Technical Appendix for:

Vaporware, Suddenware, and Trueware: New Product Preannouncements under Market Uncertainty

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In this Technical Appendix, we provide: 1. Detailed proofs of the results reported in Sections 4 and 5 of the paper, 2. Proof that the results stated in Propositions 1 and 2 continue to hold for any value of c_I, and 3. Discussion and proofs of four extensions mentioned in Section 3 of the paper.

TA1 The Detailed Proofs of Sections 4 and 5

Observations Regarding Firms' Expected Payoffs: From payoff expression (5) one can see that the optimal R&D level chosen by the entrant is $\phi_E^* = \frac{\mu_E(\pi_m - \tilde{\phi}_I(\pi_m - \pi_d))}{c_E}$. Since $\mu_E \in (0,1]$, we need $\frac{\pi_m}{c_E} < 1$ to guarantee that $\phi_E^* \in (0,1)$. Similarly, if the incumbent chooses to pursue the new product opportunity from payoff expression (3) one can see that $\phi_I^* = \frac{\mu_I(\pi_m - \pi_0 - \Delta\tilde{\phi}_E)}{c_I}$, where $\Delta = \pi_m - \pi_d - \pi_0$. From payoff expressions (3)-(5), $\frac{\partial EV_I}{\partial \tilde{\phi}_E} = -\mu_I \pi_0 - \Delta \frac{\mu_I^2(\pi_m - \pi_0 - \Delta\tilde{\phi}_E)}{c_I} < 0$ if the incumbent pursues the new product opportunity, $\frac{\partial EV_I}{\partial \tilde{\phi}_E} = -\mu_I \pi_0 < 0$ if the incumbent forgoes the new product opportunity, and $\frac{\partial EV_E}{\partial \tilde{\phi}_I} = \frac{-(\pi_m - \pi_d)\mu_E^2(\pi_m - \tilde{\phi}_I(\pi_m - \pi_d))}{c_E} < 0$. Finally, from payoff expression (5), holding $\widetilde{\phi}_I$ constant, we have $\frac{\partial^2 EV_E}{\partial \phi_E \partial \mu_E} = \pi_m - \widetilde{\phi}_I(\pi_m - \pi_d) > 0$.

From payoff expressions (3) and (4), when $s_I = high$, the incumbent's payoff is equal to $\pi_0(1 - \tilde{\phi}_E) + \frac{(\pi_m - \pi_0 - \Delta\tilde{\phi}_E)^2}{2c_I}$ if the incumbent pursues the new product opportunity and equal to $\pi_0(1 - \tilde{\phi}_E) + \pi^{\varnothing}$, otherwise. When $s_I = low$, the incumbent's payoff is equal to $\pi_0(1 - \mu_I\tilde{\phi}_E) + \frac{\mu_I^2(\pi_m - \pi_0 - \Delta\tilde{\phi}_E)^2}{2c_I}$, where $\mu_I = \frac{x(1-\sigma_I)}{1 - x\sigma_I}$, if the incumbent pursues the new product opportunity and equal to $\pi_0(1 - \mu_I\tilde{\phi}_E) + \pi^{\varnothing}$, otherwise. Therefore, if $\frac{\mu_I^2(\pi_m - \pi_0 - \Delta\tilde{\phi}_E)^2}{2c_I} < \pi^{\varnothing}$ $\forall\tilde{\phi}_E \in (0, \frac{\pi_m}{c_E}]$ and $\pi^{\varnothing} < \frac{(\pi_m - \pi_0 - \Delta\tilde{\phi}_E)^2}{2c_I}$ $\forall\tilde{\phi}_E \in (0, \frac{\pi_m}{c_E}]$, then the incumbent pursues the new product opportunity when $s_I = high$ and forgoes it when $s_I = low$. Since $\frac{\partial \mu_I}{\partial \sigma_I} < 0$ and $\lim_{\sigma_I \to 0} \mu_I \to x$, for a given $(\pi_m, \pi_d, \pi_0, c_I, c_E)$ there exist x and $\pi^{\varnothing}$ values such that the incumbent pursues the new product opportunity when $s_I = high$ and forgoes it when $s_I = low$ $\forall(\sigma_E, \sigma_I)$.■

Proof of Proposition 1: In the following we will solve for the case in which c_I is low enough such that the incumbent with $s_I = high$ prefers to set an R&D level equal to one. In Section TA2, we show that our results stated in Proposition 1 hold for any c_I value. The incumbent with $s_I = high$ prefers to set its R&D level equal to one if $c_I < \pi_m - \pi_0 - \Delta\tilde{\phi}_E$ $\forall\tilde{\phi}_E \in (0, \frac{\pi_m}{c_E}]$. In this case, since $EV_{I|_H} = \pi_m(1 - \tilde{\phi}_E) + \tilde{\phi}_E\pi_d - \frac{c_I}{2}$ the necessary condition for incumbent with $s_I = high$ to prefer to pursue the new product opportunity is $\pi^{\varnothing} < \pi_m - \pi_0 - \Delta\tilde{\phi}_E - \frac{c_I}{2}$ $\forall\tilde{\phi}_E \in (0, \frac{\pi_m}{c_E}]$. Since $c_I > 0$ and $EV_{I|_L} < \mu_I(\pi_m(1 - \tilde{\phi}_E) + \tilde{\phi}_E\pi_d) + (1 - \mu_I)\pi_0$ it is sufficient to have $\pi^{\varnothing} > \mu_I(\pi_m - \pi_0 - \Delta\tilde{\phi}_E)$ $\forall\tilde{\phi}_E \in (0, \frac{\pi_m}{c_E}]$, where $\mu_I = \frac{x(1-\sigma_I)}{1 - x\sigma_I}$, so that the incumbent with $s_I = low$ prefers to forgo the new product opportunity. Given that $\mu_I \leq x$ and $\pi_m - \pi_0 - \Delta\tilde{\phi}_E > 0$, for a given $(\pi_m, \pi_d, \pi_0, c_E, c_I)$ there exist x and $\pi^{\varnothing}$ values such that the incumbent pursues the new product opportunity when $s_I = high$ and forgoes it when $s_I = low$ $\forall(\sigma_E, \sigma_I)$.

In vaporware equilibrium, from payoff expressions (3)-(5), the incumbent's expected payoff is equal to $EV_{I|_H}^{v*} = \pi_m - \tilde{\phi}_E^{v*}(\pi_m - \pi_d) - \frac{c_I}{2}$ when $s_I = high$ and equal to $EV_{I|_L}^{v*} = (1 - \mu_I \tilde{\phi}_E^{v*})\pi_0 + \pi^{\varnothing}$ when $s_I = low$, where $\tilde{\phi}_E^{v*} = \frac{\mu_E(\pi_m - \sigma_I(\pi_m - \pi_d))}{c_E}$, $\mu_E = \sigma_E + \frac{x(1-\sigma_E)^2}{(1-x\sigma_E)}$ and $\mu_I = \frac{x(1-\sigma_I)}{(1-x\sigma_I)}$. If the incumbent deviates to $a = s$ the entrant thinks that $s_I = low$ and its expected R&D level would be equal to $\tilde{\phi}_E^{v\prime} = \mu_E^{updated}\frac{\pi_m}{c_E}$, where $\mu_E^{updated} = \sigma_E + \frac{x(1-\sigma_E)^2(1-\sigma_I)}{1-x+x(1-\sigma_E)(1-\sigma_I)}$. Since $\frac{\partial EV_I}{\partial \tilde{\phi}_E} < 0$ the incumbent would deviate from the vaporware equilibrium if $\tilde{\phi}_E^{v*} > \tilde{\phi}_E^{v\prime}$. $\tilde{\phi}_E^{v*}(\sigma_I \geq \sigma_{I1}) \geq \tilde{\phi}_E^{v\prime}(\sigma_I \geq \sigma_{I1})$, where $\sigma_{I1} = \frac{\pi_m(\mu_E(1-x\sigma_E)^2 - x(1-x)(1-\sigma_E)^2) - \pi_d\mu_E(1-x\sigma_E)^2}{\mu_E(1-x\sigma_E)x(1-\sigma_E)(\pi_m-\pi_d)}$. Thus, the incumbent deviates to $a = s$ for $\sigma_I > \sigma_{I1}$. Note that if $\pi_m(1 - \frac{x(1-\sigma_E)^2}{\mu_E(1-x\sigma_E)}) < \pi_d < \pi_m(1 - \frac{x(1-x)(1-\sigma_E)^2}{\mu_E(1-x\sigma_E)^2})$ then there exists a $\sigma_{I1} \in (0,1)$. It is obvious that $1 - \frac{x(1-x)(1-\sigma_E)^2}{\mu_E(1-x\sigma_E)^2} > 1 - \frac{x(1-\sigma_E)^2}{\mu_E(1-x\sigma_E)}$.

In suddenware equilibrium, from payoff expressions (3)-(5), the incumbent's expected payoff is equal to $EV_{I|_H}^{s*} = \pi_m - \tilde{\phi}_E^{s*}(\pi_m - \pi_d) - \frac{c_I}{2}$ when $s_I = high$ and equal to $EV_{I|_L}^{s*} = (1 - \mu_I \tilde{\phi}_E^{s*})\pi_0 + \pi^{\varnothing}$ when $s_I = low$, where $\tilde{\phi}_E^{s*} = \frac{\mu_E(\pi_m - \sigma_I(\pi_m - \pi_d))}{c_E}$, $\mu_E = \sigma_E + \frac{x(1-\sigma_E)^2}{(1-x\sigma_E)}$, and $\mu_I = \frac{x(1-\sigma_I)}{(1-x\sigma_I)}$. If the incumbent deviates to $a = p$ the entrant thinks that $s_I = high$ and its expected R&D level would be equal to $\tilde{\phi}_E^{s\prime} = \frac{\pi_d}{c_E}$. Since $\frac{\partial EV_I}{\partial \tilde{\phi}_E} < 0$ the incumbent would deviate from the suddenware equilibrium if $\tilde{\phi}_E^{s*} > \tilde{\phi}_E^{s\prime}$. $\tilde{\phi}_E^{s*}(\sigma_I \leq \sigma_{I2}) \geq \tilde{\phi}_E^{s\prime}(\sigma_I \leq \sigma_{I2})$, where $\sigma_{I2} = \frac{\mu_E\pi_m - \pi_d}{\mu_E(\pi_m - \pi_d)}$. Note that $\sigma_{I2} > 0$ if $\mu_E\pi_m > \pi_d$.

As a result, if $\sigma_I < \min\{\sigma_{I1}, \sigma_{I2}\}$ only the vaporware equilibrium exists and if $\sigma_I > \max\{\sigma_{I1}, \sigma_{I2}\}$ only the suddenware equilibrium exists. Let σ_I^v denote $\min\{\sigma_{I1}, \sigma_{I2}\}$ and σ_I^s denote $\max\{\sigma_{I1}, \sigma_{I2}\}$. Note that $(1 - \frac{x(1-x)(1-\sigma_E)^2}{\mu_E(1-x\sigma_E)^2}) > \mu_E$. Hence, if $\pi_m(1 - \frac{x(1-\sigma_E)^2}{\mu_E(1-x\sigma_E)}) < \pi_d < \mu_E\pi_m$, then there exist $\sigma_I^v \in (0,1)$ and $\sigma_I^s \in (0,1)$. For example, for $(\pi_m = 2\pi_d, \pi_0 = \pi_d, \pi^{\varnothing} = 0.85\pi_d, c_E = 4\pi_d, c_I = 0.1\pi_d, x = 0.5, \sigma_E = 0.25)$, $\sigma_I^v = 0.25$ and $\sigma_I^s = \frac{5}{6}$. Finally, since $\sigma_{I1} > \sigma_{I2}$ for $\pi_d(1 - x\sigma_E) < \pi_m(1-x)$ and $\sigma_{I1} < \sigma_{I2}$ for $\pi_d(1 - x\sigma_E) > \pi_m(1-x)$, if $\pi_d(1 - x\sigma_E) < \pi_m(1-x)$ both the vaporware equilibrium and the suddenware equilibrium exist for $\sigma_I^s > \sigma_I > \sigma_I^v$ and if $\pi_d(1 - x\sigma_E) > \pi_m(1-x)$ only mixed strategy equilibria exist for $\sigma_I^s > \sigma_I > \sigma_I^v$.

