-x))(\pi_M - \pi_m)\Bigg] + (1-q_{E1})\Bigg[p(\pi_M - \pi_m)\Bigg] \geq K,$$

while fix $q_I \in [0,1]$, $E1$ develops iff

$$q_I[p(x\pi_X + (1-x)(p\pi_D^E + (1-p)\pi_M))] + (1-q_I)[p(x\pi_X + (1-x)\pi_M)] \geq K.$$

Note that by Assumption 1 of the main text, if I pursues development with probability zero, then $E1$ always prefers to pursue development. Therefore, we have three equilibrium possibilities:

- **Case 1:** $(q_I^*, q_{E1}^*) = (1,1)$. This requires

  $$K \leq \min\{p(x\pi_X + (1-x)(p\pi_D^E + (1-p)\pi_M)), p(p(1-x)\pi_D^I + (1-p(1-x))(\pi_M - \pi_m))\}.$$

- **Case 2:** $(q_I^*, q_{E1}^*) \in int([0,1]^2)$. That is, both firms randomize between pursuing development and not. This requires

  $$p(x\pi_X + (1-x)(p\pi_D^E + (1-p)\pi_M)) < K \leq p(p(1-x)\pi_D^I + (1-p(1-x))(\pi_M - \pi_m)).$$

  In this equilibrium, $E1$ obtains a profit of zero, while I obtains a profit of $(1 - pq_E^*)\pi_m$. Furthermore, to ensure firms' indifference, the probabilities that firms pursue development are given by

$$q_{E1}^* = \frac{K - p(\pi_M - \pi_m)}{p^2(1-x)[\pi_D^I - (\pi_M - \pi_m)]}, \quad q_I^* = \frac{p(x\pi_X + (1-x)\pi_M) - K}{p^2(1-x)(\pi_M - \pi_D^E)}.$$

- **Case 3:** $(q_I^*, q_{E1}^*) = (0, 1)$. This requires I to prefer not to pursue development if $E1$ always pursues development, i.e.,

$$K \geq p(p(1-x)\pi_D^I + (1 - p(1-x))(\pi_M - \pi_m)).$$

Stage 2 We now prove that I always acquires $E2$. By Section 3.2.2 of the main text, I acquires $E2$ if and only if I's profits with an acquisition exceed the sum of I and $E2$'s profits those without an acquisition. Given x, the latter is given by equation (2). Meanwhile, I's profit with acquisitions depends on the development cost. There are four cases to consider.

Case 1: $K \leq \min\{p(x\pi_X + (1-x)(p\pi_D^E + (1-p)\pi_M)), p(p(1-x)\pi_D^I + (1-p(1-x))(\pi_M - \pi_m))\}$ As discussed above, in Stage 3, both I and $E1$ pursue development with probability one conditional on an acquisition occurring. Thus, I's total profits from acquisition is

$$p^2(1-x)\pi_D^I + (1 - p(1-x))(p\pi_M + (1-p)\pi_m) - K.$$

This is the same as I's profit in the region $K \leq K_M^I$ in the main text. Therefore, following the proof of Lemma 2 in the main text, an acquisition always occurs.

Case 2: $p(p(1-x)\pi_D^I + (1 - p(1-x))(\pi_M - \pi_m)) < K$ As discussed in Section 3, $E1$ pursues development with probability one, while I pursues development with probability zero. Thus, I's profit from acquisition is $(1-p)\pi_m$. This is the same as I's profit in the region $K > K_D^I$ in the main text. Therefore, following the proof of Lemma 2 in the main text, an acquisition always occurs.

Case 3: $p(x\pi_x + (1-x)(p\pi_D^E + (1-p)\pi_M)) < K \leq p(p(1-x)\pi_D^I + (1-p(1-x))(\pi_M - \pi_m))$. As discussed in Section 3, both firms randomize between pursuing development and not, so I's profit is given by $(1 - pq_E^*)\pi_m$. Subtracting the sum of I

and $E1$'s pre-acquisition profits from this, yields

$$G(K) = p(1 - (1-x)(q^*_{E1} + [1-p]))\pi_m - p(x\pi_X + (1-x)\Pi) + K.$$

Observe that

$$G'(K) = 1 - \frac{\pi_m}{p(\pi^I_D - (\pi_M - \pi_m))} = \frac{-\pi_m(1-p) + p(\pi^I_D - \pi_M)}{p(\pi^I_D - (\pi_M - \pi_m))} < 0,$$

and at the largest K in which this case applies (at which $q^*_{E1} = 1$) we find that

$$\begin{aligned} G(K) &= p(1-p(1-x))\pi_m - p(x\pi_X + (1-x)\Pi) + p^2(1-x)\pi^I_D + p(1-p(1-x))(\pi_M - \pi_m) \\ &= p^2(1-x)(\pi^I_D - \pi_D) + px(\pi_M - \pi_X) > 0. \end{aligned}$$

Thus, I's profit under an acquisition is always higher than I and $E1$'s total profits pre-acquisition. Hence, an acquisition always occurs.

Stage 1 Since, I always acquires $E2$, we need only focus on the post-acquisition equilibrium in stage 3 to characterize $E1$'s project choice. There are four possibilities to consider.

Case 1: $K \leq p(\pi_M - \pi_m)$**.** Here, I and $E1$ always pursue development for all $x \in [0,1]$. Hence, the equilibrium outcome remains identical to that in the main text. In particular, $E1$ chooses the type-0 project if and only if

$$\int_0^1 x[\Pi - \pi_X + p(\pi^E_D - \pi_D)]dF(x) \geq 0.$$

Case 2: $K^I_M < K \leq p\min\{p\pi^E_D + (1-p)\pi_M, p\pi^I_D + (1-p)(\pi_M - \pi_m)\} = \min\{K^{E1}_D(0), pK^I_D + (1-p)K^I_M\}$**.** Here, for sufficiently large x, I acquires $E2$, $E1$ develops, and I does not develop, while for small x, I acquires $E2$ and both develop, where this cutoff is exactly given by $\overline{x}(K)$. A simple computation reveals that by comparing $E1$'s profits between the type-0 and type-X project, $E1$ chooses the type-0 project if and only if

$$\int_0^{\overline{x}(K)} x\Big[\Pi - \pi_X + p(\pi^E_D - \pi_D)\Big]dF(x) + \int_{\overline{x}(K)}^1 \Big[\Pi - (x\pi_X + (1-x)\pi_M)\Big]dF(x) \geq 0.$$

Case 3: $K_D^{E1}(0) < K \leq pK_D^I + (1-p)K_M^I$. Here, for all $x < \min\{\underline{x}(K), \overline{x}(K)\}$, I and $E1$ develop with probabilities q_I^* and q_{E1}^* (such that $E1$ obtains a profit of zero), (ii) for all $\underline{x}(K) < K \leq \overline{x}(K)$, both I and $E1$ always pursue development, (iii) for all $K > \overline{x}(K)$, $E1$ pursues development and I does not pursue development regardless of the outcome of $E1$'s development. Note that this means if $E1$ chooses the type-0 project, then $E1$ always obtains a profit of zero. Meanwhile, for any realization of x sufficiently close to one, $E1$'s expected profit is close to $p\pi_X(x) - K > 0$, regardless of whether I acquires $E2$ and I's subsequent counter-development. Because the CDF over x, F, is continuous, so x close to 1 is drawn with strictly positive probability, it follows that $E1$'s expected profit from choosing the type-X project is strictly positive. Therefore, $E1$ chooses the type-X project.

Case 4: $K > pK_D^I + (1-p)K_M^I$. Here, I never develops regardless of the realization of x. Therefore, $E1$'s profit so $p\pi_M - K$. As discussed in text, this is the largest possible expected profit $E1$ can get under any project regardless of other firms' development decisions. Thus, $E1$ chooses the type-0 project. □

OA3: Large Development Cost

In this section, we assume that development costs are sufficiently large so $p\Pi - K < 0$ holds. Note that this also implies $K_D^{E1}(0) < K$.

Multiplicity of Equilibria. A key observation is that there can multiple equilibria in stage 3 following no acquisition. To see this, fix $x \in [0, 1]$, and recall that $E1$'s profit is $K_D(x) := p(x\pi_X(x) + (1-x)\Pi)$. Because $p\pi_X(x) \geq K > p\Pi$, $K_D(x)$ is strictly increasing in x. Thus, there exists a unique $\underline{x}(K)$ such that for all $x > \underline{x}(K)$, $E1$ strictly prefers to pursue development, provided $E2$ is doing the same, while for all $x < \underline{x}(K)$, the opposite holds. This implies the following:[1]

- For all $x > \underline{x}(K)$, the unique equilibrium in the no-acquisition subgame involves both $E1$ and $E2$ pursuing development in stage 3.

[1]When $x = \underline{x}(K)$, there are equilibria in which both firms pursue development and only one firm pursues development. For simplicity, we focus on the one in which both pursue development.

- For all $x < \underline{x}(K)$, any pure-strategy equilibrium in the no-acquisition subgame involves only one of two startups pursuing development.[2]

Thus, the project choice of $E1$ in stage 1, and the reservation value of $E2$ and so acquisition decision of I in stage 2 (conditional on acquisitions being allowed) both depend on which continuation equilibrium is selected in stage 3 for each $x < \underline{x}(K)$. As discussed in the main text, we focus on the most-adversarial SPNE. That is, where if $x < \underline{x}(K)$, then the equilibrium in which $E1$ does not pursue development is selected.

Benchmark case: no acquisitions. Let us first describe the equilibrium project choice of $E1$ when acquisitions are banned. Choosing the type-0 project yields 0 as we select the equilibrium under which $E2$ enters. Meanwhile, choosing the type-X project yields $\int_{\underline{x}(K)}^{1}(K_D(x) - K)dF(x) \geq 0$. Thus, $E1$ always chooses the type-X project in the benchmark. Additionally, $E2$ always pursues development of its project, while $E1$ pursues development if and only if $x \geq \underline{x}(K)$.

Acquisitions allowed. We now state the equilibrium in the setting where acquisitions are allowed.

Proposition 3. *Suppose that $K > p\Pi$ and the equilibrium in which $E1$ does not develop is selected in the continuation game if an acquisition does not occur.*

1. *When $K_D^{E1}(0) < K \leq K_D^I$, $E1$ chooses the type-X project, I always acquires $E1$, $E1$ pursues development if and only if x is successfully large, and I pursues development if and only if $E1$ obtains a superior substitute.*

2. *When $K > K_D^I$, $E1$ chooses the type-X project, I acquires $E2$ if and only if x is sufficiently large, $E1$ pursues development if and only if I is acquired by $E2$, and conditional on $E2$ being acquired, I never pursues development.*

Proof. Fixing the realization of x and whether I acquires $E2$ or not, Stage 3 plays out as described in Lemma 1 of the main text (if acquisition occurs), or as described

[2] There also exists an equilibrium under which both $E1$ and $E2$ randomize over pursuing development and not in stage 3. To simplify exposition, we focus only on pure-strategy equilibria.

above (if acquisition does not occur). Meanwhile, stages 1 and 2 play out depending on whether $K > K_D^I$ holds. We detail both possibilities below.

Case 1: $K \leq K_D^I$. We first argue that I acquires $E2$ regardless of x. Following the proof of Lemma 2 in the main text, if $x \geq \underline{x}(K)$ such that both $E1$ and $E2$ enter, I acquires $E2$. Thus, suppose $x < \underline{x}(K)$. Because $E2$ enters in the no-acquisition subgame, $E2$'s reservation value is $p\pi_M - K$ and I's pre-acquisition profit is $(1-p)\pi_m$. Meanwhile, because $K > K_D(x) \geq K_D^{E1}(x)$, conditional on acquiring $E2$, neither $E1$ nor I develop, so I's profit is π_m. Since $\pi_m > p\pi_M + (1-p)\pi_m - K$, it follows that I acquires $E2$.

Given I always acquires $E2$, following the proof of Proposition 2 in the main text, $E1$ chooses the type-X project.

Case 2: $K > K_D^I$. Following the proof of Lemma 2 in the main text, if $x \geq \underline{x}(K)$ such that both $E1$ and $E2$ enter, I acquires $E2$. Thus, suppose that $x < \underline{x}(K)$. I's gain is given by $(1-p(1-x))\pi_m - (1-p)\pi_m = xp\pi_m$, while $E2$'s reservation value is $p\pi_M - K$. Hence, acquisitions occur only when $xp\pi_m - p\pi_M + K \geq 0$, which is strictly increasing in x. Thus, for all $x \in [0, \min\{\underline{x}(K), \frac{p\pi_M - K}{p\pi_m}\}]$, where $\min\{\underline{x}(K), \frac{p\pi_M - K}{p\pi_m}\} > 0$, no acquisitions occur. Since, when no acquisitions occur, $E1$'s profit from choosing the type-0 project is zero, it follows that $E1$ always chooses the type-X project. □

Discussion. In both cases, allowing I to acquire $E2$ now has a smaller impact on the equilibrium outcomes compared to the main text. First, the prospect of $E2$'s acquisition does not distort $E1$'s project choice. $E1$ always chooses the type-X project with and without acquisitions, the former to avoid direct competition with $E2$, while the latter to avoid competition with I (when $K_D^I \geq K$), or to induce I into acquiring $E2$ to allow $E1$ to enter (when $K_D^I < K$). Additionally, in case 1, the equilibrium outcome plays out identically to that in the main-text, and so any differences between the case of $p\Pi - K \geq 0$ and $p\Pi - K < 0$ lies with the difference in the development probabilities in the continuation games following an acquisition and no acquisition.

OB: Related Strategies and Managerial Implications

OB1: Entry-For-Buyout

In this section, we characterize the equilibrium for entry-for-buyout, discussed in Section 4.1 of the main text. As noted in the main text, we assume $K \leq K_D^I$ throughout.

When acquisitions are banned, the game plays out identically to that discussed in the main text, swapping the roles of $E1$ and $E2$. Hence, we derive the equilibrium, summarized in Proposition 4, when acquisitions are allowed.

Proposition 4. *For all $K > 0$, there exists $\Delta(K) > 0$ such that $E1$ chooses the type-0 project if and only if*

$$\int_0^1 (x(\Pi - \pi_X(x))dF(x) + \Delta(K) \geq 0.$$

Additionally, the equilibrium behaviour of firms is as follows.

1. *When $K \leq K_M^I$, I acquires $E2$ and both firms pursue development (of their projects).*

2. *When $K_M^I < K \leq K_D^{E1}(0)$, I acquires $E2$, $E1$ pursues development, and I pursues development unconditionally when x is sufficiently large, and pursues development of its project if and only if $E1$ obtains a superior substitute otherwise.*

3. *When $K < K_D^{E1}(0)$, I acquires $E2$, $E1$ pursues development of its project if and only if x is sufficiently large, and I pursues development unconditionally when x is sufficiently large, and pursues development if and only if $E1$ obtains a superior substitute otherwise.*

Proof. We characterize the equilibrium via backwards induction.

Stage 3B. Fix any $x \in [0, 1]$ ($x > 0$ implies I acquired a type-x project). Suppose that acquisition occurs. If $E1$ did not obtain a superior substitute, then I pursues development if and only if

$$K \leq p(x\pi_X(x) + (1 - x)(\pi_M - \pi_m)) := K_M^I(x),$$

where $K_M^I(0) = K_M^I$. If $E1$ obtained a superior substitute, then I pursues development if and only if

$$p(x\pi_X(x) + (1-x)\pi_D^I) \geq K.$$

Since $p\pi_D^I \geq K$ by assumption, the above always holds.

Stage 3A. Now consider $E1$'s development decision. By the above, $E1$ knows that I always counter-develops in response to $E1$ obtaining a superior substitute. Hence, $E1$ pursues development if and only if

$$p((1-x)p\pi_D^E + (1-(1-x)p)\pi_M) := \overline{K}_D^{E1}(x) \geq K,$$

where we note that $\overline{K}_D^{E1}(x)$ is increasing in x and satisfies $\overline{K}_D^{E1}(0) = K_D^{E1}(0)$.

Stage 2. For an acquisition to occur, I's post-acquisition profits with an acquisition must exceed that the sum of I and $E2$'s profits without an acquisition. In the latter case, conditional on realizing x, the firms' joint profits are

$$p\Pi - K + px(\pi_X(x) - \Pi) + (x(1-p) + (1-x)(1-p)^2)\pi_m.$$

Case 1: $K_M^I(x) \geq K$ Both I and $E1$ always pursue development. Hence, I's expected profit from acquisitions is

$$p\Pi - K + px(\pi_X(x) - \Pi) + p^2(1-x)(\pi_D^I - \pi_D) + (x(1-p) + (1-x)(1-p)^2\pi_m$$

Subtracting the no acquisition sum of profits between I and $E2$ from the above yields

$$p^2(1-x)(\pi_D^I - \pi_D) \geq 0.$$

Hence, an acquisition occurs.

Case 2: $K_M^I(x) < K \leq \overline{K}_D^{E1}(x)$**.** Here, I pursues development if and only if $E1$

successfully obtains a superior substitute. Therefore, I's profit from an acquisition is

$$\begin{aligned}
&p(p(x\pi_X(x) + (1-x)\pi_D^I) - K) + (1-p)\pi_m \\
&= p\Pi - K + px(\pi_X(x) - \Pi) + p^2(1-x)(\pi_D^I - \pi_D)) + (x(1-p) + (1-x)(1-p)^2)\pi_m \\
&+ (1-p)(K - K_M^I(x))
\end{aligned}$$

Subtracting the no acquisition sum of profits between I and $E2$ from the above yields

$$p^2(1-x)(\pi_D^I - \pi_D) + (1-p)(K - K_M^I(x)) > 0.$$

Hence, an acquisition occurs.

Case 3: $\overline{K}_D^{E1}(x) < K$. Here, neither $E1$ nor I pursue development of their projects. Hence, I's post-acquisition profit is π_m. Subtracting the no acquisition sum of profits between I and $E2$ from this yields

$$\begin{aligned}
&(xp + (1-x)(p + p(1-p))\pi_m - p\Pi + K - px(\pi_X(x) - \Pi) \\
&= K - K_M^I(x) + p^2(1-x)(\pi_M - \pi_D) + p(1-p)\pi_m > 0.
\end{aligned}$$

where the inequality holds as $K - K_M^I(x) > K - \overline{K}_D^{E1}(x) > 0$. Hence, an acquisition always occurs.

Stage 1. We move on to $E2$'s project choice. Since acquisitions always occur in stage 2, $E2$ compares its gain from acquisition from choosing either project type, i.e., the sum of $E2$'s reservation value, $p\Pi - K$, plus β times the increase in expected total surplus of I and $E2$ from acquisitions occurring over when acquisitions do not occur. Note throughout that

1. If $E2$ chooses the type-0 project without acquisitions, then $E2$'s payoff (and thus his reservation value) is $p\Pi - K$.

2. If $E2$ chooses the type-X project without acquisitions, then $E2$'s payoff is $p\Pi - K + p\int_0^1 x(\pi_X(x) - \Pi)dF(x)$.