From payoff expressions (3)-(5), when $s_I = high$, $EV_{I|_H}^{t*} = (\pi_m - \frac{\pi_d}{c_E}(\pi_m - \pi_d)) - \frac{c_I}{2}$ and when $s_I = low$, $EV_{I|_L}^{t*} = (1 - \mu_I\mu_E^{updated}\frac{\pi_m}{c_E})\pi_0 + \pi^{\varnothing}$, where $\mu_E^{updated} = \sigma_E + \frac{x(1-\sigma_E)^2(1-\sigma_I)}{1-x+x(1-\sigma_E)(1-\sigma_I)}$ and $\mu_I = \frac{x(1-\sigma_I)}{(1-x\sigma_I)}$. If the incumbent with $s_I = high$ deviates to $a = s$, then the entrant thinks that $s_I = low$ and its expected R&D level would be equal to $\mu_E^{updated}\frac{\pi_m}{c_E}$. In this case, $EV_{I|_H}^{t\prime} = (\pi_m - \mu_E^{updated}\frac{\pi_m}{c_E}(\pi_m - \pi_d)) - \frac{c_I}{2}$. If the incumbent with $s_I = low$ deviates to $a = p$ the entrant thinks that $s_I = high$ and its expected R&D level would be equal to $\frac{\pi_d}{c_E}$. In this case, $EV_{I|_L}^{t\prime} = (1 - \mu_I\frac{\pi_d}{c_E})\pi_0 + \pi^{\varnothing}$. Since $\frac{\partial EV_I}{\partial \tilde{\phi}_E} < 0$ the incumbent with $s_I = high$ would deviate from the trueware equilibrium if $\frac{\pi_d}{c_E} > \mu_E^{updated}\frac{\pi_m}{c_E}$ and the incumbent with $s_I = low$ would deviate from the trueware equilibrium otherwise.■

Proof of Proposition 2: When the demand-side benefits are integrated, the updated payoff expressions are as follows. If the incumbent chooses to pursue the new product opportunity (i.e., $d_I = p$)

and the β-segment consumers postpone their purchase its expected payoffs:

$$EV_I = \mu_I(\phi_I\tilde{\phi}_E(1+\beta)\pi_d + \phi_I(1-\tilde{\phi}_E)(1+\beta)\pi_m + (1-\phi_I)(1-\tilde{\phi}_E)\pi_0) + (1-\mu_I)\pi_0 - \frac{1}{2}c_I(\phi_I)^2. \quad \text{(TA1)}$$

If the incumbent chooses to pursue the new product opportunity (i.e., $d_I = p$), but the β-segment consumers do not postpone their purchase its expected payoffs:

$$EV_I = \mu_I(\phi_I\tilde{\phi}_E\pi_d + \phi_I(1-\tilde{\phi}_E)\pi_m + (1-\phi_I)(1-\tilde{\phi}_E)\pi_0) + (1-\mu_I)\pi_0 - \frac{1}{2}c_I(\phi_I)^2. \quad \text{(TA2)}$$

If the incumbent chooses to forgo the new product opportunity (i.e., $d_I = f$), its expected payoffs:

$$EV_I = (1-\mu_I\tilde{\phi}_E)\pi_0 + \pi^{\varnothing}. \quad \text{(TA3)}$$

The entrant's expected payoffs if the β-segment consumers postpone their purchase:

$$EV_E = (1+\beta)\mu_E(\tilde{\phi}_I\phi_E\pi_d + (1-\tilde{\phi}_I)\phi_E\pi_m) - \frac{1}{2}c_E(\phi_E)^2. \quad \text{(TA4)}$$

The entrant's expected payoffs if the β-segment consumers do not postpone their purchase:

$$EV_E = \mu_E(\tilde{\phi}_I\phi_E\pi_d + (1-\tilde{\phi}_I)\phi_E\pi_m) - \frac{1}{2}c_E(\phi_E)^2. \quad \text{(TA5)}$$

First, from expressions (TA4) and (TA5), $\phi_E^* \leq \frac{\mu_E(1+\beta)(\pi_m - \tilde{\phi}_I(\pi_m-\pi_d))}{c_E}$. Since $\mu_E \in (0,1]$, to guarantee that $\phi_E^* \in (0,1)$ for the rest of the analysis for a given β and π_m we will solve for c_E such that $c_E > (1+\beta)\pi_m$.

We would like to note that when the β-segment thinks that the incumbent is for sure pursuing the new product opportunity and delay their purchase, this increases the potential market size for the new product for the entrant also. This, in turn, encourages the entrant to set a higher R&D level. For that reason, to prevent to the market preemption force to disappear we will conduct the analysis for $(1+\beta)\pi_d < \pi_m$-i.e., $\beta < \frac{\pi_m - \pi_d}{\pi_d}$

We will solve for the case in which c_I is low enough such that the incumbent with $s_I = high$ prefers to set an R&D level equal to one, and in Section TA2 we show that the results stated in Proposition 2 hold for any c_I value. From payoff expressions (TA1) and (TA2) The incumbent with $s_I = high$ prefers to set its R&D level to one if $c_I < \pi_m - \pi_0 - \Delta\tilde{\phi}_E \; \forall \tilde{\phi}_E \in (0, \frac{\pi_m}{c_E}]$ and $c_I < (\pi_m - \pi_0 - \Delta\tilde{\phi}_E + \beta(\pi_m - \tilde{\phi}_E(\pi_m - \pi_d)) \; \forall \tilde{\phi}_E \in (0, \frac{(1+\beta)\pi_m}{c_E}]$. In this case, $EV_{I|_H} = \pi_m(1-\tilde{\phi}_E) + \tilde{\phi}_E\pi_d - \frac{c_I}{2}$ if β-segment consumers do not postpone their purchase and $EV_{I|_H} = (1+\beta)(\pi_m(1-\tilde{\phi}_E) + \tilde{\phi}_E\pi_d) - \frac{c_I}{2}$ otherwise. Thus, the necessary conditions for incumbent with $s_I = high$ to prefer to pursue the new product opportunity are $\pi^{\varnothing} < \pi_m - \pi_0 - \Delta\tilde{\phi}_E - \frac{c_I}{2} \; \forall \tilde{\phi}_E \in (0, \frac{\pi_m}{c_E}]$ and $\pi^{\varnothing} < \pi_m - \pi_0 - \Delta\tilde{\phi}_E + \beta(\pi_m - \tilde{\phi}_E(\pi_m - \pi_d)) - \frac{c_I}{2}$

$\forall\tilde{\phi}_E \in (0, \frac{(1+\beta)\pi_m}{c_E}]$. Since $c_I > 0$, if the incumbent with $s_I = low$ pursues the new product opportunity $EV_{I|_L} < \mu_I(\pi_m(1-\tilde{\phi}_E) + \tilde{\phi}_E\pi_d) + (1-\mu_I)\pi_0$, where $\tilde{\phi}_E \in (0, \frac{\pi_m}{c_E}]$ and $\mu_I = \frac{x(1-\sigma_I)}{1-x\sigma_I}$, if β-segment consumers do not postpone their purchase and $EV_{I|_L} < \mu_I(1+\beta)(\pi_m(1-\tilde{\phi}_E) + \tilde{\phi}_E\pi_d) + (1-\mu_I)\pi_0$, where $\tilde{\phi}_E \in (0, \frac{(1+\beta)\pi_m}{c_E}]$, otherwise. Hence, it is sufficient to have $\pi^{\varnothing} > \mu_I(\pi_m - \pi_0 - \Delta\tilde{\phi}_E)$ $\forall\tilde{\phi}_E \in (0, \frac{\pi_m}{c_E}]$ and $\pi^{\varnothing} > \mu_I(\pi_m - \pi_0 - \Delta\tilde{\phi}_E + \beta(\pi_m - \tilde{\phi}_E(\pi_m - \pi_d)))$ $\forall\tilde{\phi}_E \in (0, \frac{(1+\beta)\pi_m}{c_E}]$ for the incumbent with $s_I = low$ to prefer to forgo the new product opportunity. Given that $\mu_I \leq x$ and $\pi_m - \pi_0 - \Delta\tilde{\phi}_E > 0$, for a given $(\pi_m, \pi_d, \pi_0, c_E, c_I, \beta)$ there exist x and $\pi^{\varnothing}$ values such that the incumbent pursues the new product opportunity when $s_I = high$ and forgoes it when $s_I = low$ $\forall(\sigma_E, \sigma_I)$.

Trueware equilibrium: β-segment consumers' posterior belief is $prob(s_I = high \mid \text{market potential}= high, a = p) = 1$ and $prob(s_I = low \mid \text{market potential}= high, a = s) = 1$. From payoff expressions above, when $s_I = high$, $EV^{t*}_{I|_H} = (1+\beta)(\pi_m - \frac{(1+\beta)\pi_d}{c_E}(\pi_m - \pi_d)) - \frac{c_I}{2}$ and when $s_I = low$, $EV^{t*}_{I|_L} = (1 - \mu_I\mu_E^{updated}\frac{\pi_m}{c_E})\pi_0 + \pi^{\varnothing}$, where $\mu_E^{updated} = \sigma_E + \frac{x(1-\sigma_E)^2(1-\sigma_I)}{1-x+x(1-\sigma_E)(1-\sigma_I)}$ and $\mu_I = \frac{x(1-\sigma_I)}{(1-x\sigma_I)}$. If the incumbent with $s_I = high$ deviates to $a = s$, then the entrant thinks that $s_I = low$ and its expected R&D level would be equal to $\mu_E^{updated}\frac{\pi_m}{c_E}$. In this case, $EV^{t\prime}_{I|_H} = (\pi_m - \mu_E^{updated}\frac{\pi_m}{c_E}(\pi_m - \pi_d)) - \frac{c_I}{2}$. If the incumbent with $s_I = low$ deviates to $a = p$ the entrant thinks that $s_I = high$ and its expected R&D level would be equal to $\frac{(1+\beta)\pi_d}{c_E}$. In this case, $EV^{t\prime}_{I|_L} = (1 - \mu_I\frac{(1+\beta)\pi_d}{c_E})\pi_0 + \pi^{\varnothing}$. Since $\frac{\partial EV_I}{\partial\tilde{\phi}_E} < 0$ the incumbent would not deviate from the trueware equilibrium if $\frac{(1+\beta)\pi_d}{c_E} > \mu_E^{updated}\frac{\pi_m}{c_E}$ and $\mu_E^{updated}\frac{\pi_m}{c_E} > \frac{(1+\beta)^2\pi_d}{c_E} - \frac{\beta\pi_m}{(\pi_m - \pi_d)}$. Since $\frac{\partial\left(\frac{(1+\beta)^2\pi_d}{c_E} - \frac{\beta\pi_m}{(\pi_m-\pi_d)}\right)}{\partial\beta} < 0$, $\left(\frac{(1+\beta)^2\pi_d}{c_E} - \frac{\beta\pi_m}{(\pi_m-\pi_d)}\right)\big|_{\beta=\frac{\pi_m-\pi_d}{\pi_d}} < 0$, $\mu_E^{updated}(\sigma_I = 1)\frac{\pi_m}{c_E} = \sigma_E\frac{\pi_m}{c_E}$, and $\mu_E^{updated}(\sigma_I = 0)\frac{\pi_m}{c_E} = \mu_E\frac{\pi_m}{c_E}$. Given that $\mu_E\frac{\pi_m}{c_E} < \frac{(1+\beta)\pi_d}{c_E}$ for $\beta > \frac{\mu_E\pi_m - \pi_d}{\pi_d}$, where $\frac{\mu_E\pi_m - \pi_d}{\pi_d} < \frac{\pi_m - \pi_d}{\pi_d}$ for any σ_I there exists a β^t such that the trueware equilibrium can exist for $\beta > \beta^t$.

Vaporware equilibrium: In this equilibrium the β-segment consumers' posterior belief is $prob(s_I = high \mid \text{market potential}= high, a = p) = \sigma_I$ and off-the-equilibrium-path belief is $prob(s_I = low \mid \text{market potential}= high, a = s) = 1$. Therefore, β-segment consumers do not postpone their purchase neither in equilibrium nor off the equilibrium path. From payoff expressions above, the entrant's expected equilibrium R&D level is $\tilde{\phi}_E^{v*} = \frac{\mu_E(\pi_m - \sigma_I(\pi_m - \pi_d))}{c_E}$, $\mu_E = \sigma_E + \frac{x(1-\sigma_E)^2}{(1-x\sigma_E)}$. When the incumbent deviates to $a = s$, the entrant's expected R&D level is $\tilde{\phi}_E^{v\prime} = \mu_E^{updated}\frac{\pi_m}{c_E}$, where $\mu_E^{updated} = \sigma_E + \frac{x(1-\sigma_E)^2(1-\sigma_I)}{1-x+x(1-\sigma_E)(1-\sigma_I)}$. Since $\frac{\partial EV_I}{\partial\tilde{\phi}_E} < 0$ the incumbent would deviate from the vaporware equilibrium if $\tilde{\phi}_E^{v*} > \tilde{\phi}_E^{v\prime}$. As we know from Proposition 1, $\tilde{\phi}_E^{v*} > \tilde{\phi}_E^{v\prime}$ if $\sigma_I > \sigma_{I1}$.

Suddenware equilibrium: In this equilibrium the β-segment consumers' posterior belief is $prob(s_I = high \mid \text{market potential}= high, a = s) = \sigma_I$ and off-the-equilibrium-path belief is $prob(s_I = high \mid \text{market potential}= high, a = p) = 1$ (note that this off-the-equilibrium-path belief is consistent with standard equilibrium treatments that require all players to have the same beliefs). Hence, β-segment consumers postpone their purchase only when the incumbent deviates to $a = p$. From payoff expressions above, when $s_I = high$, $EV^{s*}_{I|_H} = \pi_m - \tilde{\phi}_E^{s*}(\pi_m - \pi_d) - \frac{c_I}{2}$ and when $s_I = low$, $EV^{s*}_{I|_L} = (1 - \mu_I\tilde{\phi}_E^{s*})\pi_0 + \pi^{\varnothing}$ where

$\tilde{\phi}_E^{s*} = \frac{\mu_E(\pi_m - \sigma_I(\pi_m - \pi_d))}{c_E}$, $\mu_E = \sigma_E + \frac{x(1-\sigma_E)^2}{(1-x\sigma_E)}$, and $\mu_I = \frac{x(1-\sigma_I)}{(1-x\sigma_I)}$. If the incumbent deviates to $a = p$ the entrant thinks that $s_I = high$ and its expected R&D level would be equal to $\frac{(1+\beta)\pi_d}{c_E}$. Since $\frac{\partial EV_I}{\partial \tilde{\phi}_E} < 0$ the incumbent with $s_I = low$ would not deviate if $\tilde{\phi}_E^{s*} < \frac{(1+\beta)\pi_d}{c_E}$. On the other hand, if the incumbent with $s_I = high$ deviates, then $EV^{s\prime}_{I|_H} = (1+\beta)(\pi_m - \frac{(1+\beta)\pi_d}{c_E}(\pi_m - \pi_d)) - \frac{c_I}{2}$. Therefore, the incumbent with $s_I = high$ would not deviate if $\frac{(1+\beta)^2\pi_d}{c_E} - \frac{\beta\pi_m}{(\pi_m - \pi_d)} > \tilde{\phi}_E^{s*}$. Since $\frac{(1+\beta)^2\pi_d}{c_E} - \frac{\beta\pi_m}{(\pi_m-\pi_d)} < \frac{(1+\beta)\pi_d}{c_E}$, $\frac{\partial(\frac{(1+\beta)^2\pi_d}{c_E} - \frac{\beta\pi_m}{(\pi_m-\pi_d)})}{\partial\beta} < 0$, $\frac{(1+\beta)^2\pi_d}{c_E} - \frac{\beta\pi_m}{(\pi_m-\pi_d)} \mid_{\beta = \frac{\pi_m - \pi_d}{\pi_d}} < 0$, and $\frac{(1+\beta)^2\pi_d}{c_E} - \frac{\beta\pi_m}{(\pi_m-\pi_d)} \mid_{\beta=0} = \frac{\pi_d}{c_E}$ for $\sigma_I > \sigma_{I2}$ there exists a β^s such that $\left(\frac{(1+\beta)^2\pi_d}{c_E} - \frac{\beta\pi_m}{(\pi_m-\pi_d)}\right) \mid_{\beta=\beta^s} = \tilde{\phi}_E^{s*}$ and suddenware equilibrium exists only for $\sigma_I > \sigma_{I2}$ and $\beta < \beta^s$.