Case 1: $K_M^I(0) \geq K$ By the discussion of stage 3, if $E2$ chooses the type-0 project, then I's post-acquisition profits is

$$p\Pi - K + \beta p^2(\pi_D^I - \pi_D).$$

while if $E2$ chooses the type-X project, then $E2$'s expected profit from choosing the type-X project is

$$p\Pi - K + p\int_0^1 x(\pi_X(x) - \Pi)dF(x) + \beta(p^2(1-\mu)(\pi_D^I - \pi_D)).$$

Hence, $E2$'s payoff from choosing the type-X project is

$$p\Pi - K + \int_0^1 x[x\pi_X(x) - \Pi]dF(x) + \beta[p^2(1-\mu)(\pi_D^I - \pi_D) - (\mu(1-p) + (1-\mu)(1-p)^2)\pi_m].$$

Comparing the two, we see that $E2$ chooses a type-0 project if and only if

$$\int_0^1 x[\Pi - \pi_X(x)]dF(x) + \beta \underbrace{p^2\mu(\pi_D^I - \pi_D)}_{:=\Delta(K)>0.} \geq 0.$$

Case 2: $K_M^I(0) < K \leq \overline{K}_D^{E1}(0)$**.** By the discussion of stage 3, if $E2$ chooses the type-0 project, then $E2$'s payoff under a type-0 project is

$$p\Pi - K + \beta(p^2(\pi_D^I - \pi_D) + (1-p)(K - K_D^{E1}(0)).$$

Meanwhile, let $x^I(K)$ denote the unique solution to $K = K_M^I(x^I(K))$, such that $K \leq K_M^I(x)$ if and only if $x \geq x^I(K)$. Then if $x \geq x^I(K)$, $E2$'s profit is

$$p\Pi - K + px(\pi_X(x) - \Pi) + \beta(p^2(1-x)(\pi_D^I - \pi_D)).$$

while if $x < x^I(K)$, $E2$'s profit is

$$p\Pi - K + px(\pi_X(x) - \Pi) + p^2(1-x)(\pi_D^I - \pi_D)) + (1-p)(K - K_M^I(x)).$$

Hence, $E2$'s payoff under a type-X project is

$$p\Pi - K + p\int_0^1 x(\pi_X(x) - \Pi)dF(x) + \beta(p^2(1-\mu)(\pi_D^I - \pi_D) + (1-p)\int_0^{x^I(K)}(K - K_M^I(x))).$$

Comparing the two, we see that $E2$ chooses a type-0 project if and only if

$$\int_0^1 x[\Pi - \pi_X(x)]dF(x) + \beta\underbrace{\left(p^2\mu(\pi_D^I - \pi_D) + (1-p)\left[\begin{array}{c}\int_{x^I(K)}^1 (K - K_M^I(0))dF(x) \\ + \int_0^{x^I(K)}(K_M^I(x) - K_M^I(0))dF(x)\end{array}\right]\right)}_{:=\Delta(K)} \geq 0.$$

Finally, note that by assumption on the primitives, $p(\pi_M - \pi_m) < K \leq p\pi_X(x)$ holds for all $x \in [0,1]$. Therefore, $K_M^I(0) = p(\pi_M - \pi_m) \leq p(x\pi_X(x) + (1-x)(\pi_M - \pi_m) = K_M^I(x)$. This means that $\Delta(K) > 0$.

Case 3: $\overline{K}_D^{E1}(0) < K \leq K_D^I(0)$. Let $x^E(K) \leq x^I(K)$ denote the unique solution to $\overline{K}_D^{E1}(x^E(K)) = K$, such that (i) $K > \overline{K}_D^{E1}(x)$ if $x < x^E(K)$, (ii) $K_M^I(x) < K \leq \overline{K}_D^{E1}(x)$ if $x \in [x^E(K), x^I(K))$, and (iii) $K \geq K_M^I(x)$ if $x \geq x^(K)$. $E2$'s profits under cases (ii) and (iii) have been covered previously. Meanwhile, for case (i), if $E2$ chooses the type-0 project, then $E2$'s post-acquisition profit is

$$p\Pi - K + px(\pi_X(x) - \Pi) + \beta(K - K_M^I(x) + p^2(1-x)(\pi_M - \pi_D) + p(1-p)\pi_m).$$

Thus, if $E2$ chooses the type-0 project, then $E2$'s payoff is

$$p\Pi - K + \beta(p^2(\pi_D^I - \pi_D) + K - K_M^I(0) + p^2(\pi_M - \pi_D^I) + p(1-p)\pi_m).$$

If $E2$ chooses the type-X project, then $E2$'s payoff is

$$p\Pi - K + p\int_0^1 x[\pi_X(x) - \Pi]dF(x) + \left(\begin{array}{c} p^2(1-\mu)(\pi_D^I - \pi_D) \\ \int_0^{x^I(K)}(K - K_M^I(x))dF(x) \\ \int_0^{x^E(K)}(p^2(1-x)(\pi_M - \pi_D^I) + p(1-p)\pi_m)dF(x)\end{array}\right).$$

Hence, comparing the two, we see that $E2$ chooses the type-0 project if and only if

$$p\int_0^1 x[\Pi - \pi_X(x)]dF(x) + \underbrace{\left(p^2\mu(\pi_D^I - \pi_D) + \begin{array}{r} \int_{x^I(K)}^1 (K - K_M^I(0) + p^2(1-x)(\pi_M - \pi_D^I) + p(1-p)\pi_m)dF(x) \\ \int_{x^E(K)}^{x^I(K)} (K_M^I(x) - K_M^I(0)) + p^2(1-x)(\pi_M - \pi_D^I) + p(1-p)\pi_m)dF(x) \\ + \int_0^{x^E(K)} (K_M^I(x) - K_M^I(0))dF(x) \end{array} \right)}_{:=\Delta(K)}$$

$\geq 0.$

Since we had previously proven that $K_M^I(x) \geq K_M^I(0)$, $\Delta(K) > 0$ holds. □

OB2: In-House Innovation vs Acquiring to Innovate

This section analyzes the model of in-house R&D by the incumbent introduced in Section 4.2 of the main text. Section OB2.1 introduces additional assumptions on model parameters. Section OB2.2 provides a complete characterization of equilibrium behavior and the proof. Section OB2.3 compares innovation outcomes and the incumbent's revenues and profits in the model with acquisitions to that with in-house R&D.

OB2.1: Additional Assumptions

Let $\Pi_T := p^2\pi_T^E + p(1-p)\pi_D + p(1-p)\pi_D^E + (1-p)^2\pi_M$ and $\Pi_D := p\pi_D^E + (1-p)\pi_M$. Π_T is the profit a startup obtains from obtaining a superior substitute conditional on the other startup and the incumbent pursuing development of a type-0 project. Meanwhile, Π_D is the profit of a startup from obtaining a superior substitute conditional on only the incumbent pursuing development of a type-0 project.

We make the following four assumptions throughout:

1. **Profit ordering:** $\pi_M - \pi_m < \Pi_T < \pi_T^I < \pi_D^I < \Pi_D.$, $\Pi_T + p^2(\pi_D - \pi_T^D) < \pi_T^I$ and $\pi_m > p\pi_I^D$

2. **Development success rate:** $p = 1/2$

3. **In house R&D cost:** $\frac{1}{4}[\pi_D^I - \pi_T^I] > c.$

One example of when this holds is the following numerical example: $\pi_m = 0.75$, $\pi_M = 1.05$, $\pi_T^E = 0$, $\pi_D = 0.3$, $\pi_D^E = 0.25$, $\pi_T^I = 0.55$, $\pi_D^I = 0.575$, $c = 0.005$, and $F(x) = x^2$ and $\pi_X(x) = 0.67$ for all $x \in [0,1]$. Then,

$$\underbrace{\pi_M - \pi_m}_{0.3} < \underbrace{\Pi_T}_{0.4} < \underbrace{\pi_T^I}_{0.5} < \underbrace{\pi_D^I}_{0.575} < \underbrace{\Pi_D}_{0.65},$$
$$\underbrace{\Pi_T + p^2(\pi_D - \pi_T^D)}_{0.475} < \underbrace{\pi_T^I}_{0.5},$$
$$\underbrace{\frac{1}{4}(\pi_D^I - \pi_T^I)}_{0.0625} > \underbrace{c}_{0.01}.$$

We will use this example to illustrate several our of results below.

Equilibrium behaviour. We focus on Subgame Perfect Nash Equilibrium. When there are multiple equilibria, which arises when the development cost is high so only one startup can pursue development with probability one following I's investment in in-house R&D, we focus on the one which maximizes E1's profit.

OB2.2: Equilibrium Analysis

Our main result is the following characterization of equilibrium behaviour.

Proposition 5. *In equilibrium,*

1. *Suppose that $K \leq p(\pi_M - \pi_m)$. Then, I invests into in-house R&D and all three firms always pursue development (of their projects). $E1$ chooses the type-0 project over the type-X project if and only if*

$$\int_0^1 x(\Pi_T - \pi_X(x))dF(x) \geq 0. \tag{8}$$

2. *Suppose that $p(\pi_M - \pi_m) < K \leq p\Pi_T$. Then, I invests into in-house R&D, both $E1$ and $E2$ always pursue development, and I pursues development if and only if either $E1$ or $E2$ obtain a superior substitute. $E1$ chooses the type-0 project over the type-X project if and only if (8) holds.*

3. *Suppose that* $p\Pi_T < K \leq p\pi_T^I$. *Let*

$$\overline{x}(K) := \frac{K - p\Pi_T}{p(\Pi_D - \Pi_T)}$$

Then, I invests into in-house R&D, E1 always pursues development, E2 pursues development if and only if E1 had chosen a type-X project and realizes $x > \overline{x}(K)$, *and I pursues development if and only if either E1 or E2 obtain a superior substitute. E1 chooses the type-0 project over the type-X project if and only if*

$$\int_0^1 x(\Pi - \pi_X(x) + p(\pi_D^E - \pi_D))dF(x) + \int_{\overline{x}(K)}^1 p(1-x)\begin{pmatrix} p(\pi_D^E - \pi_T^E) \\ +(1-p)(\pi_M - \pi_D^E) \end{pmatrix} dF(x) \geq 0. \tag{9}$$

which holds if and only if K is sufficiently small.

4. *Suppose that* $\pi_T^I < K$. *Let*

$$\underline{x}(K) := \frac{K - p(\Pi_T + p^2(\pi_D - \pi_T^E))}{p(\Pi_D - \Pi_T - p^2(\pi_D - \pi_T^E))}.$$
$$K_x := [x\pi_m + (1-x)1/2\pi_D^I - 2c]$$

Then,

(a) *For all* $K \leq K_0$, *I invests into in-house R&D, E1 always pursues development, E2 pursues development if and only if E1 had chosen a type-X project and realizes* $x > \underline{x}(K)$, *and I pursues development if and only if either E1 or E2 successfully obtain a superior substitute. E1 chooses the type-0 project over the type-X project if and only if*

$$\int_0^1 x(\Pi - \pi_X(x) + p(\pi_D^E - \pi_D))dF(x) + \int_{\underline{x}(K)}^1 p(1-x)\begin{pmatrix} p(\pi_D^E - \pi_D) \\ +(1-p)(\pi_M - \pi_D^E) \end{pmatrix} dF(x) \geq 0. \tag{10}$$

which holds if and only if K is sufficiently small.

(b) *For all $K > K_0$, I invests into in-house R&D if and only if the realized value of x satisfies $x < \underline{x}(K)$ and $K_x \geq K$. If I does not invest into in-house R&D, $E1$ and $E2$'s development decisions coincide with the benchmark model. Otherwise, $E1$ and $E2$'s development decisions are as described above. $E1$ chooses the type-0 project over the type-X project if and only if*

$$\int_0^1 x(\Pi - \pi_X(x))dF(x) - \int_{x \in \{x' < \underline{x}(K): K_{x'} \geq K\}} (1-x)p(\pi_D^E - \pi_D)dF(x) \geq 0. \tag{11}$$

We prove Proposition 5 below. Readers who are interested in the comparison of equilibrium behaviour to that in the main model may skip directly ahead to OB2.3.

Proof: We first characterize the equilibrium development of startups following $E1$'s project choice and for a given development response by I.

Lemma 1. *Suppose that $K \leq \Pi_D$, $E1$ realizes a type-x project, and I invests into in-house R&D. Then,*

1. *If startups anticipate I pursuing development when at least one of the startups obtain a superior substitute, then the unique equilibrium which maximizes $E1$'s profit is given as follows*
   - *If $x \geq \overline{x}(K)$, then both $E1$ and $E2$ pursue development (of their projects).*
   - *If $x < \overline{x}(K)$, then $E1$ pursues development, and $E2$ does not.*
2. *If startups' anticipate I developing when exactly one of the startups obtains a superior substitute, then the unique equilibrium which maximizes $E1$'s profit is given as follows*
   - *If $x \geq \underline{x}(K)$ then both $E1$ and $E2$ pursue development.*
   - *If $x < \underline{x}(K)$, then $E1$ pursues development, and $E2$ does not.*
3. *Otherwise, the unique equilibrium has both $E1$ and $E2$ pursue development.*

Proof. Suppose startups anticipate I developing when at least one of them obtain a superior substitute. Then, $E1$'s profit from pursuing development conditional on $E1$ pursuing and not pursuing development is $p(x\pi_X(x)+(1-x)\Pi_T)-K$ and $p(x\pi_X(x)+(1-x)\Pi_D)-K$ respectively. Meanwhile, $E2$'s profit from pursuing development conditional on $E1$ pursuing and not pursuing development is $p(x\Pi_D+(1-x)\Pi_T)-K$, and $p\pi_D-K$ respectively. Observe then that if $p(x\Pi_D+(1-x)\Pi_T)-K \geq 0$, i.e., $x \geq \overline{x}(K)$, then the unique equilibrium involves both startup pursuing development. Meanwhile, if $p(x\Pi_D+(1-x)\Pi_T)-K < 0$, i.e., $x < \overline{x}(K)$, then there are three possible equilibria: only $E1$ pursues development, only $E2$ pursues development, or both $E1$ and $E2$ randomize between pursuing development and not. In the latter two cases, $E1$'s profit is zero. Meanwhile, in the first case, $E1$'s profit is $p(x\pi_X(x)+(1-x)\Pi_D)-K > 0$. Thus, the equilibrium which maximizes $E1$'s profit is the one in which $E1$ pursues development with probability one.

Next, suppose startups anticipate I pursuing development when only one of the startups obtain a superior substitute. Then, $E1$'s profit from pursuing development conditional on $E1$ pursuing and not pursuing development is $p(x\pi_X(x)+(1-x)[\Pi_T+p^2(\pi_D-\pi_T^E)])-K$ and $p(x\pi_X(x)+(1-x)\Pi_D)-K$ respectively. Meanwhile, $E2$'s profit from pursuing development conditional on $E1$ pursuing and not pursuing development is $p(x\Pi_D+(1-x)[\Pi_T+p^2(\pi_D-\pi_T^E)])-K$, and $p\pi_D-K$ respectively. Following a similar logic to the preceding case then shows that if $p(x\Pi_D+(1-x)[\Pi_T+p^2(\pi_D-\pi_T^E)])-K \geq 0$, i.e., $x \geq \underline{x}(K)$, then the unique equilibrium involves both $E1$ and $E2$ pursuing development. Otherwise, i.e., $x < \underline{x}(K)$, then the equilibrium which maximizes $E1$'s profit is the one in which $E1$ pursues development with probability one.

Finally, suppose that startups anticipate I to never pursue development. Then, the game between startups mirrors that in the benchmark case with no acquisition. Hence, as per Proposition 1 in-text, both startups pursue development. □

We now characterize the equilibrium development of firms in stage 3.

Lemma 2. *Suppose that $x \in [0,1]$ is realized, and I invests into in-house R&D. Then,*

1. *Suppose that $K \leq p(\pi_M - \pi_m)$. Then, all three firms always pursue development (of their projects).*

2. *Suppose that* $p(\pi_M - \pi_m) < K \leq p\Pi_T$. *Then, both* $E1$ *and* $E2$ *always pursue development, and* I *pursues development if and only if either* $E1$ *or* $E2$ *obtain a superior substitute.*

3. *Suppose that* $\Pi_T < K \leq p\pi_T^I$. *Then,* $E1$ *always pursues development. Meanwhile,* $E2$ *pursues development if and only if* $x \geq \overline{x}(K)$.

4. *Suppose that* $\pi_T^I < K \leq p\pi_D^I$. *Then,* $E1$ *always pursues development. Meanwhile,* $E2$ *pursues development if and only if* $x \geq \underline{x}(K)$.

5. *Suppose that* $K > p\pi_D^I$. *Then, both* $E1$ *and* $E2$ *always pursue development, while* I *never pursues development.*

Proof. We divide the proof depending on the development cost.

Case 1: $K \leq p(\pi_M - \pi_m)$**.** First, consider I's development decision. If two (one) startups obtain a superior substitute, then I's expected profit is $p\pi_T^I - K$ ($p\pi_D^I - K$) from pursuing development, and 0 otherwise. If no startups obtain a superior substitute, then I's expected profit is $p\pi_M + (1-p)\pi_m - K$ from pursuing development, and π_m otherwise. Given the profit orderings, it follows that since $K \leq p(\pi_M - \pi_m)$, I's profit from pursuing development is always positive, so I pursues development. Applying Lemma 1 then yields the equilibrium behaviour of $E1$ and $E2$ as stated above (here, $\overline{x}(K) < 0$, so $E1$ and $E2$ always pursue development).

Case 2: $p(\pi_M - \pi_m) < K \leq p\Pi_T$**.** Consider I's development decision. Following the preceding logic, I's profit from pursuing development is positive if and only if at least one startup obtains a superior substitute. Thus, I pursues development if and only if at least one startup obtains a superior substitute. Applying Lemma 1 then yields the equilibrium behaviour of $E1$ and $E2$ as stated in the Lemma (here, $\overline{x}(K) < 0$, so $E1$ and $E2$ always pursue development).

Case 3: $p\Pi_T < K \leq p\pi_I^T$**.** As in Case 2, it is easily verified that I pursues development if and only if at least one startup obtains a superior substitute. Applying Part 1 of Lemma 1 then yields the equilibrium behaviour of $E1$ and $E2$ as stated above.

Case 4: $p\pi_T^I < K \leq p\pi_D^I$**.** Consider I's development decision. Following the logic of Case 1, I's profit from pursuing development is positive if and only if exactly one startup obtains a superior substitute. Thus, I pursues development if and only if exactly one startup obtains a superior substitute. Applying Part 2 of Lemma 1 then yields the equilibrium behaviour of $E1$ and $E2$ as stated above.

Case 5: $K > p\pi_D^I$. Consider I's development decision. Following the logic of Case 1, I never pursues development. Applying Part 3 of Lemma 1 then yields the equilibrium behaviour of $E1$ and $E2$ as stated above. □

We now complete the proof of Proposition 5.

Proof. We divide it into cases depending on the development cost.

Case 1: $K \leq p(\pi_M - \pi_m)$. We first show that I always invests into in-house R&D. Suppose that $E1$ holds a type-x project. By Lemma 2, all three firms pursue development. Thus, I's profit from pursuing in-house R&D is

$$\begin{aligned}
&x(p[p\pi_D^I - K] + (1-p)[p\pi_M - K]) \\
&+ (1-x)(p^2[p\pi_I^T - K] + 2p(1-p)[p\pi_D^I - K] + (1-p)^2[p\pi_M - K])) \\
&+ (1-p)[x(1-p) + (1-x)(1-p)^2]\pi_m - c
\end{aligned}$$

Meanwhile, if I does not pursue in-house R&D, then both $E1$ and $E2$ always pursue development. Thus, I's profit from not pursuing in-house R&D is

$$(x(1-p) + (1-x)(1-p)^2)\pi_m$$

Hence, I invests in in-house R&D if and only if

$$\begin{aligned}
&x(p[p\pi_D^I - K] + (1-p)[p(\pi_M - \pi_m) - K]) \\
&+ (1-x)(p^2[p\pi_I^T - K] + 2p(1-p)[p\pi_D^I - K] + (1-p)^2[p(\pi_M - \pi_m) - K])) \geq c
\end{aligned}$$

This is positive as $p(\pi_M - \pi_m - K) \geq 0$, $p\pi_I^T - K \geq 0$ and

$$\begin{aligned}
(xp + 2(1-x)p(1-p))(p\pi_D^I - K) &\geq 1/4(\pi_D^I - \pi_T^I) \quad (\text{as } K < p\pi_I^T) \\
&\geq c \quad (\text{by assumption on } c).
\end{aligned}$$

Given I always invests into in-house R&D, it follows that $E1$'s profit from choosing the type-0 project is $p\Pi_T - K$, and from choosing the type-X project is $p\int_0^1 [x\pi_X(x) +$

$(1-x)\Pi_T]dF(x) - K$. The former is greater than the latter if and only if (8) holds.