Therefore, for $\sigma_I < \sigma_I^v$ and $\beta < \beta^t$ only the vaporware equilibrium can exist. Note that since $\mu_E^{updated}\frac{\pi_m}{c_E} < \tilde{\phi}_E^{s*} < \frac{\pi d}{c_E}$ for $\sigma_I > \sigma_I^s$ and $\frac{\partial(\frac{(1+\beta)^2\pi_d}{c_E} - \frac{\beta\pi_m}{(\pi_m-\pi_d)})}{\partial\beta} < 0$, $\beta^t > \beta^s$ for $\sigma_I > \sigma_I^s$. Thus, for $\sigma_I > \sigma_I^s$ and $\beta < \beta^s$ only the suddenware equilibrium can exist and for $\sigma_I > \sigma_I^s$ and $\beta > \beta^t$ only the trueware equilibrium can exist.

We know from proof of Proposition 1 that $\mu_E^{updated}\frac{\pi_m}{c_E} < \frac{\mu_E(\pi_m - \sigma_I(\pi_m-\pi_d))}{c_E} < \frac{\pi_d}{c_E}$ for $\sigma_I > \sigma_I^s$. Therefore, for $\sigma_I > \sigma_I^s$ when the incumbent deviates from the suddenware equilibrium, the highest expected R&D level of the entrant is equal to $\frac{(1+\beta)\pi_d}{c_E}$ and this happens if the entrant's off-the-equilibrium-path-belief is *prob*($s_I = high \mid a = p$)= 1 and the β-segment consumers' off-the-equilibrium-path belief is *prob*($s_I = high$ | market potential= $high, a = p$)= 1. We also know from the proof of Proposition 2 that for $\sigma_I > \sigma_I^s$ the incumbent with $s_I = high$ prefers to deviate from the suddenware equilibrium to $a = p$ when the entrant's off-the-equilibrium-path-belief is *prob*($s_I = high \mid a = p$)= 1, the β-segment consumers' off-the-equilibrium-path belief is *prob*($s_I = high$ | market potential= $high, a = p$)= 1, and $\beta > \beta^t$. When the incumbent deviates from the suddenware equilibrium, the lowest expected R&D level of the entrant is equal to $\mu_E^{updated}\frac{\pi_m}{c_E}$ and this happens if the entrant's off-the-equilibrium-path-belief is *prob*($s_I = low \mid a = p$)= 1 and the β-segment consumers' off-the-equilibrium-path belief is *prob*($s_I = low$ | market potential= $high, a = p$)= 1. Since $\mu_E^{updated}\frac{\pi_m}{c_E} < \tilde{\phi}_E^{s*} = \frac{\mu_E(\pi_m - \sigma_I(\pi_m-\pi_d))}{c_E}$ for $\sigma_I > \sigma_I^s$ the incumbent would deviate from the suddenware equilibrium if the entrant's off-the-equilibrium-path-belief were *prob*($s_I = low \mid a = p$)= 1 and the β-segment consumers' off-the-equilibrium-path belief were *prob*($s_I = low$ | market potential= $high, a = p$)= 1. Thus, for $\sigma_I > \sigma_I^s$ and $\beta > \beta^t$ the suddenware equilibrium cannot exist for any off-the-equilibrium-path-belief.

If the incumbent deviates from the vaporware equilibrium to $a = s$, then for $\sigma_I > \sigma_I^s$ the lowest expected R&D level of the entrant is equal to $\mu_E^{updated}\frac{\pi_m}{c_E}$ (this happens if the entrant's off-the-equilibrium-path-belief is *prob*($s_I = low \mid a = s$)= 1 and the β-segment consumers' off-the-equilibrium-path belief is *prob*($s_I = low$ | market potential= $high, a = s$)= 1) and the highest expected R&D level of the entrant is equal to $\frac{(1+\beta)\pi_d}{c_E}$ (this happens if the entrant's off-the-equilibrium-path-belief is *prob*($s_I = high$ | $a = s$)= 1 and the β-segment consumers' off-the-equilibrium-path belief is *prob*($s_I = high$ | market potential= $high, a = s$)= 1). If the entrant's off-the-equilibrium-path-belief were $prob(s_I = high \mid a = s)$= 1 and the β-segment consumers' off-the-equilibrium-path belief were $prob(s_I = high \mid$ market potential= $high, a = s$)= 1, when the incumbent with $s_I = high$ deviates to $a = s$, its expected payoff would be equal to $(1+\beta)(\frac{(1+\beta)\pi_d}{c_E}\pi_d + (1-\frac{(1+\beta)\pi_d}{c_E})\pi_m) - \frac{c_I}{2}$. Since $\tilde{\phi}_E^{v*} = \frac{\mu_E(\pi_m - \sigma_I(\pi_m-\pi_d))}{c_E} > \mu_E^{updated}\frac{\pi_m}{c_E}$ for $\sigma_I > \sigma_I^s$ and $\frac{(1+\beta)\pi_d}{c_E} > \mu_E^{updated}\frac{\pi_m}{c_E} > \frac{(1+\beta)^2\pi_d}{c_E} - \frac{\beta\pi_m}{(\pi_m-\pi_d)}$ for $\beta > \beta^t$, $(1+\beta)(\frac{(1+\beta)\pi_d}{c_E}\pi_d + (1 - \frac{(1+\beta)\pi_d}{c_E})\pi_m) > \tilde{\phi}_E^{v*}\pi_d + (1-\tilde{\phi}_E^{v*})\pi_m$ for $\sigma_I > \sigma_I^s$ and $\beta > \beta^t$. This means that for $\sigma_I > \sigma_I^s$ and $\beta > \beta^t$ the incumbent with $s_I = high$ deviates from the vaporware equilibrium for any off-the-equilibrium-path-belief .

As a result, the trueware equilibrium is unique for $\sigma_I > \sigma_I^s$ and $\beta > \beta^t$.

Finally, in the following we will show that there exist parameter values $(\pi_m, \pi_d, \pi_0, x, c_E, c_I, \sigma_E, \beta)$ such that $\sigma_I^s < \sigma_E$ and such that $\sigma_I^v > \sigma_E$.

Let $\pi_m = 3\pi_d$, $\pi_0 = 0.5\pi_d$, $c_E = 9\pi_d$, $c_I = 0.1\pi_d$, $\pi^{\varnothing} = 1.5\pi_d$, $x = 0.5$, $\beta = 0.1$. For these values $\sigma_I^v = \frac{1+\sigma_E}{2}$, where $\frac{1+\sigma_E}{2} > \sigma_E$. Therefore, the incumbent prefers to engage in vaporware for $\sigma_I < \sigma_E$, $\sigma_I > \sigma_E$, or $\sigma_I = \sigma_E$.

Let $\pi_m = 1.5\pi_d$, $\pi_0 = 0.5\pi_d$, $c_E = 2\pi_d$, $c_I = 0.1\pi_d$, $\pi^{\varnothing} = 0.85\pi_d$, $\beta = 0.03, x = 0.5$, and $\sigma_E = 0.25$. For these values $\sigma_I^s = 0.083$. Therefore, the incumbent prefers to engage in suddenware for $\sigma_I < \sigma_E$, $\sigma_I > \sigma_E$, or $\sigma_I = \sigma_E$. Furthermore, for $\pi_m = 1.5\pi_d$, $\pi_0 = 0.5\pi_d$, $c_E = 2\pi_d$, $c_I = 0.1\pi_d$, $\pi^{\varnothing} = 0.85\pi_d$, $\beta = 0.2$, $x = 0.5$, $\sigma_E = 0.25$, and $\sigma_I > \sigma_I^s = 0.083$ the trueware equilibrium exists uniquely.■

Proofs of Lemma 1 and Proposition 3: As in the proofs of Propositions 1 and 2 we will solve for the case in which c_I is low enough such that the incumbent with $s_I = high$ prefers to set its R&D level equal to one. We know from the proof of Proposition 2 that if the entrant does not wait and invests at t=2 the sufficient conditions for this to happen are $c_I < \pi_m - \pi_0 - \Delta\tilde{\phi}_E\ \forall\tilde{\phi}_E \in (0, \frac{\pi_m}{c_E}]$ and $c_I < (\pi_m - \pi_0 - \Delta\tilde{\phi}_E + \beta(\pi_m - \tilde{\phi}_E(\pi_m - \pi_d))\ \forall\tilde{\phi}_E \in (0, \frac{(1+\beta)\pi_m}{c_E}]$. If the entrant chooses to wait till t=2′ to invest in new product opportunity, then $EV_I = \phi_I\pi_m + (1-\phi_I)(1-\tilde{\phi}_E)\pi_0 - \frac{1}{2}c_I(\phi_I)^2$, where $\tilde{\phi}_E$ is the expected R&D level of the entrant at t=2′, if β-segment consumers do not postpone their purchase and $EV_I = (1+\beta)\phi_I\pi_m + (1-\phi_I)(1-\tilde{\phi}_E)\pi_0 - \frac{1}{2}c_I(\phi_I)^2$ otherwise. Therefore, if $c_I < \pi_m - \pi_0$ then the incumbent with $s_I = high$ prefers to set its R&D level equal to one when the entrant chooses to wait till t=2′.

From the proof of Proposition 2 we know the necessary and sufficient conditions for which the incumbent with $s_I = high$ to pursue the new product opportunity and the incumbent with $s_I = low$ to forgo it when the entrant invests at t=2. In the following we will derive the necessary and sufficient conditions for which the incumbent with $s_I = high$ to pursue the new product opportunity and the incumbent with $s_I = low$ to forgo it when the entrant waits till t=2′. When the entrant waits till t=2′, $EV_{I|_H} = \pi_m - \frac{c_I}{2}$ if β-segment consumers do not postpone their purchase and $EV_{I|_H} = (1+\beta)\pi_m - \frac{c_I}{2}$ otherwise. Thus, the necessary conditions for incumbent with $s_I = high$ to prefer to pursue the new product opportunity when the entrant chooses to wait till t=2$'$ is $\pi^{\varnothing} < \pi_m - \pi_0 - \frac{c_I}{2}$. Since $c_I > 0$, when the entrant waits till t=2$'$, if the incumbent with $s_I = low$ pursues the new product opportunity $EV_{I|_L} < \mu_I \pi_m + (1-\mu_I)\pi_0$, where $\mu_I = \frac{x(1-\sigma_I)}{1-x\sigma_I}$, if β-segment consumers do not postpone their purchase and $EV_{I|_L} < \mu_I(1+\beta)\pi_m + (1-\mu_I)\pi_0$ otherwise. Hence, it is sufficient to have $\pi^{\varnothing} > \mu_I((1+\beta)\pi_m - (1-\frac{(1+\beta)\pi_m}{c_E})\pi_0)$ for the incumbent with $s_I = low$ to prefer to forgo the new product opportunity when the entrant waits till t=2$'$. Given that $\mu_I \leq x$, for a given $(\pi_m, \pi_d, \pi_0, c_E, c_I, \beta)$ there exist x and $\pi^{\varnothing}$ values such that the incumbent pursues the new product opportunity when $s_I = high$ and forgoes it when $s_I = low$ $\forall(\sigma_E, \sigma_I)$ when the entrant waits till t=2$'$.

Next, we will derive the necessary conditions for the entrant not to deviate from the equilibrium in which the incumbent either pursues the vaporware or the suddenware strategy and the entrant waits till t=2$'$ to invest in new product opportunity. From (TA5) in such equilibrium the expected payoff of the entrant is equal to $(1-\sigma_I)\frac{\pi_m^2}{2c_E}$ if $s_E = high$ and to $\frac{\pi_m^2}{2c_E}\underline{\mu}_E(2(1-\sigma_I)\mu_E - (1-\mu_E\sigma_I)\underline{\mu}_E)$ if $s_E = low$, where $\mu_E = \frac{x(1-\sigma_E)}{1-x\sigma_E}$ and $\underline{\mu}_E = \frac{x(1-\sigma_E)(1-\sigma_I)}{1-x+x(1-\sigma_E)(1-\sigma_I)}$. If the entrant deviates and invests at t=2, then its expected payoff is equal to $\frac{(\pi_m-\sigma_I(\pi_m-\pi_d))^2}{2c_E}$ if $s_E = high$ and to $\frac{\mu_E^2(\pi_m-\sigma_I(\pi_m-\pi_d))^2}{2c_E}$ if $s_E = low$. Note that $1-\sigma_I > \frac{\underline{\mu}_E(2(1-\sigma_I)\mu_E-(1-\mu_E\sigma_I)\underline{\mu}_E)}{\mu_E^2}$. Thus, in equilibrium in which the incumbent pursues the either vaporware or suddenware strategy if $\frac{\underline{\mu}_E(2(1-\sigma_I)\mu_E-(1-\mu_E\sigma_I)\underline{\mu}_E)}{\mu_E^2} > \frac{(\pi_m-\sigma_I(\pi_m-\pi_d))^2}{\pi_m^2}$ the entrant prefers to wait till t=2$'$ both when $s_E = high$ and $s_E = low$, if $\frac{\underline{\mu}_E(2(1-\sigma_I)\mu_E-(1-\mu_E\sigma_I)\underline{\mu}_E)}{\mu_E^2} < \frac{(\pi_m-\sigma_I(\pi_m-\pi_d))^2}{\pi_m^2} < 1-\sigma_I$ the entrant with $s_E = high$ waits till t=2$'$ and the entrant with $s_E = low$ invests at t=2, and if $\frac{(\pi_m-\sigma_I(\pi_m-\pi_d))^2}{\pi_m^2} > 1-\sigma_I$ the entrant prefers to invest at t=2 both when $s_E = high$ and when $s_E = low$.

Let ψ denote $\frac{\underline{\mu}_E(2(1-\sigma_I)\mu_E-(1-\mu_E\sigma_I)\underline{\mu}_E)}{\mu_E^2}$ and Σ denote $\frac{(\pi_m-\sigma_I(\pi_m-\pi_d))^2}{\pi_m^2}$. Note that $\frac{\partial(1-\sigma_I)}{\partial\sigma_I} = -1$, $\frac{\partial\Sigma}{\partial\sigma_I} < 0$, $\frac{\partial\psi}{\partial\sigma_I} < 0$, $\lim_{\sigma_I\to1}\Sigma \to \left(\frac{\pi_d}{\pi_m}\right)^2$, $\lim_{\sigma_I\to1}\psi \to 0$, $\lim_{\sigma_I\to0}\frac{\partial\Sigma}{\partial\sigma_I} \to \frac{-2(\pi_m-\pi_d)}{\pi_m}$, $\lim_{\sigma_I\to0}\frac{\partial\psi}{\partial\sigma_I} \to -(2-\mu_E)$, and $(2-\mu_E) > \frac{2(\pi_m-\pi_d)}{\pi_m}$ if $\frac{\mu_E\pi_m}{2} < \pi_d$. Since $\frac{\partial^2\psi}{\partial^2\sigma_I} > 0$, $\frac{\partial^3\psi}{\partial^3\sigma_I} > 0$, $\frac{\partial^2\Sigma}{\partial^2\sigma_I} > 0$, $\frac{\partial^3\Sigma}{\partial^3\sigma_I} = 0$, and $\lim_{\sigma_I\to0}\frac{\partial\Sigma}{\partial\sigma_I} < \lim_{\sigma_I\to0}\frac{\partial\psi}{\partial\sigma_I}$ if $\pi_d < \frac{\mu_E\pi_m}{2}$ there exists a $\hat{\sigma}_{I2}$ such that $\psi \geq \Sigma$ for $\sigma_I \leq \hat{\sigma}_{I2}$ and $\psi < \Sigma$ for $\sigma_I > \hat{\sigma}_{I2}$. Furthermore, if $\pi_d < \frac{\pi_m}{2}$, then $\Sigma \leq 1-\sigma_I$ for $\sigma_I \leq \hat{\sigma}_{I1} \equiv \frac{\pi_m(\pi_m-2\pi_d)}{(\pi_m-\pi_d)^2}$, where $\hat{\sigma}_{I1} > \hat{\sigma}_{I2}$, and $\Sigma > 1-\sigma_I$ for $\sigma_I > \hat{\sigma}_{I1}$.

This means that if in equilibrium the incumbent pursues either the vaporware or the suddenware strategy the entrant waits till t=2$'$ both when $s_E = high$ and $s_E = low$ for $\sigma_I < \hat{\sigma}_{I2}$, the entrant waits till t=2$'$ when $s_E = high$ and invests at t=2 for $\hat{\sigma}_{I2} < \sigma_I < \hat{\sigma}_{I1}$, and the entrant invests at t=2 both when $s_E = high$ and $s_E = low$ for $\sigma_I > \hat{\sigma}_{I1}$.

Note that for $\sigma_I < \hat{\sigma}_{I2}$ the incumbent never wants to deviate from the vaporware equilibrium. In vaporware equilibrium the expected payoff of the incumbent is equal to $\pi_m - \frac{c_I}{2}$ if $s_I = high$ and to $\pi^{\varnothing} + (1-\mu_I(\sigma_E + (1-\sigma_E)\underline{\mu}_E)\frac{\pi_m}{c_E})\pi_0$ if $s_I = low$. If the incumbent deviates to $a = s$ at t=1, then the entrant thinks that $s_I = low$ and invests at t=2. In this case, the expected payoff of the incumbent is equal to $\pi_m(1-(\sigma_E+(1-\sigma_E)\underline{\mu}_E)\frac{\pi_m}{c_E})+(\sigma_E+(1-\sigma_E)\underline{\mu}_E)\frac{\pi_m}{c_E}\pi_d-\frac{c_I}{2}$ if $s_I = high$ and to $\pi^{\varnothing}+(1-\mu_I(\sigma_E+(1-\sigma_E)\underline{\mu}_E)\frac{\pi_m}{c_E})\pi_0$ if $s_I = low$. It is obvious that the incumbent with $s_I = high$ would not want to deviate and the incumbent with $s_I = low$ is indifferent. In suddenware equilibrium, the expected payoff of the incumbent is equal to $\pi_m - \frac{c_I}{2}$ if $s_I = high$ and to $\pi^{\varnothing} + (1 - \mu_I(\sigma_E + (1-\sigma_E)\underline{\mu}_E)\frac{\pi_m}{c_E})\pi_0$ if $s_I = low$. If the incumbent deviates to $a = p$ at t=1, then the entrant thinks that $s_I = high$ and invests at t=2. In this case, β-segment consumers also think that $s_I = high$ and prefer to postpone their purchase. Thus, the expected payoff of the incumbent is equal to $(1+\beta)(\pi_m(1-(1+\beta)\frac{\pi d}{c_E}) + (1+\beta)\frac{\pi d^2}{c_E}) - \frac{c_I}{2}$ if $s_I = high$ and to $\pi^{\varnothing} + (1 - \mu_I(1+\beta)\frac{\pi d}{c_E})\pi_0$ if $s_I = low$. Therefore, if $(1+\beta)^2\frac{\pi d}{c_E} - \frac{\beta\pi_m}{\pi_m - \pi_d} < 0$ the incumbent with $s_I = high$ would deviate and if $\frac{(1+\beta)\pi d}{c_E} < (\sigma_E + (1-\sigma_E)\underline{\mu}_E)\frac{\pi_m}{c_E}$ the incumbent with $s_I = low$ would deviate. Since $\frac{\partial((1+\beta)^2\frac{\pi d}{c_E} - \frac{\beta\pi_m}{\pi_m-\pi_d})}{\partial\beta} < 0$ and $(1+\beta)^2\frac{\pi d}{c_E} - \frac{\beta\pi_m}{\pi_m-\pi_d} < 0$ at $\beta = \frac{\pi_m - \pi d}{\pi d}$ for high β values the incumbent with $s_I = high$ would deviate. Furthermore, since $\frac{\pi d}{c_E} < (\sigma_E + (1-\sigma_E)\underline{\mu}_E)\frac{\pi_m}{c_E}$ for $\sigma_I \leq \hat{\sigma}_{I2}$ the incumbent with $s_I = low$ would deviate for low β values. It is ambiguous whether for $\sigma_I < \hat{\sigma}_{I2}$ there exist any β values such that $(1+\beta)^2\frac{\pi d}{c_E} - \frac{\beta\pi_m}{\pi_m-\pi_d} > 0$ and $\frac{(1+\beta)\pi d}{c_E} > (\sigma_E + (1-\sigma_E)\underline{\mu}_E)\frac{\pi_m}{c_E}$. Thus, it is ambiguous whether for $\sigma_I < \hat{\sigma}_{I2}$ the suddenware equilibrium can exist. However, we know from the proof of Proposition 2 that the trueware equilibrium can exist only for $\beta > \beta^t$. Given that for $\sigma_I < \hat{\sigma}_{I2}$ the vaporware equilibrium can always exist, for $\sigma_I < \hat{\sigma}_{I2}$ and $\beta < \beta^t$ in equilibrium the entrant waits till t=$2'$ both when $s_E = high$ and when $s_E = low$.

For $\hat{\sigma}_{I2} < \sigma_I < \hat{\sigma}_{I1}$ in vaporware equilibrium the incumbent's expected payoff is equal to $\pi_m(1-(1-\sigma_E)\frac{\mu_E(\pi_m - \sigma_I(\pi_m-\pi_d))}{c_E}) + (1-\sigma_E)\frac{\mu_E(\pi_m-\sigma_I(\pi_m-\pi_d))}{c_E}\pi_d - \frac{c_I}{2}$ if $s_I = high$ and to $\pi^{\varnothing} + (1 - \mu_I(\sigma_E\frac{\pi_m}{c_E} + (1-\sigma_E)\frac{\mu_E(\pi_m-\sigma_I(\pi_m-\pi_d))}{c_E}))\pi_0$ if $s_I = low$. If the incumbent deviates to $a = s$ at t=1, the expected payoff of the incumbent is equal to $\pi_m(1-(\sigma_E+(1-\sigma_E)\underline{\mu}_E)\frac{\pi_m}{c_E}) + (\sigma_E + (1-\sigma_E)\underline{\mu}_E)\frac{\pi_m}{c_E}\pi_d - \frac{c_I}{2}$ if $s_I = high$ and to $\pi^{\varnothing} + (1-\mu_I(\sigma_E + (1-\sigma_E)\underline{\mu}_E)\frac{\pi_m}{c_E})\pi_0$ if $s_I = low$. It is obvious that the incumbent deviates from the vaporware equilibrium if $\frac{\pi_d}{\underline{\mu}_E} > \pi_m$. Note that $\frac{\partial\underline{\mu}_E}{\partial\sigma_I} < 0$ and $\frac{\pi_d}{\underline{\mu}_E}(\sigma_I = \hat{\sigma}_{I1}) > \pi_m$ if $(1-\mu_E)\pi_m > \pi_d$. Recall from the proof of Proposition 1 that $\pi_m\frac{\sigma_E(1-x\sigma_E)}{\sigma_E(1-x\sigma_E)+x(1-\sigma_E)^2} < \pi_d < \pi_m\frac{\sigma_E(1-x\sigma_E)+x(1-\sigma_E)^2}{(1-x\sigma_E)}$ so that there exist $\sigma_I^v \in (0,1)$ and $\sigma_I^s \in (0,1)$. Thus, if $\pi_m\frac{\sigma_E(1-x\sigma_E)}{\sigma_E(1-x\sigma_E)+x(1-\sigma_E)^2} < \pi_d < \min\left\{(1-\mu_E), \frac{\mu_E}{2}\right\}\pi_m$ then $\frac{\pi_d}{\underline{\mu}_E} > \pi_m$ for $\sigma_I^* \equiv 1 - \frac{(1-x)\pi_d}{(1-\sigma_E)x(\pi_m-\pi_d)} < \sigma_I < \hat{\sigma}_{I1}$. Since $\psi < \Sigma$ for $\sigma_I \geq \sigma_I^*$, $\sigma_I^* > \hat{\sigma}_{I2}$. In suddenware equilibrium, the incumbent's expected payoff is equal to $\pi_m(1-(1-\sigma_E)\frac{\mu_E(\pi_m-\sigma_I(\pi_m-\pi_d))}{c_E}) + (1-\sigma_E)\frac{\mu_E(\pi_m-\sigma_I(\pi_m-\pi_d))}{c_E}\pi_d - \frac{c_I}{2}$ if $s_I = high$ and to $\pi^{\varnothing} + (1-\mu_I(\sigma_E\frac{\pi_m}{c_E} + (1-\sigma_E)\frac{\mu_E(\pi_m-\sigma_I(\pi_m-\pi_d))}{c_E}))\pi_0$ if $s_I = low$. If the incumbent deviates to $a = p$ at t=1, then the entrant thinks that $s_I = high$ and invests at t=2. In this case, β-segment consumers also think that $s_I = high$ and prefer to postpone their purchase. Thus, the expected payoff of the incumbent is equal to $(1+\beta)(\pi_m(1-(1+\beta)\frac{\pi d}{c_E}) + (1+\beta)\frac{\pi d^2}{c_E}) - \frac{c_I}{2}$ if $s_I = high$ and to $\pi^{\varnothing} + (1-\mu_I(1+\beta)\frac{\pi d}{c_E})\pi_0$ if $s_I = low$. Thus, the incumbent with $s_I = high$ would deviate if $(1-\sigma_E)\frac{\mu_E(\pi_m-\sigma_I(\pi_m-\pi_d))}{c_E} > (1+\beta)^2\frac{\pi d}{c_E} - \frac{\beta\pi_m}{\pi_m-\pi_d}$ and the incumbent with $s_I = low$ would deviate if $\sigma_E\frac{\pi_m}{c_E} + (1-\sigma_E)\frac{\mu_E(\pi_m-\sigma_I(\pi_m-\pi_d))}{c_E} > (1+\beta)\frac{\pi d}{c_E}$. Since $\frac{\partial((1+\beta)^2\frac{\pi d}{c_E} - \frac{\beta\pi_m}{\pi_m-\pi_d})}{\partial\beta} < 0$ and $(1+\beta)^2\frac{\pi d}{c_E} - \frac{\beta\pi_m}{\pi_m-\pi_d}\,|_{\beta=\frac{\pi_m-\pi d}{\pi d}} < 0$ there exists a $\hat{\beta}^s$ such that for $\beta > \hat{\beta}^s$ the incumbent with $s_I = high$ would deviate and hence the suddenware equilibrium cannot exist. Since the trueware equilibrium can exist for any σ_I if $\beta > \beta^t$, for $\sigma_I^* < \sigma_I < \hat{\sigma}_{I1}$ and $\beta > \max\left\{\hat{\beta}^s, \beta^t\right\}$ only the trueware equilibrium can exist. Note that $\left(\sigma_E \frac{\pi_m}{c_E} + (1-\sigma_E)\frac{\mu_E(\pi_m - \sigma_I(\pi_m - \pi_d))}{c_E}\right)|_{\sigma_I \le \sigma_I^*} > \frac{\pi d}{c_E}$. Furthermore, it is ambiguous whether for $\hat{\sigma}_{I2} < \sigma_I < \sigma_I^*$ there exist any β values such that $(1+\beta)^2 \frac{\pi d}{c_E} - \frac{\beta \pi_m}{\pi_m - \pi_d} > (1-\sigma_E)\frac{\mu_E(\pi_m - \sigma_I(\pi_m - \pi_d))}{c_E}$ and $\frac{(1+\beta)\pi d}{c_E} > \sigma_E \frac{\pi_m}{c_E} + (1-\sigma_E)\frac{\mu_E(\pi_m - \sigma_I(\pi_m - \pi_d))}{c_E}$. Thus, it is ambiguous whether for $\hat{\sigma}_{I2} < \sigma_I < \sigma_I^*$ the suddenware equilibrium can exist. However, since the vaporware equilibrium can exist for $\hat{\sigma}_{I2} < \sigma_I < \sigma_I^*$ in equilibrium the entrant waits till t=$2'$ when $s_E = high$ and invests at t=2 for $\hat{\sigma}_{I2} < \sigma_I < \sigma_I^*$ and $\beta < \beta^t$.