Case 2: $p(\pi_M - \pi_m) < K \leq p\Pi_T$. We first show that I always invests into in-house R&D. Suppose that $E1$ holds a type-x project. By Lemma 2, $E1$ and $E2$ pursue development, while I pursues development if and only if at least $E1$ or $E2$ obtain a superior substitute. Thus, I's profit from pursuing in-house R&D is

$$xp[p\pi_D^I - K] \\ + (1-x)(p^2[p\pi_I^T - K] + 2p(1-p)[p\pi_D^I - K]) + (1-p)[x(1-p) + (1-x)(1-p)^2]\pi_m - c.$$

Meanwhile, I's profit from not pursuing in-house R&D is

$$[x(1-p) + (1-x)(1-p)^2]\pi_m.$$

Hence, I invests in in-house R&D if and only if

$$xp[p\pi_D^I - K] + (1-x)(p^2[p\pi_I^T - K] + 2p(1-p)[p\pi_D^I - K]) \geq c.$$

Following the logic of Case 1 verifies that the preceding inequality holds, so I always invests into in-house R&D. Following the logic of Case 1 then shows that $E1$ chooses the type-0 project if and only if (8) holds.

Case 3. $p\Pi_T < K \leq p\pi_T^I$. We first show that I always invests into in-house R&D.

Consider when $x \geq \overline{x}(K)$. Then, the equilibrium behaviour of $E1$ and $E2$ (and I) mirrors Case 2. Thus, I prefers to invest into in-house R&D.

Next, suppose $x < \overline{x}(K)$. By Lemma 2, $E1$ is the only startup which pursues development, while I pursues development if and only if $E1$ obtains a superior substitute. Thus, I's profit from pursuing in-house R&D is

$$x\pi_m + (1-x)[p(p\pi_D^I - K) + (1-p)\pi_m] - c$$

Meanwhile, I's profit from not pursuing in-house R&D is

$$(x(1-p) + (1-x)(1-p)^2)\pi_m.$$

Hence, I invests in in-house R&D if and only if if and only if

$$px\pi_m + (1-x)p(p\pi_D^I - K) \geq c.$$

This holds as

$$\begin{aligned} px\pi_m + (1-x)p(p\pi_D^I - K) &\geq x(p\pi_M - K) + (1-x)p(p\pi_D^I - K) \quad (\text{as } p(\pi_M - \pi_m) < K) \\ &\geq [x + p(1-x)(1-p)](p\pi_D^I - K) \quad (\text{as } \pi_M > \pi_D^I) \\ &\geq (xp + 2(1-x)p(1-p))(p\pi_D^I - K) \geq c \end{aligned}$$

We now consider $E1$'s project choice decision. Consider $E1$'s profit from choosing the type-0 project. Note that because $K > p\Pi_T$, $\overline{x}(K) > 0$. Thus, if $E1$ chooses the type-0 project, then $E2$ never pursues development of its project. Hence, $E1$'s profit from chooses the type-0 project is

$$p[\Pi + p(\pi_D^E - \pi_D)] - K,$$

Meanwhile, if $E1$ chooses the type-X project, then $E1$'s expected profit is

$$p\bigg(\int_0^{\overline{x}} [x\pi_X(x) + (1-x)(\Pi + p(\pi_D^E - \pi_D))]dF(x) + \int_{\overline{x}}^1 [x\pi_X(x) + (1-x)\Pi_T]dF(x)\bigg) - K.$$

Thus, taking the difference between the two, it follows that $E1$ chooses the type-0 project if and only if (8) holds.

Case 4. $p\pi_T^I < K$**.** It is straightforward to argue that for all $K \geq p\pi_D^I$, I's profit conditional on investing into in-house R&D is non-positive. Thus, I never invests into in-house R&D. In turn, $E1$'s project choice, and $E1$ and $E2$ development decisions, mirror those in the benchmark model.

Hence, we focus on the region $p\pi_T^I < K < p\pi_D^I$. We begin with the following observation. Defining

$$K_x := [x\pi_m + 1/2\pi_D^I - 2c],$$

we will argue the following:

1. If $K \leq K_0$, then I develops for all x

2. If $K > K_0$, then I develops if and only if $x \leq \underline{x}(K)$ and $K_x \geq K$.

To prove this, we argue that for all $x \geq \overline{x}(K)$, I invests into in-house R&D if and only if $K \leq K_0$, while for all $x < \underline{x}(K)$, I invests into in-house R&D if and only if $K \leq K_x$. These claims, combined with the fact that K_x is increasing in x by assumption (as $\pi_m > 1/2\pi_D^I$ by assumption), proves the above.

Consider first $x \geq \underline{x}(K)$. By Lemma 1, both $E1$ and $E2$ pursue development, while I pursues development if and only if exactly one start-up obtains a superior substitute. Thus, I's profit from pursuing in-house R&D is

$$\begin{aligned}&xp[p\pi_D^I - K]\\&+(1-x)(2p(1-p)[p\pi_D^I - K]) + (1-p)[x(1-p) + (1-x)(1-p)^2]\pi_m - c.\end{aligned}$$

Meanwhile, I's profit from not pursuing in-house R&D is

$$[x(1-p) + (1-x)(1-p)^2]\pi_m$$

Hence, I invests in in-house R&D if and only if if and only if

$$[xp + 2(1-x)p(1-p)][p\pi_D^I - K]) = 1/2[1/2\pi_D^I - K] \geq c$$

which holds if and only if $K < K_0$.

Next, suppose that $x < \underline{x}(K)$. By Lemma 1, only $E1$ pursues development, while I pursues development if and only if exactly one start-up obtains a superior substitute. Thus, I's profit from pursuing in-house R&D is

$$x\pi_m + (1-x)[p(p\pi_D^I - K) + (1-p)\pi_m] - c.$$

Meanwhile, I's profit from not pursuing in-house R&D is

$$(x(1-p) + (1-x)(1-p)^2)\pi_m.$$

Hence, I invests in in-house R&D if and only if if and only if

$$px\pi_m + (1-x)p(p\pi_D^I - K) \geq c,$$

which holds if and only if $K \leq K_x$.

We now turn to $E1$'s development decision. First, consider $K \leq K_0$. Consider $E1$'s profit from choosing the type-0 project. Then, I always invests into in-house R&D, $E1$ pursues development while $E2$ never pursues development (as, since $\pi_T^I > \Pi_T + p^2(\pi_D - \pi_D^E)$, $\underline{x}(K) > 0$), and I counter-develops in response if and only if $E1$ obtains a superior substitute. Thus, $E1$'s profit from choosing the type-0 project is

$$p[\Pi + p(\pi_D^E - \pi_D)] - K.$$

Meanwhile, if $E1$ chooses the type-X project, I always invests into in-house R&D, $E1$ pursues development while $E2$ pursues development if and only if $x \geq \underline{x}(K)$, and I counter-develops in response if and only if $E1$ (or $E2$) obtains a superior substitute. Thus, $E1$'s expected profit is

$$p\bigg(\int_0^{\overline{x}} [x\pi_X(x) + (1-x)(\Pi + p(\pi_D^E - \pi_D))]dF(x) + \int_{\overline{x}}^1 [x\pi_X(x) + (1-x)\Pi_T + p^2[\pi_D - \pi_T^E]]dF(x)\bigg) - K.$$

Taking the difference between the two, it follows that $E1$ chooses the type-0 project if and only if (8) holds.

Next, suppose $K > K_0$. If $E1$ chooses the type-0 project, then I never invests into in-house R&D. Thus, $E1$'s profit mirrors the benchmark case, which is

$$p\Pi - K.$$

Meanwhile, if $E1$ chooses the type-X project, then I invests into in-house R&D if and only if $x \in \{x' < \underline{x}(K) : K_{x'} \geq K\}$. Furthermore, conditional on investing into in-house R&D, I always invests into in-house R&D, $E1$ pursues development while $E2$ never pursues development, and I counter-develops in response if and only if $E1$

obtains a superior substitute. Thus, $E1$'s profit from choosing the type-X project is

$$\int_{x \notin \{x' < \underline{x}(K): K_{x'} \geq K\}} [p(x\pi_X(x) + (1-x)\Pi) - K] dF(x)$$
$$+ \int_{x \in \{x' < \underline{x}(K): K_{x'} \geq K\}} [p(x\pi_X(x) + (1-x)(\Pi + p(\pi_D^E - \pi_D)) - K] dF(x).$$

Taking the difference between the two, it follows that $E1$ chooses the type-0 project if and only if (11) holds. □

OB2.3: Discussion

Comparison of equilibrium. We now discuss the difference between the equilibrium of this model with in-house R&D, and that in the main text with acquisitions.

Low Development Cost. First, observe that in the region $K \leq p\Pi_T$ (so $K \leq \min\{K_D^{E1}(0), p\pi_D^I\}$, both models have the same equilibrium behaviour by firms given $E1$'s project choice: I obtains a type-0 project either by investing in in-house R&D (in this model) or by acquiring E2 (in the main model), $E1$ (and $E2$) pursue development of their projects, and I always counter-develops in response to a startup obtaining a superior substitute. Furthermore, we recall that in the benchmark case without acquisitions/in-house R&D, $E1$ chooses the type-0 over the type-X project if and only if

$$\int_0^1 x(\Pi - \pi_X(x)) dF(x) \geq 0.$$

This condition is easier to satisfy than (8). Therefore, I's in-house R&D induces a kill zone. This is similar to the model with acquisitions where, as discussed in Corollary 1 of the main text, I's acquisition induces a kill zone.

In the numerical example, we find that

$$\int_0^1 x(\Pi - \pi_X(x))dF(x) \approx 0.003 > 0;$$
$$\int_0^1 x(\Pi - \pi_X(x) + p^2(\pi_D^E - \pi_D))dF(x) \approx -0.005 < 0;$$
$$\int_0^1 x(\Pi_T - \pi_X(x))dF(x) \approx 0.3133 < 0.$$

Thus, $E1$ chooses the type-0 project in the absence of acquisitions/in-house R&D, and chooses the type-X project anticipating I to acquire $E2$ or for I to invest in in-house R&D.

Medium Development Cost. Next, consider the region $p\Pi_T < K \leq p\pi_D^I$. In the main model, firms have the same equilibrium project choices and development decisions as described above. In the alternate model, I still invests in in-house R&D, $E1$ (but possibly not $E2$) always pursues development, and I counter-develops at least in response to exactly one startup obtaining a superior substitute. However, $E1$'s project choice decision may now differ from the main model. For $K \leq K_0$, the conditions for when $E1$ chooses the type-0 project over the type-X project, (9) and (10) respectively, may or may not be weaker than the benchmark setting. By inspecting the corresponding formulas, they are more likely to hold for K is small, i.e., so $E1$ chooses the type-0 project if and only if K is sufficiently small. Meanwhile, for $K > K_0$, (11) is weaker than the benchmark setting, so the incumbent's R&D induces a safe space.

In the numerical example, we find that both (9) and (10) are strictly satisfied for all K within this region (see below). Thus, for all $p\Pi_T < K \leq p\pi_D^I$, either I invests into in-house R&D and, anticipating this, $E1$ chooses the type-0 project (which occurs when K is low), or I does not invest into in-house R&D and, anticipating this, $E1$'s project choice mirrors that in the benchmark case, which involves choosing the type-0 project. This differs sharply from the main model with acquisitions where, as discussed above, $E1$ chooses the type-X project anticipating I to acquire $E2$.

To verify this, first consider the range $p\Pi_T < K \leq p\pi_T^I$. (9) reduces to

$$\int_0^1 x(\Pi - \pi_X(x))dF(x) + \underbrace{0.525\left[\frac{1}{6} - \frac{(K-0.1)^2}{2\times 0.225^2} + \frac{(K-0.1)^3}{3\times 0.225^3}\right]}_{:=\nabla_1(K)}.$$

A simple calculation reveals $\nabla_1(K)$ is strictly decreasing in K and strictly positive at $K = p\pi_T^I$. Thus, (9) is strictly satisfied for all $p\Pi_T < K \leq p\pi_T^I$.

Next, consider the range $p\pi_T^I < K \leq K_0$. (10) reduces to

$$\int_0^1 x(\Pi - \pi_X(x))dF(x) + \underbrace{0.375\left[\frac{1}{6} - \frac{(K-0.1375)^2}{2\times 0.1875^2} + \frac{(K-0.1375)^3}{3\times 0.1875^3}\right]}_{:=\nabla_2(K)}.$$

A simple calculation reveals $\nabla_2(K)$ is strictly positive on $p\pi_T^I \leq K < p\pi_D^I$. Hence, (10) is strictly satisfied for all $p\pi_T^I < K \leq K_0$.

High Development Cost. Finally, in the region $K \geq p\pi_D^I$, I does not invest in in-house R&D as there is no incentive to pursues development of the project ex-post, so the equilibrium mirrors that in the benchmark. This differs from the main model, where because I still benefits from acquiring $E2$ by deterring $E2$'s entry, I acquires $E2$ and, anticipating this, $E1$ chooses the type-0 project.

Revenue from In-house vs Acquired R&D. As discussed in text, our analysis suggests that the marginal revenue from an acquisition, i.e., ignoring the acquisition price which is equal to $E2$'s reservation value, is often greater than in-house R&D, i.e., ignoring in-house R&D costs. We shall prove this claim in the case where there is a kill zone effect in the main model, i.e., $E1$ chooses a type-0 project in the absence of acquisitions, but a type-X project with acquisitions.

Corollary 1. *Suppose that*

$$\int_0^1 x[\Pi - \pi_X(x)]dF(x) > 0 > \int_0^1 x(\Pi - \pi_X(x) + p(\pi_D^E - \pi_D))dF(x). \qquad (12)$$

so $E1$ chooses a type-0 project in the absence of acquisitions, but a type-X project with acquisitions. Then, the incumbent's marginal revenue from acquiring $E2$ in the model with acquisitions is always strictly larger than the incumbent's marginal revenue from investing into in-house R&D in the model with in-house R&D.

Proof. Let $\mathcal{R}^A(K)$ denote the incumbent's total revenue from acquiring $E2$ in the model with acquisitions, and $\mathcal{R}^H(K)$ denote the incumbent's total revenue from investing into in-house R&D in the model with in-house R&D. Because the incumbent's revenue in the absence of an acquisition or in-house R&D is the same, the incumbent's marginal revenue is strictly greater in the model with acquisitions than under in-house R&D if and only if $\mathcal{R}^A(K) > \mathcal{R}^H(K)$.

We now compare the two across the various ranges of development costs.

Case 1: $K \le p(\pi_M - \pi_m)$. Because (12) holds, (8) fails to hold, i.e., $E1$ chooses a type-X project under in-house R&D. Therefore, we have

$$\mathcal{R}^A(K) = \int_0^1 \begin{pmatrix} x[p\pi_M + (1-p)\pi_m] \\ +(1-x)[p^2\pi_D^I + p(1-p)\pi_M + (1-p)^2\pi_m] \end{pmatrix} dF(x) - K;$$
$$\mathcal{R}^H(K) = \int_0^1 \begin{matrix} (x(p^2\pi_D^I + p(1-p)\pi_M + (1-p)^2\pi_m) \\ +(1-x)(p^2[p\pi_I^T + (1-p)\pi_D^I] + p(1-p)[p\pi_D^I + (1-p)\pi_M] + (1-p)^3\pi_m) \end{matrix})dF(x) - K.$$

Since $\pi_M > p\pi_D^I + (1-p)\pi_M$ and $\pi_D^I > p\pi_D^T + (1-p)\pi_D^I$, it follows that $\mathcal{R}^A(K) > \mathcal{R}^H(K)$.

Case 2: $p(\pi_M - \pi_m) < K \le p\Pi_T$. Because (12) holds, (8) fails to hold, i.e., $E1$ chooses a type-X project under in-house R&D. Therefore, we have

$$\mathcal{R}^A(K) = \int_0^1 \left(x\pi_m + (1-x)[p[p\pi_D^I - K] + (1-p)\pi_m]\right) dF(x); \tag{13}$$
$$\mathcal{R}^H(K) = \int_0^1 \begin{matrix} (x(p[p\pi_D^I - K] + (1-p)\pi_m) \\ +(1-x)(p^2[p\pi_I^T - K] + 2p(1-p)[p\pi_D^I - K] + (1-p)^2\pi_m) \end{matrix})dF(x). \tag{14}$$

Since $p\pi_D^I - K \le p\pi_m < \pi_M$ and so

$$\begin{aligned} &p^2[p\pi_I^T - K] + 2p(1-p)[p\pi_D^I - K] + (1-p)^2\pi_m \\ &= p(p[p\pi_T^I] + (1-p)[p\pi_D^I] - K) + (1-p)(p[\pi_D^I - K] + (1-p)\pi_m) \\ &< p[p\pi_D^I - K] + (1-p)\pi_m, \end{aligned}$$

it follows that $\mathcal{R}^A(K) > \mathcal{R}^H(K)$.

Case 3: $p\Pi_T < K \leq p\pi_I^T$. Here, $\mathcal{R}^A(K)$ is given by (13). Now if $E1$ chose the type-0 project under in-house R&D, then since $E2$ does not pursue development by Proposition 5, total revenue under in-house R&D is

$$\mathcal{R}^H(K) = p[p\pi_D^I - K] + (1-p)\pi_m.$$

Comparing the above to (13), it is easy to see that $\mathcal{R}^A(K) > \mathcal{R}^H(K)$.

Meanwhile, if $E1$ chose the type-X project under in-house R&D, then since $E2$ pursues development if and only if $x > \overline{x}(K)$, total revenue under in-house R&D is given by

$$\mathcal{R}^H(K) = \int_{\overline{x}(K)}^{1} \left(\underbrace{\begin{array}{c} (x(p[p\pi_D^I - K] + (1-p)\pi_m) \\ +(1-x)(p^2[p\pi_I^T - K] + 2p(1-p)[p\pi_D^I - K] + (1-p)^2\pi_m) \end{array}}_{(A)} \right) dF(x)$$
$$+ \underbrace{\int_0^{\overline{x}} \big(x\pi_m + (1-x)[p[p\pi_D^I - K] + (1-p)\pi_m]\big)\, dF(x)}_{(B)}.$$

For each $x \geq \overline{x}(K)$, term (A) is identical to the term inside of (14). Meanwhile, for each $x < \overline{x}(K)$, term (B) is identical to the term inside of (13). Since the proof of Case 2 shows that, for each $x > 0$, the term inside of (13) is strictly greater than the term inside of (14), it follows that $\mathcal{R}^A(K) > \mathcal{R}^H(K)$.

Case 4: $p\pi_T^I < K \leq p\pi_D^I$. Here, $\mathcal{R}^A(K)$ is given by (13). We focus on proving the claim under the assumption that $K < K_0$ (the logic for $K \geq K_0$ is similar and thus omitted).

Suppose $E1$ chose the type-0 project under in-house R&D, then since $E2$ does not pursue development by Proposition 5, total revenue under in-house R&D is

$$\mathcal{R}^H(K) = p[p\pi_D^I - K] + (1-p)\pi_m.$$

Comparing the above to (13), it is easy to see that $\mathcal{R}^A(K) > \mathcal{R}^H(K)$.

Next, suppose $E1$ chose the type-X project under in-house R&D, then since $E2$ pursues development if and only if $x > \overline{x}(K)$, total revenue under in-house R&D is given by

$$\mathcal{R}^H(K) = \int_{\overline{x}(K)}^{1} \underbrace{\begin{pmatrix} (x(p[p\pi_D^I - K] + (1-p)\pi_m) \\ +(1-x)(2p(1-p)[p\pi_D^I - K] + (1-p)^2\pi_m) \end{pmatrix}}_{(A)} dF(x)$$
$$+ \underbrace{\int_0^{\overline{x}} \left(x\pi_m + (1-x)[p[p\pi_D^I - K] + (1-p)\pi_m]\right) dF(x)}_{(B)} .$$

Note that

$$\begin{aligned} 2p(1-p)[p\pi_D^I - K] + (1-p)^2\pi_m &< p(1-p)[p\pi_D^I - K] + (1-p)\pi_m \\ &< p[p\pi_D^I - K] + (1-p)\pi_m, \end{aligned}$$

where the first strict inequality holds as $p\pi_D^I - K < \pi_m$. Thus, for each $x \geq \overline{x}(K)$, term (A) is identical to the term inside of (13). Meanwhile, term (B) is identical to the term inside of (13). It follows that $\mathcal{R}^A(K) > \mathcal{R}^H(K)$.