In the following we will show that for $\sigma_I^* < \sigma_I < \hat{\sigma}_{I1}$ and $\beta > \max\left\{\hat{\beta}^s, \beta^t\right\}$ the trueware equilibrium is unique. We know from above that if the entrant's off-the-equilibrium-path-belief is *prob*($s_I = low \mid a = s$)= 1, the β-segment consumers' off-the-equilibrium-path belief is *prob*($s_I = low$ |market potential= $high, a = s$)= 1, and $\sigma_I^* < \sigma_I < \hat{\sigma}_{I1}$ the incumbent with $s_I = low$ deviates from the vaporware equilibrium to $a = s$. On the other hand, if the entrant's off-the-equilibrium-path-belief were *prob*($s_I = high \mid a = s$)= 1 and the β-segment consumers' off-the-equilibrium-path belief were *prob*($s_I = high$ |market potential= $high, a = s$)= 1, the expected R&D level of the entrant would be equal to $\frac{(1+\beta)\pi_d}{c_E}$. Therefore, if the entrant's off-the-equilibrium-path-belief were *prob*($s_I = high \mid a = s$)= 1 and the β-segment consumers' off-the-equilibrium-path belief were *prob*($s_I = high$ |market potential= $high, a = s$)= 1, when the incumbent with $s_I = high$ deviates to $a = s$, its expected payoff would be equal to $(1+\beta)(\frac{(1+\beta)\pi d^2}{c_E} + (1 - \frac{(1+\beta)\pi_d}{c_E})\pi_m) - \frac{c_I}{2}$. Since $(1+\beta)((1+\beta)\frac{\pi d^2}{c_E} + (1 - \frac{(1+\beta)\pi_d}{c_E})\pi_m) > \pi_m(1 - (1-\sigma_E)\frac{\mu_E(\pi_m - \sigma_I(\pi_m - \pi_d))}{c_E}) + (1-\sigma_E)\frac{\mu_E(\pi_m - \sigma_I(\pi_m - \pi_d))}{c_E}\pi_d$ for $\beta > \hat{\beta}^s$ the incumbent with $s_I = high$ would deviate from the vaporware equilibrium for $\beta > \hat{\beta}^s$. This means that the incumbent deviates from the vaporware equilibrium for any off-the-equilibrium-path-belief if $\sigma_I^* < \sigma_I < \hat{\sigma}_{I1}$ and $\beta > \max\left\{\hat{\beta}^s, \beta^t\right\}$. Similarly, when the incumbent deviates from the suddenware equilibrium to $a = p$, if the entrant's off-the-equilibrium-path-belief were *prob*($s_I = low \mid a = p$) = 1 and the β-segment consumers' off-the-equilibrium-path belief were *prob*($s_I = low$ |market potential= $high, a = p$)= 1 then the expected R&D level of the entrant would be equal to $(\sigma_E + (1-\sigma_E)\underline{\mu}_E)\frac{\pi_m}{c_E}$. In this case, as in the vaporware equilibrium, the incumbent with $s_I = low$ would deviate from the suddenware equilibrium if $\sigma_I^* < \sigma_I < \hat{\sigma}_{I1}$. Given that the incumbent with $s_I = high$ deviates from the suddenware equilibrium if the entrant's off-the-equilibrium-path-belief is *prob*($s_I = high \mid a = p$)= 1, the β-segment consumers' off-the-equilibrium-path belief is *prob*($s_I = high$ | market potential= $high, a = p$)= 1, and $\beta > \hat{\beta}^s$ the suddenware equilibrium cannot exist for any off-the-equilibrium-path-belief if $\sigma_I^* < \sigma_I < \hat{\sigma}_{I1}$ and $\beta > \max\left\{\hat{\beta}^s, \beta^t\right\}$. This proves that for $\sigma_I^* < \sigma_I < \hat{\sigma}_{I1}$ and $\beta > \max\left\{\hat{\beta}^s, \beta^t\right\}$ the trueware equilibrium is unique.

Next, we will show that for $\hat{\sigma}_{I1} < \sigma_I$ and $\beta > \beta^t$ the trueware equilibrium is unique. First, note that for $\hat{\sigma}_{I1} < \sigma_I$ the entrant invests in new product at t=2 even if the incumbent pursues the vaporware or the suddenware strategy and $\mu_E^{updated}\frac{\pi_m}{c_E} < \frac{(1+\beta)\pi_d}{c_E}$ for $\beta > \beta^t$. Therefore, for $\beta > \beta^t$ when the incumbent deviates from the suddenware equilibrium, the highest expected R&D level of the entrant is equal to $\frac{(1+\beta)\pi_d}{c_E}$ and this happens if the entrant's off-the-equilibrium-path-belief is $prob(s_I = high \mid a = p)= 1$ and the β-segment consumers' off-the-equilibrium-path belief is $prob(s_I = high \mid \text{market potential} = high, a = p)= 1$. We also know from the proof of Proposition 2 that for $\beta > \beta^t$ the incumbent with $s_I = high$ prefers to deviate from the suddenware equilibrium to $a = p$ when the entrant's off-the-equilibrium-path-belief is $prob(s_I = high \mid a = p)= 1$, the β-segment consumers' off-the-equilibrium-path belief is $prob(s_I = high \mid \text{market potential} = high, a = p)= 1$, and $\beta > \beta^t$. Thus, for $\beta > \beta^t$ the suddenware equilibrium cannot exist for any off-the-equilibrium-path-belief.

If the incumbent deviates from the vaporware equilibrium to $a = s$, then for $\beta > \beta^t$ the lowest expected R&D level of the entrant is equal to $\mu_E^{updated}\frac{\pi_m}{c_E}$, where $\mu_E^{updated} = \sigma_E + \frac{x(1-\sigma_E)^2(1-\sigma_I)}{1-x+x(1-\sigma_E)(1-\sigma_I)}$, (this happens if the entrant's off-the-equilibrium-path-belief is $prob(s_I = low \mid a = s)= 1$ and the β-segment consumers' off-the-equilibrium-path-belief is $prob(s_I = low \mid \text{market potential} = high, a = s)= 1$) and the highest expected R&D level of the entrant is equal to $\frac{(1+\beta)\pi_d}{c_E}$ (this happens if the entrant's off-the-equilibrium-path-belief is $prob(s_I = high \mid a = s)= 1$ and the β-segment consumers' off-the-equilibrium-path-belief is $prob(s_I = high \mid \text{market potential} = high, a = s)= 1$). If the entrant's off-the-equilibrium-path-belief were $prob(s_I = high \mid a = s)= 1$ and the β-segment consumers' off-the-equilibrium-path-belief were $prob(s_I = high \mid \text{market potential} = high, a = s)= 1$, when the incumbent with $s_I = high$ deviates to $a = s$, its expected payoff would be equal to $(1+\beta)(\frac{(1+\beta)\pi_d}{c_E}\pi_d + (1 - \frac{(1+\beta)\pi_d}{c_E})\pi_m) - \frac{c_I}{2}$. We know from the proof of Proposition 2 that $\frac{(1+\beta)^2\pi_d}{c_E} - \frac{\beta\pi_m}{(\pi_m-\pi_d)} < \tilde{\phi}_E^{v*} = \frac{\mu_E(\pi_m-\sigma_I(\pi_m-\pi_d))}{c_E}$ for $\beta > \beta^s$. Given that $\beta^t > \beta^s$, the incumbent with $s_I = high$ deviates from the vaporware equilibrium for any off-the-equilibrium-path-belief for $\beta > \beta^t$. With a simple numerical example one can show that all the conditions above can hold. For example, let $\pi_m = 5\pi_d$, $\pi_0 = 4\pi_d$, $\pi^{\varnothing} = 0.95\pi_d$, $c_I = 0.1\pi_d$, $c_E = 6\pi_d$, $x = 0.5$, and $\sigma_E \to 0$. Then, $\sigma_I^v = \sigma_I^s = \frac{3}{4}$, $\hat{\sigma}_{I1} = \frac{15}{16}$, $\sigma_I^* = \frac{3}{4}$, and $\hat{\sigma}_{I2} \simeq 0.3$. For $\frac{3}{4} < \sigma_I$ and $\beta \geq 0$ the trueware equilibrium can exist. If $\sigma_I < \frac{3}{4}$ the trueware equilibrium can exist only for $\beta > 0$.■

TA2 Robustness Check: The Incumbent's R&D Cost Factor (c_I) is Unrestricted

For ease of exposition in the main Appendix, our proofs used a simplifying assumption on the incumbent's R&D cost factor. Specifically, c_I was low enough such that when the incumbent received a high signal and planned to pursue the new product it would set an R&D level of one. We now relax this assumption by allowing the incumbent's R&D cost factor to take on higher values as well, and which would result in its setting an R&D level less than one. In particular, we will investigate the case of

$c_I = c_E = c$, where c can take on any positive value, and show that the results stated in Propositions 1 and 2 continue to hold.

Without demand-side benefits (i.e., the case of Proposition 1):

We first note that from payoff expression (3)-(5) one can see that the optimal R&D level chosen by the entrant is $\phi_E^* = \frac{\mu_E(\pi_m - \tilde{\phi}_I(\pi_m - \pi_d))}{c}$. Since $\mu_E \in (0,1]$, we need $\frac{\pi_m}{c} < 1$ to guarantee that $\phi_E^* \in (0,1)$. From payoff expressions (3)-(5), one can see that when $s_I = high$, $EV_{I|_H} = \pi_0(1-\tilde{\phi}_E) + \frac{(\pi_m - \pi_0 - \Delta\tilde{\phi}_E)^2}{2c}$ if the incumbent pursues the new product opportunity and $EV_{I|_H} = \pi_0(1-\tilde{\phi}_E) + \pi^{\varnothing}$, otherwise. When $s_I = low$, $EV_{I|_L} = \pi_0(1-\mu_I\tilde{\phi}_E) + \frac{\mu_I^2(\pi_m - \pi_0 - \Delta\tilde{\phi}_E)^2}{2c}$ if the incumbent pursues the new product opportunity and $EV_{I|_L} = \pi_0(1-\mu_I\tilde{\phi}_E) + \pi^{\varnothing}$, otherwise. Therefore, if $\frac{\mu_I^2(\pi_m - \pi_0 - \Delta\tilde{\phi}_E)^2}{2c} < \pi^{\varnothing}$ $\forall \tilde{\phi}_E \in (0, \frac{\pi_m}{c}]$ and $\pi^{\varnothing} < \frac{(\pi_m - \pi_0 - \Delta\tilde{\phi}_E)^2}{2c}$ $\forall \tilde{\phi}_E \in (0, \frac{\pi_m}{c}]$, then the incumbent pursues the new product opportunity when $s_I = high$ and forgoes it when $s_I = low$. Since $\frac{\partial \mu_I}{\partial \sigma_I} < 0$ and $\lim_{\sigma_I \to 0} \mu_I \to x$ there always exist x and $\pi^{\varnothing}$ values such that the incumbent pursues the new product when $s_I = high$ and forgoes it when $s_I = low$. In vaporware equilibrium, from payoff expressions (3)-(5), the entrant's expected R&D level is $\tilde{\phi}_E^{v*} = \frac{\mu_E(\pi_m c - \sigma_I(\pi_m - \pi_0)(\pi_m - \pi_d))}{c^2 - \mu_E\sigma_I\Delta(\pi_m - \pi_d)}$, where $\mu_E = \sigma_E + \frac{x(1-\sigma_E)}{1-x\sigma_E}$. When $s_I = high$, the incumbent's payoff is $EV_{I|_H}^{v*} = \pi_0(1-\tilde{\phi}_E^{v*}) + \frac{(\pi_m - \pi_0 - \Delta\tilde{\phi}_E^{v*})^2}{2c}$ and when $s_I = low$, the incumbent's payoff is $EV_{I|_L}^{v*} = \pi_0(1 - \mu_I\tilde{\phi}_E^{v*}) + \pi^{\varnothing}$, where $\mu_I = \frac{x(1-\sigma_I)}{(1-x\sigma_I)}$. If the incumbent deviates to $a = s$ the entrant thinks that $s_I = low$ and its expected R&D level would be equal to $\tilde{\phi}_E^{v\prime} = \frac{\mu_E^{updated}\pi_m}{c}$, where $\mu_E^{updated} = \sigma_E + \frac{x(1-\sigma_E)(1-\sigma_I)}{1-x+x(1-\sigma_E)(1-\sigma_I)}$. Since $\frac{\partial EV_I}{\partial\tilde{\phi}_E} < 0$ the incumbent deviates when $\tilde{\phi}_E^{v*} > \tilde{\phi}_E^{v\prime}$. In suddenware equilibrium, from payoff expressions (3)-(5), the entrant's expected R&D level is $\tilde{\phi}_E^{s*} = \frac{\mu_E(\pi_m c - \sigma_I(\pi_m - \pi_0)(\pi_m - \pi_d))}{c^2 - \mu_E\sigma_I\Delta(\pi_m - \pi_d)}$. When $s_I = high$, the incumbent's payoff is $EV_{I|_H}^{s*} = \pi_0(1-\tilde{\phi}_E^{s*}) + \frac{(\pi_m - \pi_0 - \Delta\tilde{\phi}_E^{s*})^2}{2c}$ and when $s_I = low$, the incumbent's payoff is $EV_{I|_L}^{s*} = \pi_0(1-\mu_I\tilde{\phi}_E^{s*}) + \pi^{\varnothing}$. If the incumbent deviates to $a = p$ the entrant thinks that $s_I = high$ and its expected R&D level would be equal to $\tilde{\phi}_E^{s\prime} = \frac{\pi_m c - (\pi_m - \pi_0)(\pi_m - \pi_d)}{c^2 - \Delta(\pi_m - \pi_d)}$. Since $\frac{\partial EV_I}{\partial\tilde{\phi}_E} < 0$ the incumbent deviates when $\tilde{\phi}_E^{s*} > \tilde{\phi}_E^{s\prime}$. Note that $\frac{\partial\tilde{\phi}_E^{s*}}{\partial\sigma_E} > 0$, $\frac{\partial\tilde{\phi}_E^{s*}}{\partial\sigma_I} < 0$, for a given σ_E, $\tilde{\phi}_E^{s*} < \tilde{\phi}_E^{s\prime}$ if σ_I is high enough ($\lim_{\sigma_I \to 1}\tilde{\phi}_E^{s*} < \tilde{\phi}_E^{s\prime}$ $\forall\sigma_E$), and for a given σ_I, $\lim_{\sigma_E \to 1}\tilde{\phi}_E^{s*} > \lim_{\sigma_E \to 1}\tilde{\phi}_E^{s\prime}$. Since $\frac{\partial\tilde{\phi}_E^{v*}}{\partial\sigma_E} > 0$, $\frac{\partial\tilde{\phi}_E^{v\prime}}{\partial\sigma_E} > 0$, and $\lim_{\sigma_E \to 1}\tilde{\phi}_E^{v\prime} > \lim_{\sigma_E \to 1}\tilde{\phi}_E^{v*}$ $\forall\sigma_I$, there always exists $(\pi_m, \pi_d, \pi_0, c, x, \sigma_E)$ values such that for low enough σ_I such that $\frac{\mu_E^{updated}\pi_m}{c} > \frac{\mu_E(\pi_m c - \sigma_I(\pi_m - \pi_0)(\pi_m - \pi_d))}{c^2 - \mu_E\sigma_I\Delta(\pi_m - \pi_d)} > \frac{\pi_m c - (\pi_m - \pi_0)(\pi_m - \pi_d)}{c^2 - \Delta(\pi_m - \pi_d)}$ and hence, the incumbent prefers to pursue the vaporware strategy. Furthermore, $\frac{\partial\tilde{\phi}_E^{v*}}{\partial\sigma_I} < 0$, $\frac{\partial\tilde{\phi}_E^{v\prime}}{\partial\sigma_I} < 0$, $\lim_{\sigma_I \to 1}\tilde{\phi}_E^{v\prime} \to \frac{\sigma_E\pi_m}{c}$, $\lim_{\sigma_I \to 1}\tilde{\phi}_E^{v*} \to \frac{\mu_E(\pi_m c - (\pi_m - \pi_0)(\pi_m - \pi_d))}{c^2 - \mu_E\Delta(\pi_m - \pi_d)}$, and $\frac{\mu_E(\pi_m c - (\pi_m - \pi_0)(\pi_m - \pi_d))}{c^2 - \mu_E\Delta(\pi_m - \pi_d)} > \frac{\sigma_E\pi_m}{c}$ for low σ_E values. Therefore, there always exist $(\pi_m, \pi_d, \pi_0, c, x, \sigma_E)$ values such that for high enough σ_I such that $\frac{\mu_E^{updated}\pi_m}{c} < \frac{\mu_E(\pi_m c - \sigma_I(\pi_m - \pi_0)(\pi_m - \pi_d))}{c^2 - \mu_E\sigma_I\Delta(\pi_m - \pi_d)} < \frac{\pi_m c - (\pi_m - \pi_0)(\pi_m - \pi_d)}{c^2 - \Delta(\pi_m - \pi_d)}$ and hence, the incumbent prefers to pursue the suddenware strategy.

In trueware equilibrium, from payoff expressions (3)-(5), when $s_I = high$, $EV_{I|_H}^{t*} = \pi_0(1-\tilde{\phi}_E^{s\prime}) + \frac{(\pi_m - \pi_0 - \Delta\tilde{\phi}_E^{s\prime})^2}{2c}$ and when $s_I = low$, $EV_{I|_L}^{t*} = \pi_0(1-\mu_I\tilde{\phi}_E^{v\prime}) + \pi^{\varnothing}$. If the incumbent with $s_I = high$ deviates to $a = s$, then the entrant thinks that $s_I = low$ and its expected R&D level would be equal to $\tilde{\phi}_E^{v\prime}$. In this case, $EV_{I|_H}^{t\prime} = \pi_0(1-\tilde{\phi}_E^{v\prime}) + \frac{(\pi_m-\pi_0-\Delta\tilde{\phi}_E^{v\prime})^2}{2c}$. If the incumbent with $s_I = low$ deviates to $a = p$ the entrant thinks that $s_I = high$ and its expected R&D level would be equal to $\tilde{\phi}_E^{s\prime}$. In this case, $EV_{I|_L}^{t\prime} = (1-\mu_I\tilde{\phi}_E^{s\prime})\pi_0 + \pi^{\varnothing}$. Since $\frac{\partial EV_I}{\partial\tilde{\phi}_E} < 0$ the incumbent with $s_I = high$ would deviate from the trueware equilibrium if $\tilde{\phi}_E^{s\prime} > \tilde{\phi}_E^{v\prime}$ and the incumbent with $s_I = low$ would deviate from the trueware equilibrium otherwise.

With the demand-side benefits (i.e., the case of Proposition 2):

From expressions (TA4) and (TA5), $\phi_E^* \leq \frac{\mu_E(1+\beta)(\pi_m-\tilde{\phi}_I(\pi_m-\pi_d))}{c}$. Since $\mu_E \in (0,1]$, to guarantee that $\phi_E^* \in (0,1)$ for the rest of the analysis for a given β and π_m we will solve for c such that $c > (1+\beta)\pi_m$. Furthermore, as in the proof of Proposition 2, in order to prevent the preemptive force to disappear we will restrict our analysis for the parameter values such that $(1+\beta)\pi_d < \pi_m$ (i.e., $\beta < \frac{\pi_m-\pi_d}{\pi_d}$).

From payoff expressions (TA1)-(TA5), one can see that when $s_I = high$ and the incumbent pursues the new product opportunity, $EV_{I|_H} = \pi_0(1-\tilde{\phi}_E) + \frac{(\pi_m-\pi_0-\Delta\tilde{\phi}_E)^2}{2c}$, where $\tilde{\phi}_E \in (0, \frac{\pi_m}{c}]$, if the β-segment consumers do not delay their purchase and $EV_{I|_H} = \pi_0(1-\tilde{\phi}_E) + \frac{(\pi_m-\pi_0-\Delta\tilde{\phi}_E+\beta(\pi_m-\tilde{\phi}_E(\pi_m-\pi_d))^2}{2c}$, where $\tilde{\phi}_E \in (0, \frac{(1+\beta)\pi_m}{c}]$, otherwise. When $s_I = high$ and the incumbent forgoes the new product opportunity, $EV_{I|_H} = \pi_0(1-\tilde{\phi}_E) + \pi^{\varnothing}$, where $\tilde{\phi}_E \in (0, \frac{\pi_m}{c}]$, if the β-segment consumers do not delay their purchase and $\tilde{\phi}_E \in (0, \frac{(1+\beta)\pi_m}{c}]$ otherwise. When $s_I = low$ and the incumbent pursues the new product opportunity, $EV_{I|_L} = \pi_0(1-\mu_I\tilde{\phi}_E) + \frac{\mu_I^2(\pi_m-\pi_0-\Delta\tilde{\phi}_E)^2}{2c}$, where $\mu_I = \frac{x(1-\sigma_I)}{(1-x\sigma_I)}$ and $\tilde{\phi}_E \in (0, \frac{\pi_m}{c}]$, if the β-segment consumers do not delay their purchase and $EV_{I|_L} = \pi_0(1-\mu_I\tilde{\phi}_E) + \frac{\mu_I^2(\pi_m-\pi_0-\Delta\tilde{\phi}_E+\beta(\pi_m-\tilde{\phi}_E(\pi_m-\pi_d)))^2}{2c}$, where $\tilde{\phi}_E \in (0, \frac{(1+\beta)\pi_m}{c}]$, otherwise. When $s_I = low$ and the incumbent forgoes the new product opportunity $EV_{I|_L} = \pi_0(1-\mu_I\tilde{\phi}_E) + \pi^{\varnothing}$, where $\tilde{\phi}_E \in (0, \frac{\pi_m}{c}]$, if the β-segment consumers do not delay their purchase and $\tilde{\phi}_E \in (0, \frac{(1+\beta)\pi_m}{c}]$ otherwise. Therefore, if $\frac{\mu_I^2(\pi_m-\pi_0-\Delta\tilde{\phi}_E)^2}{2c} < \pi^{\varnothing}\ \forall\tilde{\phi}_E \in (0, \frac{\pi_m}{c}]$ and $\frac{\mu_I^2(\pi_m-\pi_0-\Delta\tilde{\phi}_E+\beta(\pi_m-\tilde{\phi}_E(\pi_m-\pi_d)))^2}{2c} < \pi^{\varnothing}\ \forall\tilde{\phi}_E \in (0, \frac{(1+\beta)\pi_m}{c}]$, then the incumbent forgoes the new product opportunity when $s_I = low$. Similarly, if $\pi^{\varnothing} < \frac{(\pi_m-\pi_0-\Delta\tilde{\phi}_E)^2}{2c}\ \forall\tilde{\phi}_E \in (0, \frac{\pi_m}{c}]$ and $\pi^{\varnothing} < \frac{(\pi_m-\pi_0-\Delta\tilde{\phi}_E+\beta(\pi_m-\tilde{\phi}_E(\pi_m-\pi_d))^2}{2c}\ \forall\tilde{\phi}_E \in (0, \frac{(1+\beta)\pi_m}{c}]$, then the incumbent pursues the new product opportunity when $s_I = high$. Since $\frac{\partial\mu_I}{\partial\sigma_I} < 0$ and $\lim_{\sigma_I\to 0}\mu_I \to x$ there always exist x and $\pi^{\varnothing}$ values such that the incumbent pursues the new product when $s_I = high$ and forgoes it when $s_I = low$.

In vaporware equilibrium, from payoff expressions (TA1)-(TA5), the entrant's expected R&D level is $\tilde{\phi}_E^{v*} = \frac{\mu_E(\pi_m c-\sigma_I(\pi_m-\pi_0)(\pi_m-\pi_d))}{c^2-\mu_E\sigma_I\Delta(\pi_m-\pi_d)}$. When $s_I = high$, the incumbent's payoff is $EV_{I|_H}^{v*} = \pi_0(1-\tilde{\phi}_E^{v*}) + \frac{(\pi_m-\pi_0-\Delta\tilde{\phi}_E^{v*})^2}{2c}$. When $s_I = low$, the incumbent's payoff is $EV_{I|_L}^{v*} = \pi_0(1-\mu_I\tilde{\phi}_E^{v*}) + \pi^{\varnothing}$, where $\mu_I = \frac{x(1-\sigma_I)}{(1-x\sigma_I)}$. If the incumbent deviates to $a = s$ the entrant thinks that $s_I = low$ and its expected R&D level would be equal to $\tilde{\phi}_E^{v\prime} = \frac{\mu_E^{updated}\pi_m}{c}$. Since $\frac{\partial EV_I}{\partial\tilde{\phi}_E} < 0$ the vaporware equilibrium can exist only when $\tilde{\phi}_E^{v*} < \tilde{\phi}_E^{v\prime}$.