Case 5: $K > p\pi_D^I$. Here, I's total revenue under an acquisition and in-house are, respectively,

$$\mathcal{R}^A(K) = (1-p)\pi_m, \ \mathcal{R}^H(K) = (1-p)^2\pi_m.$$

Thus, $\mathcal{R}^A(K) > \mathcal{R}^H(K)$. □

Profitability of In-house vs Acquired R&D. While the previous result suggests that the incumbent's gross revenue is often higher under acquisitions than in-house R&D, the following example demonstrates that, due to how the acquisition price varies in development costs, the comparison of the incumbent's profit under acquisitions to in-house R&D can often be ambiguous, and the former is often greater when development costs are sufficiently large.

Low Development Cost. Suppose $K \le p(\pi_M - \pi_m)$. Because the incumbent pursues development unconditionally and $E1$ chooses the type-X project, the incumbent's profit under acquisition is

$$\underbrace{\int_0^1 (x[p\pi_M + (1-p)\pi_m] + (1-x)[p^2\pi_D^I + p(1-p)\pi_M + (1-p)^2\pi_m])dF(x) - K}_{\text{I's payoff under acquisition}}$$
$$-\underbrace{[\int_0^1 p(x\pi_M + (1-x)(p\pi_D + (1-p)\pi_M))dF(x) - K]}_{\text{E2's reservation value}} \approx 0.3364.$$

Likewise, the incumbent pursues development unconditionally and $E1$ chooses the type-X project. Thus, the incumbent's profit under in-house R&D is

$$\int_0^1 \begin{pmatrix} (x(p^2\pi_D^I + p(1-p)\pi_M + (1-p)^2\pi_m) \\ +(1-x)(p^3\pi_I^T + 2p^2(1-p)\pi_D^I + p(1-p)^2\pi_M + (1-p)^3\pi_m) \end{pmatrix} dF(x) - K - c$$
$$= 0.536777 - K.$$

Since $K \le p(\pi_M - \pi_m) = 0.15$, it follows that in-house R&D is more profitable on this region.

Moderate Development Cost. Suppose $p(\pi_M - \pi_m) < K \le p\pi_D^I$. Because the incumbent pursues development if and only if $E1$ obtains a superior substitute and $E1$ chooses the type-X project, the incumbent's profit under acquisition is

$$\underbrace{\int_0^1 (x(\pi_m) + (1-x)[p(p\pi_D^I - K) + (1-p)\pi_m])dF(x)}_{\text{I's payoff under acquisition}}$$
$$-\underbrace{[\int_0^1 p(x\pi_M + (1-x)(p\pi_D + (1-p)\pi_M))dF(x) - K]}_{\text{E2's reservation value}} \approx 0.21042 + 0.8333K.$$

Meanwhile, under in-house R&D,

1. If $K \le p\Pi_T$, then I invests in in-house R&D, both $E1$ and $E2$ pursue development, I counter-develops if and only if at least one entrant obtains a superior

substitute, and $E1$ chooses the type-X project. Therefore, the incumbent's profit is

$$\int_0^1 \left(\begin{array}{c} x(p(p\pi_D^I - K) + (1-p)\pi_m) \\ +(1-x)(p^2(p\pi_T^I - K) + 2p(1-p)(p\pi_D^I - K) + (1-p)^2\pi_m) \end{array} \right) dF(x) - c$$
$$= 0.4742 - 0.583K.$$

A simple calculation shows that in-house R&D is more profitable than acquisitions if and only if $K \leq 0.1863$ (for reference, $p\Pi_T = 0.2$).

2. Meanwhile, if $p\Pi_T < K \leq p\pi_D^I$, then I invests in in-house R&D, only $E1$ pursues development, I counter-develops if and only if $E1$ obtains a superior substitute, and $E1$ chooses the type-0 project. Therefore, the incumbent's profit is

$$p(p\pi_D^I - K) + (1-p)\pi_m - c = 0.51375 - 0.5K.$$

A simple calculation shows that in-house R&D is more profitable than acquisitions if and only if $K \leq 0.2275$ (for reference, $p\pi_D^I = 0.2875$).

Large Development Cost. Finally, suppose $K > p\pi_D^I$. Clearly, the incumbent finds acquisitions more profitable than in-house R&D as the profit under the latter is exactly zero.

OC: Consumer Welfare and Merger Policy

In this section, we expand upon the analysis in Section 5 of the main text.

OC1: Laissez-Faire vs Ban on Acquisitions

In Section 5.1 of the main text, we developed conditions under which a laissez-faire policy yields greater consumer welfare than a total ban on acquisitions when acquisitions induce a kill zone, i.e., so (15) holds but (16) does not hold. Our next result covers the remaining cases not covered in the main text. Throughout, we let

$$\int_0^1 x(\Pi - \pi_X(x))dF(x) \geq 0, \tag{15}$$

$$\int_0^1 x(\Pi - \pi_X(x) + p(\pi_D^E - \pi_D))dF(x) \geq 0, \tag{16}$$

which coincide with conditions (1) and (9) in the main text.

Lemma 3. *Suppose that $K \leq K_D^I$. Then, a Laissez-faire policy yields a greater consumer welfare than a ban if either of the following conditions holds:*

1. *If $K_M^I < K \leq K_D^{E1}(0)$, (15) and (16) both hold, and*

$$\underbrace{\frac{(1-p)}{p}V_0}_{\text{Loss from lower development probability}} \leq \underbrace{\delta}_{\text{Synergy}} \tag{17}$$

2. *If $K_M^I < K \leq K_D^{E1}(0)$, (15) and (16) both do not hold, and*

$$\underbrace{\left(\frac{\mu}{p(1-\mu)} + \frac{(1-p)}{p}\right)V_0}_{\text{Loss from lower development probability}} \leq \underbrace{\delta}_{\text{Synergy}} \tag{18}$$

3. *If $K_D^{E1}(0) < K$, (15) does not hold, and*

$$\underbrace{\frac{\int_{x:K_D^E(x)<K}\Big(xV_X(x) + (1-x)(p(\epsilon+\delta) + V_0)\Big)dF(x)}{p(1-\mu)} + \left(\frac{\mu}{p(1-\mu)} + \frac{(1-p)}{p}\right)V_0}_{\text{Loss from lower development probability}} \leq \underbrace{\delta}_{\text{Synergy}} \tag{19}$$

Proof: To start, observe that if (15) holds, so by Proposition 1, $E1$ chooses the type-0 project in the absence of acquisitions, then expected consumer welfare is

$$p^2(V_0 + \epsilon) + 2p(1-p)V_0, \tag{20}$$

while if (15) does not hold, so by Proposition 1, $E1$ chooses the type-X project in the absence of acquisitions, then expected consumer welfare is

$$p\bigg(\int_0^1 (x(V_0 + V_X(x)))dF(x) + (1-\mu)(p(V_0+\epsilon) + 2(1-p)V_0)\bigg). \tag{21}$$

1. If $K_M^I < K \leq K_D^{E1}(0)$, (15) and (16) both hold, then $E1$ chooses the type-0 project under a ban on acquisitions and a Laissez-faire policy. Furthermore, under a Laissez-faire policy, $E1$ always pursues development, and I counter-develops in response to $E1$ obtaining superior substitute. Hence, consumer welfare is given by, respectively, (20) and

   $$p(p(V_0+\epsilon+\delta) + (1-p)V_0).$$

   Comparing the two shows that Laissez-faire policy is preferred by consumers if and only if (17) holds.

2. If $K_M^I < K \leq K_D^{E1}(0)$, (15) and (16) both do not hold, then $E1$ chooses the type-X project under a ban on acquisitions and a Laissez-faire policy. Furthermore, under a Laissez-faire policy, $E1$ always pursues development, and I counter-develops in response to $E1$ obtaining a superior substitute. Consumer welfare is given by, respectively, (20) and

   $$p\bigg(\int_0^1 xV_X(x)dF(x) + (1-\mu)(p(\epsilon+\delta) + V_0)\bigg). \tag{22}$$

   Comparing the two shows that Laissez-faire policy is preferred by consumers if and only if (18) holds.

3. If $K_D^{E1}(0) < K$, (15) does not hold, then $E1$ chooses the type-X project under a ban on acquisitions and a Laissez-faire policy. $E1$ pursues development if and only if $K_D^{E1}(x) \geq K$, and I only counter-develops in response to $E1$ obtaining a

superior substitute. Consumer welfare is given by, respectively, (21) and

$$p\left(\int_{x:K_D^E(x)\geq K} \left(xV_X(x) + (1-x)(p(\epsilon+\delta)+V_0) \right) dF(x) \right)$$

Comparing the two shows that Laissez-faire policy is preferred by consumers if and only if (19) holds. □

OC2: General Approval Rates

In Section 5.2 and Appendix B of the main text, we identified sufficient conditions for intermediate merger policies to outperform extreme merger policies in the lowest development cost region $K \leq K_M^I$ and, when one such policy exists, characterized the consumer-welfare maximizing one. In this section, we derive analogous results for other development cost regions. To streamline the analysis, we focus on class of coarse merger policies, i.e., which approve a merger with probability $\hat{q} \in [0,1]$ regardless of the realization of x.

Our first result focuses on the region $K_M^I < K \leq K_D^{E1}(0)$. The key observation is that there exists an intermediate coarse merger policy that outperforms both extremes if and only if there is a kill zone effect, and the development cost is moderately large.

Lemma 4. *Suppose that* $K_M^I < K \leq K_D^{E1}(0)$.

1. *Suppose (15) and (16) both hold or both do not hold, so there is no kill zone effect. Then no intermediate coarse merger policy outperforms an extreme merger policy.*

2. *Suppose (15) holds strictly but (16) does not hold, so there is a kill zone effect. Let*

$$\hat{q}^* := \max\left\{ \hat{q} \in (0,1) : \int_0^1 x[\Pi - \pi_X(x) + p\hat{q}(\pi_D^E - \pi_D)]dF(x) \geq 0 \right\}. \qquad (23)$$

Then, there exists an intermediate coarse merger policy which yields strictly *greater consumer welfare than either extreme merger policy if and only if*

$$\begin{array}{c} \int_0^1 x[p\epsilon + (1-p)V_0 - V_X(x)]dF(x) \\ +(V_0+\delta)(p\mu + (1-p)(1-\hat{q}^*)) \end{array} > (1-\hat{q}^*)\delta; \text{ and} \tag{24}$$

$$\frac{(1-p)}{p}V_0 \leq \delta. \tag{25}$$

If (24) and (25) hold, then among all intermediate coarse merger policies, the one which maximizes consumer welfare is unique and has an approval rate of $\hat{q}^*$*.*

Proof. We first observe that fixing $E1$'s project choice, $E1$'s payoff and consumer welfare is linear in the probability of approval. As a result, if $E1$'s project choice does not vary depending on the acquisition, then it is the same regardless of the approval probability, and thus no coarse merger policy yields strictly higher consumer welfare than an extreme policy.