In suddenware equilibrium, from payoff expressions (TA1)-(TA5), the entrant's expected R&D level is $\tilde{\phi}_E^{s*} = \frac{\mu_E(\pi_m c-\sigma_I(\pi_m-\pi_0)(\pi_m-\pi_d))}{c^2-\mu_E\sigma_I\Delta(\pi_m-\pi_d)}$. When $s_I = high$, the incumbent's payoff is $EV_{I|_H}^{s*} = \pi_0(1 - \tilde{\phi}_E^{s*}) + \frac{(\pi_m-\pi_0-\Delta\tilde{\phi}_E^{s*})^2}{2c}$ and when $s_I = low$, the incumbent's payoff is $EV_{I|_L}^{s*} = \pi_0(1-\mu_I\tilde{\phi}_E^{s*}) + \pi^{\varnothing}$. If the incumbent deviates to $a = p$ the entrant thinks that $s_I = high$ and β-segment consumers delay their purchase. In this case, $EV_{I|_H}^{s\prime} = \pi_0(1-\tilde{\phi}_E^{s\prime}) + \frac{(\pi_m-\pi_0-\tilde{\phi}_E^{s\prime}\Delta+\beta(\pi_m-\tilde{\phi}_E^{s\prime}(\pi_m-\pi_d)))^2}{2c}$, where $\tilde{\phi}_E^{s\prime} = \frac{(1+\beta)(\pi_m c-((1+\beta)\pi_m-\pi_0)(\pi_m-\pi_d))}{c^2-(1+\beta)(\Delta+\beta(\pi_m-\pi_d))(\pi_m-\pi_d)}$. Thus, the incumbent with $s_I = high$ would deviate if $\frac{(\pi_m-\pi_0-\tilde{\phi}_E^{s\prime}\Delta+\beta(\pi_m-\tilde{\phi}_E^{s\prime}(\pi_m-\pi_d)))^2}{2c} - \frac{(\pi_m-\pi_0-\Delta\tilde{\phi}_E^{s*})^2}{2c} > \pi_0(\tilde{\phi}_E^{s\prime}-\tilde{\phi}_E^{s*})$ and the incumbent with $s_I = low$ would deviate if $\tilde{\phi}_E^{s*} > \tilde{\phi}_E^{s\prime}$. $\frac{(\pi_m-\pi_0-\tilde{\phi}_E^{s\prime}\Delta+\beta(\pi_m-\tilde{\phi}_E^{s\prime}(\pi_m-\pi_d)))^2}{2c} - \frac{(\pi_m-\pi_0-\Delta\tilde{\phi}_E^{s*})^2}{2c} < \pi_0(\tilde{\phi}_E^{s\prime}-\tilde{\phi}_E^{s*})$ is sufficient for $\tilde{\phi}_E^{s*} < \tilde{\phi}_E^{s\prime}$. Note that $\frac{\partial EV_{I|_H}^{s\prime}}{\partial\beta} > 0$ and $EV_{I|_H}^{s\prime}(\beta = \frac{\pi_m-\pi_d}{\pi_d}) > EV_{I|_H}^{s*}\ \forall(\sigma_E,\sigma_I)$. Given that $\frac{\partial\tilde{\phi}_E^{s\prime}}{\partial\beta} > 0$ and $\lim_{\beta\to 0} EV_{I|_H}^{s\prime} \to \pi_0(1-\tilde{\phi}_E^{s\prime}) + \frac{(\pi_m-\pi_0-\tilde{\phi}_E^{s\prime}\Delta)^2}{2c}$, where $\tilde{\phi}_E^{s\prime} = \frac{\pi_m c-(\pi_m-\pi_0)(\pi_m-\pi_d)}{c^2-\Delta(\pi_m-\pi_d)}$, the suddenware equilibrium exists if $\frac{\mu_E(\pi_m c-\sigma_I(\pi_m-\pi_0)(\pi_m-\pi_d))}{c^2-\mu_E\sigma_I\Delta(\pi_m-\pi_d)} < \frac{\pi_m c-(\pi_m-\pi_0)(\pi_m-\pi_d)}{c^2-\Delta(\pi_m-\pi_d)}$ and β is low enough.

In trueware equilibrium, from payoff expressions (TA1)-(TA5), when $s_I = high$, the incumbent's payoff is $EV_{I|_H}^{t*} = \pi_0(1-\tilde{\phi}_{E|_H}^{t*}) + \frac{(\pi_m-\pi_0-\tilde{\phi}_{E|_H}^{t*}\Delta+\beta(\pi_m-\tilde{\phi}_{E|_H}^{t*}(\pi_m-\pi_d)))^2}{2c}$, where $\tilde{\phi}_{E|_H}^{t*} = \frac{(1+\beta)(\pi_m c-((1+\beta)\pi_m-\pi_0)(\pi_m-\pi_d))}{c^2-(1+\beta)(\Delta+\beta(\pi_m-\pi_d))(\pi_m-\pi_d)}$. When $s_I = low$, the incumbent's payoff is $EV_{I|_L}^{t*} = \pi_0(1-\mu_I\tilde{\phi}_{E|_L}^{t*}) + \pi^{\varnothing}$, where $\tilde{\phi}_{E|_L}^{t*} = \frac{\mu_E^{updated}\pi_m}{c}$. If the incumbent with $s_I = high$ deviates to $a = s$, then $EV_{I|_H}^{t\prime} = \pi_0(1-\tilde{\phi}_{E|_L}^{t*}) + \frac{(\pi_m-\pi_0-\Delta\tilde{\phi}_{E|_L}^{t*})^2}{2c}$ and if the incumbent with $s_I = low$ deviates to $a = p$, then $EV_{I|_L}^{t\prime} = \pi_0(1-\mu_I\tilde{\phi}_{E|_H}^{t*}) + \pi^{\varnothing}$. Since $\frac{\partial EV_I}{\partial\tilde{\phi}_E} < 0$ this equilibrium exists if $\tilde{\phi}_{E|_H}^{t*} > \tilde{\phi}_{E|_L}^{t*}$ and $EV_{I|_H}^{t*} > EV_{I|_H}^{t\prime}$. Note that $\frac{\partial\tilde{\phi}_{E|_H}^{t*}}{\partial\beta} > 0$, $\tilde{\phi}_{E|_H}^{t*}(\beta = \frac{\pi_m-\pi_d}{\pi_d}) > \tilde{\phi}_{E|_L}^{t*}$ $\forall(\sigma_E,\sigma_I)$, $\frac{\partial EV_{I|_H}^{t*}}{\partial\beta} > 0$, and $EV_{I|_H}^{t*}(\beta = \frac{\pi_m-\pi_d}{\pi_d}) > EV_{I|_H}^{t\prime}\ \forall(\sigma_E,\sigma_I)$. Thus, for high enough β values the trueware equilibrium can exist.

Thus, for low enough σ_I values such that $\frac{\mu_E^{updated}\pi_m}{c} > \frac{\mu_E(\pi_m c-\sigma_I(\pi_m-\pi_0)(\pi_m-\pi_d))}{c^2-\mu_E\sigma_I\Delta(\pi_m-\pi_d)} > \frac{\pi_m c-(\pi_m-\pi_0)(\pi_m-\pi_d)}{c^2-\Delta(\pi_m-\pi_d)}$ and low enough β values the incumbent prefers to pursue the vaporware strategy. For high σ_I values such that $\frac{\mu_E^{updated}\pi_m}{c} < \frac{\mu_E(\pi_m c-\sigma_I(\pi_m-\pi_0)(\pi_m-\pi_d))}{c^2-\mu_E\sigma_I\Delta(\pi_m-\pi_d)} < \frac{\pi_m c-(\pi_m-\pi_0)(\pi_m-\pi_d)}{c^2-\Delta(\pi_m-\pi_d)}$ and low enough β values the incumbent prefers to pursue the suddenware strategy. For high σ_I values such that $\frac{\mu_E^{updated}\pi_m}{c} < \frac{\mu_E(\pi_m c-\sigma_I(\pi_m-\pi_0)(\pi_m-\pi_d))}{c^2-\mu_E\sigma_I\Delta(\pi_m-\pi_d)} < \frac{\pi_m c-(\pi_m-\pi_0)(\pi_m-\pi_d)}{c^2-\Delta(\pi_m-\pi_d)}$ and high enough β values the incumbent prefers to pursue the trueware strategy.

Note that if the incumbent deviates from the vaporware equilibrium for σ_I values such that $\frac{\mu_E^{updated}\pi_m}{c} < \frac{\mu_E(\pi_m c-\sigma_I(\pi_m-\pi_0)(\pi_m-\pi_d))}{c^2-\mu_E\sigma_I\Delta(\pi_m-\pi_d)} < \frac{\pi_m c-(\pi_m-\pi_0)(\pi_m-\pi_d)}{c^2-\Delta(\pi_m-\pi_d)}$ the highest expected R&D level of the entrant is equal to $\tilde{\phi}_{E|_H}^{t*}$ (this happens if the entrant's off-the-equilibrium-path-belief is $prob(s_I = high \mid a = s) = 1$ and the β-segment consumers' off-the-equilibrium-path belief is $prob(s_I = high \mid$ market potential$= high, a = s) = 1$). If the entrant's off-the-equilibrium-path-belief were $prob(s_I = high \mid a = s) = 1$ and the β-segment consumers' off-the-equilibrium-path belief were $prob(s_I = high \mid$ market potential$= high, a = s) = 1$, when the incumbent with $s_I = high$ deviates to $a = s$, its expected payoff would be equal to $\pi_0(1-\tilde{\phi}_{E|_H}^{t*}) + \frac{(\pi_m-\pi_0-\tilde{\phi}_{E|_H}^{t*}\Delta+\beta(\pi_m-\tilde{\phi}_{E|_H}^{t*}(\pi_m-\pi_d)))^2}{2c}$. Recall that $\tilde{\phi}_E^{v*} = \frac{\mu_E(\pi_m c-\sigma_I(\pi_m-\pi_0)(\pi_m-\pi_d))}{c^2-\mu_E\sigma_I\Delta(\pi_m-\pi_d)} > \mu_E^{updated}\frac{\pi_m}{c_E}$ for σ_I values such that $\frac{\mu_E^{updated}\pi_m}{c} < \frac{\mu_E(\pi_m c-\sigma_I(\pi_m-\pi_0)(\pi_m-\pi_d))}{c^2-\mu_E\sigma_I\Delta(\pi_m-\pi_d)} < \frac{\pi_m c-(\pi_m-\pi_0)(\pi_m-\pi_d)}{c^2-\Delta(\pi_m-\pi_d)}$, and $\tilde{\phi}_{E|_H}^{t*} > \tilde{\phi}_{E|_L}^{t*} =$

$\mu_E^{updated}\frac{\pi_m}{c_E}$ and $EV_{I|_H}^{t*} > EV_{I|_H}^{t\prime}$ for high enough β values. Therefore, for σ_I values such that $\frac{\mu_E^{updated}\pi_m}{c} < \frac{\mu_E(\pi_m c - \sigma_I(\pi_m-\pi_0)(\pi_m-\pi_d))}{c^2-\mu_E\sigma_I\Delta(\pi_m-\pi_d)} < \frac{\pi_m c-(\pi_m-\pi_0)(\pi_m-\pi_d)}{c^2-\Delta(\pi_m-\pi_d)}$ and high enough β values the incumbent with $s_I =$ *high* deviates from the vaporware equilibrium for any off-the-equilibrium-path-belief . Furthermore, for σ_I values such that $\frac{\mu_E^{updated}\pi_m}{c} < \frac{\mu_E(\pi_m c - \sigma_I(\pi_m-\pi_0)(\pi_m-\pi_d))}{c^2-\mu_E\sigma_I\Delta(\pi_m-\pi_d)} < \frac{\pi_m c-(\pi_m-\pi_0)(\pi_m-\pi_d)}{c^2-\Delta(\pi_m-\pi_d)}$ when the incumbent deviates from the suddenware equilibrium, the highest expected R&D level of the entrant is equal to $\tilde{\phi}_{E|_H}^{t*}$ and this happens if the entrant's off-the-equilibrium-path-belief is $prob(s_I = high \mid a = p) = 1$ and the β-segment consumers' off-the-equilibrium-path-belief is $prob(s_I = high \mid$ market potential$= high, a = p) = 1$. We also know that for σ_I values such that $\frac{\mu_E^{updated}\pi_m}{c} < \frac{\mu_E(\pi_m c - \sigma_I(\pi_m-\pi_0)(\pi_m-\pi_d))}{c^2-\mu_E\sigma_I\Delta(\pi_m-\pi_d)} < \frac{\pi_m c-(\pi_m-\pi_0)(\pi_m-\pi_d)}{c^2-\Delta(\pi_m-\pi_d)}$ the incumbent with $s_I = high$ prefers to deviate from the suddenware equilibrium to $a = p$ when the entrant's off-the-equilibrium-path-belief is $prob(s_I = high \mid a = p) = 1$, the β-segment consumers' off-the-equilibrium-path-belief is $prob(s_I = high \mid$ market potential$= high, a = p) = 1$, and β is high enough. Thus, for σ_I values such that $\frac{\mu_E^{updated}\pi_m}{c} < \frac{\mu_E(\pi_m c - \sigma_I(\pi_m-\pi_0)(\pi_m-\pi_d))}{c^2-\mu_E\sigma_I\Delta(\pi_m-\pi_d)} < \frac{\pi_m c-(\pi_m-\pi_0)(\pi_m-\pi_d)}{c^2-\Delta(\pi_m-\pi_d)}$ and high enough β values the suddenware equilibrium cannot exist for any off-the-equilibrium-path-belief. Thus, for σ_I values such that $\frac{\mu_E^{updated}\pi_m}{c} < \frac{\mu_E(\pi_m c - \sigma_I(\pi_m-\pi_0)(\pi_m-\pi_d))}{c^2-\mu_E\sigma_I\Delta(\pi_m-\pi_d)} < \frac{\pi_m c-(\pi_m-\pi_0)(\pi_m-\pi_d)}{c^2-\Delta(\pi_m-\pi_d)}$ and high enough β values the trueware equilibrium is unique.■

TA3 Extensions To Our Basic Model

We have conducted four extensions to our basic model-i.e., firms' signal structure is symmetric, firms' signal qualities are not common knowledge, firms can invest in improving their signal qualities, and the incumbent can affect the market potential state probabilities. In the following we will discuss both how we implement each of these extensions and their implications for our results.