Hence, consider the case where (15) holds strictly but (16) does not hold. Following a similar argument to Proposition 5 in the main text, if a coarse merger policy with approval probability $\hat{q}^* \in (0,1)$ yields strictly greater consumer welfare than either extreme policy, then it must induce $E1$ to choose a type-0 project. We further note that under any merger policy, consumer welfare is

$$\hat{q}^* p(p(V_0 + \epsilon + \delta) + (1-p)V_0) + (1-\hat{q}^*)(p^2(V_0+\epsilon) + 2p(1-p)V_0). \tag{26}$$

Now, through some algebra, one finds than $\hat{q}^*$ yields a strictly greater consumer welfare than a laissez-faire policy and a full ban, given in (20) and (22), if and only if (24) and (25) hold. Furthermore, if such a $\hat{q}^*$ exists, then because (25) holds, among all $\hat{q}^*$ which satisfies this, the largest one which preserves $E1$'s incentive to choose the type-0 project maximizes consumer welfare. The latter is exactly given by (23). □

Our next result focuses on the region $K_D^{E1}(0) < K \leq K_D^I$. The key observation is that no intermediate coarse merger policy outperforms both extremes.

Lemma 5. *Suppose that* $K_D^{E1}(0) < K \leq K_D^I$*. Then, no intermediate coarse merger policy yields strictly greater consumer welfare than both extreme merger policies.*

Proof. By following the preceding proof, it is easy to show that when $E1$'s project choice does not vary depending on the acquisition, no coarse merger policy yields strictly higher consumer welfare than an extreme policy. Thus, we focus on the case where $E1$'s project choice does vary.

By Proposition 2 of the main text, there are two cases to consider. First, suppose $K_D^{E1}(0) < K \leq K_D^I$ and (15) holds, i.e., there is a kill zone effect. Take any intermediate approval probability $\hat{q} \in (0,1)$. If $E1$ chooses the type-0 project under $\hat{q}$, then since, by Proposition 2, no firms pursue development conditional on an acquisition being approved, consumer welfare is given by $(1-\hat{q})(p^2(V_0+\epsilon)+2p(1-p)V_0)$, which is strictly lower than the consumer welfare under a ban, $p^2(V_0+\epsilon)+2p(1-p)V_0$. If $E1$ chooses a type-X project under $\hat{q}$, then consumer welfare under $\hat{q}$ is given by

$$
\begin{aligned}
&\hat{q}\left(\int_{x:K_D^E(x)\geq K}\Big(xV_X(x)+(1-x)(p(\epsilon+\delta)+V_0)\Big)dF(x)\right)\\
&+(1-\hat{q})p\left(\int_0^1 (x(V_0+V_X(x)))dF(x)+(1-\mu)(p(V_0+\epsilon)+2(1-p)V_0)\right)\\
&<\hat{q}\left(\int_{x:K_D^E(x)\geq K}\Big(xV_X(x)+(1-x)(p(\epsilon+\delta)+V_0)\Big)dF(x)\right)\\
&+(1-\hat{q})(p^2(V_0+\epsilon)+2p(1-p)V_0).
\end{aligned}
$$

where the latter is just a linear combination of the consumer welfare under a full ban and laissez-faire policy respectively. Thus, by linearity, consumer welfare is weakly lower than that under (at least) one of the two extreme policies.

□

Finally, we focus on the region $K > K_D^I$. Our main observation is that if there is a safe space effect, i.e., then an intermediate policy can dominate both extremes.

Lemma 6. *Suppose that $K > K_D^I$.*

1. *Suppose (15) holds. Then, no intermediate coarse merger policy outperforms an extreme merger policy.*

2. *Suppose (15) does not hold. Let*

$$\widetilde{q}^* := \min\left\{\widetilde{q} \in (0,1) : \int_0^1 x[\Pi - \pi_X(x) + p\widetilde{q}(\pi_M - \pi_D)]dF(x) \geq 0\right\}. \tag{27}$$

Then, there exists an intermediate coarse merger policy which yields strictly greater consumer welfare than either extreme merger policy if and only if

$$\widetilde{q}^* < \frac{\mu((1-p)V_0 + p\epsilon) - \int_0^1 xV_X(x)dF(x)}{(1-p)V_0 + p\epsilon} \tag{28}$$

If (28) holds, then among all intermediate coarse merger policies, the one which maximizes consumer welfare is unique and has an approval rate of $\widetilde{q}^*$*.*

Proof. By following the preceding proof, it is easy to show that when $E1$'s project choice does not vary depending on the acquisition, no coarse merger policy yields strictly higher consumer welfare than an extreme policy. This proves 1).

To prove 2), we first argue that if an intermediate coarse merger policy with approval rate $\widetilde{q}$ induces $E1$ to choose the type-X project, then it does not yield strictly higher consumer welfare than an extreme policy. To see this, take any such policy. Then, consumer welfare is

$$\widetilde{q} \times \underbrace{(p\int_0^1 [xV_X(x) + (1-x)V_0]dF(x)}_{:=(A)}$$
$$\underbrace{+(1-\widetilde{q}) \times p\left(\int_0^1 (x(V_0 + V_X(x)))dF(x) + (1-\mu)(p(V_0+\epsilon) + 2(1-p)V_0)\right)}_{:=(B)}.$$

It is straightforward to see that term (A) is strictly smaller than the consumer welfare under a full ban in (20), while term (B) is simply equal to the consumer welfare under a laissez-faire policy. By linearity, this means that consumer welfare under $\widetilde{q}$ is weakly lower than either extreme.

Next, we show that an intermediate coarse merger policy with approval rate $\widetilde{q}$ yields strictly higher consumer welfare than both extreme policies if and only if (28) holds (under $\widetilde{q}$). First, recall by Proposition 3 of the main text that a laissez-faire policy yields a strictly lower consumer welfare than a full ban. Thus, $\widetilde{q}$ yields strictly higher consumer welfare than both extreme policies if and only if it outperforms a full ban. We further recall by the above that $\widetilde{q}$ must induce $E1$ to choose the type-0 project. Finally, conditional on choosing the type-0 project, consumer welfare under $\widetilde{q}$ is

$$\widetilde{q} \times pV_0 + (1-\widetilde{q})(p^2(V_0+\epsilon) + 2p(1-p)V_0) \tag{29}$$

Comparing the above to consumer welfare under a full ban, (20), shows that the former is strictly greater if and only if (28) holds.

Finally, observe that (29) is strictly decreasing in $\widetilde{q}$. Therefore, if there exists an intermediate coarse merger policy with approval rate $\widetilde{q}$ which maximizes consumer welfare, then (i) it must be the one with the lowest approval probability that induces $E1$ to choose the type-0 project maximizes consumer welfare, defined in (27), and (ii) such a policy exists if and only if (28) holds under $\widetilde{q}^*$. □

OC3: Remedies

In this section, we provide an example of remedy which strictly improves upon both extreme policy regimes by instead raising the probability that $E1$ develops *without* undoing the kill zone. Note that unlike the setting studied in Section 5.2 and Appendix B of the main text, this example relies on development costs being moderately large.

Lemma 7. *Suppose that $K_D^{E1}(0) < K < K_D^I$. If*

$$\begin{pmatrix} (V_0+\delta)\int_0^1 (x + (1-x)(1-p))dF(x) \\ + \int_{x:K_D^E(x)<K} (xV_X(x) + (1-x)[p(\epsilon+\delta)+V_0])dF(x) \\ + \int_0^1 x[p\epsilon + (1-p)V_0 - V_X(x)]dF(x) \end{pmatrix} \leq \delta. \tag{30}$$

holds, then any remedy with[3]

$$R \in \left(0, \min\left\{\pi_D^I - \max\{\pi_D, \frac{K}{p}\}, \gamma^{-1}(\frac{K_D^{E1}(0) - K}{p})\right\}\right)$$

[3]One such remedy exists as $K_D^I > K$ and $\pi_D^I > \pi_D$.

yields a strictly greater consumer welfare than a laissez-faire policy or a total ban on acquisitions. Under any such remedy, $E1$ continues to choose a type-X project, and both I and $E1$ develop their projects with strictly greater probability than under a laissez-faire policy.

Proof: By the proof of Proposition 4 in Appendix B of the main text, (30) implies that consumer welfare is weakly greater under a laissez-faire policy than a total ban on acquisitions. Hence, it suffices to show that under the remedy (i) $E1$ chooses the type-X project, and (ii) $E1$ pursues development with strictly greater probability than under a laissez-faire policy. (i) holds as $R \leq \min\{\pi_D^I - \max\{\pi_D, \frac{K}{p}\}, \gamma^{-1}(\frac{K_D^{E1}(0)-K}{p})\}$ implies that I always counter-develops when $E1$ obtains a superior substitute, anticipating this, $E1$'s profit from choosing a type-0 project is zero and so strictly lower than choosing a type-X project. Meanwhile, to see why (ii) holds, first note that $E1$ develops the type-X project if and only if the realized value of x satisfies $K_D^{E1}(x) \geq K$. Because $K_D^{E1}(0) < K$, there exists a $\overline{x} \in (0,1)$ such that $K_D^{E1}(x) \geq K$ holds if and only if $x \geq \overline{x}$. Any remedy with $R > 0$ strictly raises $E1$'s profit conditional on obtaining a superior substitute and competing with the incumbent. Therefore, it strictly reduces the cutoff $\overline{x}$, and so expands the measure of x for which $E1$ develops. Since, within this range, I counter-develops conditional on $E1$'s development, the remedy also strictly increases the probability in which I pursues development of its project. □