TA3.1 Symmetric Signal Structure

We assumed a non-symmetric signal structure, whereby a firm remains uncertain about the market potential at t=1 only when it receives a low signal (as this may be a 'false negative' if the true market potential is high) as described in Section 3. If the signal structure were symmetric, such that $prob_k(s_k = high \mid \text{market potential} = high) = prob_k(s_k = low \mid \text{market potential} = low) = \sigma_k$, where $\frac{1}{2} < \sigma_k < 1$, firms could receive a high signal even when the true market potential is low (a 'false positive'). In that case, a firm receiving a high signal assigns a probability of less than 1 that the true market potential is high and is generally induced to select a lower R&D level than in our model. However, the entrant would still invest more the greater its belief that the market potential is high, and could update its belief based on inferences from the observed preannouncement; and this updating is a function of the incumbent's signal quality. Therefore, our results would qualitatively stay the same.

TA3.2 Firms' Signal Qualities Are Not Common Knowledge

Our model set up assumed that signal qualities (σ_k) are common knowledge, reflecting the idea that firms in an industry have a good sense of their rivals' competence to assess market opportunities. However, in some settings firms may be able to keep these forecasting capabilities secretive. If this is the case, the question arises as to whether the incumbent would want to reveal its signal quality (on top of whether it wishes to reveal the signal it received). To investigate this issue, we modified our basic model in the following way. At the beginning of the game only firm k knows its signal quality, which can either be high ($\overline{\sigma}_k$) or low ($\underline{\sigma}_k$) with probability y_k and $(1-y_k)$, respectively, and where $\overline{\sigma}_k > \underline{\sigma}_k$.

As in the proof of Proposition 2 we will solve for the case in which c_I is low enough that the incumbent with $s_I = high$ prefers to set its R&D level equal to one. Let $E(\sigma_I) = y_I\overline{\sigma}_I + (1-y_I)\underline{\sigma}_I$. First, we will prove that in equilibrium the incumbent never reveals its signal quality. There are ten potential pure strategy equilibria in which the incumbent's signal quality is either partially or fully revealed. 1. when $\sigma_I = \overline{\sigma}_I,\ a = p\ \forall d_I$ and when $\sigma_I = \underline{\sigma}_I,\ a = s\ \forall d_I$: In this equilibrium when $a = p$, the entrant's expected R&D level is equal to $\frac{\mu_E(\pi_m - \overline{\sigma}_I(\pi_m - \pi_d))}{c_E}$, where $\mu_E = y_E(\overline{\sigma}_E + \frac{x(1-\overline{\sigma}_E)^2}{(1-x\overline{\sigma}_E)}) + (1-y_E)(\underline{\sigma}_E + \frac{x(1-\underline{\sigma}_E)^2}{(1-x\underline{\sigma}_E)})$, and when $a = s$, the entrant's expected R&D level is equal to $\frac{\mu_E(\pi_m - \underline{\sigma}_I(\pi_m - \pi_d))}{c_E}$. Since $\frac{\partial EV_I}{\partial\tilde{\phi}_E} < 0$ the incumbent with $\sigma_I = \underline{\sigma}_I$ would deviate to $a = p$. 2. when $\sigma_I = \overline{\sigma}_I,\ a = s\ \forall d_I$ and when $\sigma_I = \underline{\sigma}_I,\ a = p$ $\forall d_I$: In this equilibrium when $a = s$, the entrant's expected R&D level is equal to $\frac{\mu_E(\pi_m - \overline{\sigma}_I(\pi_m - \pi_d))}{c_E}$ and when $a = p$, the entrant's expected R&D level is equal to $\frac{\mu_E(\pi_m - \underline{\sigma}_I(\pi_m - \pi_d))}{c_E}$. Since $\frac{\partial EV_I}{\partial\tilde{\phi}_E} < 0$ the incumbent with $\sigma_I = \underline{\sigma}_I$ would deviate to $a = s$. 3. when $\sigma_I = \overline{\sigma}_I,\ a = p\ \forall d_I$ and when $\sigma_I = \underline{\sigma}_I,\ a = p$ if $d_I = p$ and $a = s$ if $d_I = f$: In this equilibrium, when $a = s$, the entrant knows that $\sigma_I = \underline{\sigma}_I$ and $s_I = low$, but when $a = p$, the entrant is not sure about either the incumbent's signal quality or the value of its signal. Obviously, the entrant's expected R&D level would not be the same when $a = s$ and when $a = p$. Let $\tilde{\phi}^*_{E|s}$ and $\tilde{\phi}^*_{E|p}$ denote the entrant's expected R&D levels when $a = s$ and when $a = p$ respectively. Since $\frac{\partial EV_I}{\partial\tilde{\phi}_E} < 0$ when $\tilde{\phi}^*_{E|s} > \tilde{\phi}^*_{E|p}$, the incumbent with $\sigma_I = \underline{\sigma}_I$ and $s_I = low$ would deviate to $a = p$ and when $\tilde{\phi}^*_{E|s} < \tilde{\phi}^*_{E|p}$, the incumbent with $\sigma_I = \overline{\sigma}_I$ would deviate to $a = s$. 4. when $\sigma_I = \overline{\sigma}_I,\ a = p\ \forall d_I$ and when $\sigma_I = \underline{\sigma}_I,\ a = s$ if $d_I = p$ and $a = p$ if $d_I = f$: In this equilibrium, when $a = s$, the entrant knows that $\sigma_I = \underline{\sigma}_I$ and $s_I = high$, but when $a = p$, the entrant is not sure about either the incumbent's signal quality or the value of its signal. Also, when $a = s$, the β-segment consumers know that $d_I = p$ and hence they postpone their purchase. Obviously, the entrant's expected R&D level would not be the same when $a = s$ and when $a = p$. Let $\tilde{\phi}^*_{E|s}$ and $\tilde{\phi}^*_{E|p}$ denote the entrant's expected R&D levels when $a = s$ and when $a = p$ respectively. Since $\frac{\partial EV_I}{\partial\tilde{\phi}_E} < 0$ when $\tilde{\phi}^*_{E|s} > \tilde{\phi}^*_{E|p}$, either the incumbent with $\sigma_I = \overline{\sigma}_I$ and $s_I = high$ would deviate to $a = s$ to collect the demand-side benefits or the incumbent with $\sigma_I = \underline{\sigma}_I$ and $s_I = high$ would deviate to $a = p$ and trade off the demand-side benefits for lower $\tilde{\phi}_E$. When $\tilde{\phi}^*_{E|s} < \tilde{\phi}^*_{E|p}$, the incumbent with $\sigma_I = \overline{\sigma}_I$ would deviate to $a = s$. 5. when $\sigma_I = \underline{\sigma}_I,\ a = p\ \forall d_I$ and when $\sigma_I = \overline{\sigma}_I$, $a = p$ if $d_I = p$ and $a = s$ if $d_I = f$: In this equilibrium, following the same logic in 3, since $\frac{\partial EV_I}{\partial \tilde{\phi}_E} < 0$ when $\tilde{\phi}^*_{E|s} < \tilde{\phi}^*_{E|p}$, the incumbent with $\sigma_I = \underline{\sigma}_I$ and $s_I = low$ would deviate to $a = s$ and when $\tilde{\phi}^*_{E|s} > \tilde{\phi}^*_{E|p}$, the incumbent with $\sigma_I = \overline{\sigma}_I$ and $s_I = low$ would deviate to $a = p$. 6. when $\sigma_I = \underline{\sigma}_I,\ a = p\ \forall d_I$ and when $\sigma_I = \overline{\sigma}_I$, $a = s$ if $d_I = p$ and $a = p$ if $d_I = f$: In this equilibrium, following the same logic in 3, since $\frac{\partial EV_I}{\partial \tilde{\phi}_E} < 0$ when $\tilde{\phi}^*_{E|s} < \tilde{\phi}^*_{E|p}$, the incumbent with $\sigma_I = \underline{\sigma}_I$ would deviate to $a = s$. When $\tilde{\phi}^*_{E|s} > \tilde{\phi}^*_{E|p}$, the incumbent with $\sigma_I = \underline{\sigma}_I$ and $s_I = high$ would deviate to $a = s$ to collect the demand-side benefits or the incumbent with $\sigma_I = \overline{\sigma}_I$ and $s_I = high$ would deviate to $a = p$ and trade off the demand-side benefits for lower $\tilde{\phi}_E$. 7. when $\sigma_I = \underline{\sigma}_I,\ a = s\ \forall d_I$ and when $\sigma_I = \overline{\sigma}_I$, $a = p$ if $d_I = p$ and $a = s$ if $d_I = f$: In this equilibrium, when $a = p$, the entrant knows that $\sigma_I = \overline{\sigma}_I$ and $s_I = high$ and β-segment consumers delay their purchase. However, when $a = s$, the entrant is not sure about either the incumbent's signal quality or the value of its signal. Obviously, the entrant's expected R&D level would not be the same when $a = s$ and when $a = p$. When $\tilde{\phi}^*_{E|s} > \tilde{\phi}^*_{E|p}$, the incumbent with $\sigma_I = \underline{\sigma}_I$ would deviate to $a = p$. When $\tilde{\phi}^*_{E|s} < \tilde{\phi}^*_{E|p}$, the incumbent with $\sigma_I = \underline{\sigma}_I$ and $s_I = high$ would deviate to $a = p$ to collect the demand-side benefits or since $\frac{\partial EV_I}{\partial \tilde{\phi}_E} < 0$ the incumbent with $\sigma_I = \overline{\sigma}_I$ and $s_I = high$ would deviate to $a = s$ and let go the demand-side benefits for lower $\tilde{\phi}_E$. 8. when $\sigma_I = \underline{\sigma}_I,\ a = s\ \forall d_I$ and when $\sigma_I = \overline{\sigma}_I$, $a = s$ if $d_I = p$ and $a = p$ if $d_I = f$: In this equilibrium, when $a = p$, the entrant knows that $\sigma_I = \overline{\sigma}_I$ and $s_I = low$. However, when $a = s$, the entrant is not sure about either the incumbent's signal quality or the value of its signal. Obviously, the entrant's expected R&D level would not be the same when $a = s$ and when $a = p$. When $\tilde{\phi}^*_{E|s} > \tilde{\phi}^*_{E|p}$, the incumbent with $\sigma_I = \underline{\sigma}_I$ would deviate to $a = p$. When $\tilde{\phi}^*_{E|s} < \tilde{\phi}^*_{E|p}$, the incumbent with $\sigma_I = \overline{\sigma}_I$ and $s_I = low$ would deviate to $a = s$. 9. When $\sigma_I = \overline{\sigma}_I,\ a = s\ \forall d_I$ and when $\sigma_I = \underline{\sigma}_I$, $a = p$ if $d_I = p$ and $a = s$ if $d_I = f$: In this equilibrium, following the same logic in 7, when $\tilde{\phi}^*_{E|s} > \tilde{\phi}^*_{E|p}$, the incumbent with $\sigma_I = \overline{\sigma}$ would deviate to $a = p$. When $\tilde{\phi}^*_{E|s} < \tilde{\phi}^*_{E|p}$, the incumbent with $\sigma_I = \overline{\sigma}_I$ and $s_I = high$ would deviate to $a = p$ to collect the demand-side benefits or since $\frac{\partial EV_I}{\partial \tilde{\phi}_E} < 0$ the incumbent with $\sigma_I = \underline{\sigma}_I$ and $s_I = high$ would deviate to $a = s$ and let go the demand-side benefits for lower $\tilde{\phi}_E$. 10. When $\sigma_I = \overline{\sigma}_I,\ a = s\ \forall d_I$ and when $\sigma_I = \underline{\sigma}_I$, $a = s$ if $d_I = p$ and $a = p$ if $d_I = f$: In this equilibrium, when $\tilde{\phi}^*_{E|s} > \tilde{\phi}^*_{E|p}$, the incumbent with $\sigma_I = \overline{\sigma}$ would deviate to $a = p$. When $\tilde{\phi}^*_{E|s} < \tilde{\phi}^*_{E|p}$, the incumbent with $\sigma_I = \underline{\sigma}_I$ and $s_I = low$ would deviate to $a = s$.

Next, we will characterize three pure strategy equilibria: 1. $a = p\ \forall d_I$ and $\forall \sigma_I$ (vaporware equilibrium). In this equilibrium, the entrant's posterior beliefs are $prob(s_I = high \mid s_E = high, a = p)= E(\sigma_I)$, $prob(s_I = high \mid s_E = low, a = p)= \frac{x(1-\sigma_E)}{1-x\sigma_E} E(\sigma_I)$, and $prob(\sigma_I = \overline{\sigma}_I \mid a = p)= y_I$. The entrant's off-the-equilibrium-path beliefs are $prob(s_I = low \mid a = s)= 1$ and $prob(\sigma_I = \overline{\sigma}_I \mid a = s)= y_I$. The β-segment consumers' posterior beliefs are $prob(s_I = high \mid \text{market potential}= high, a = p)= E(\sigma_I)$ and off-the-equilibrium-path belief is $prob(s_I = low \mid \text{market potential}= high, a = s)= 1$. Note that since the β-segment consumers delay their purchase only when they think that the incumbent is for sure pursuing

the new product their belief regarding the incumbent's signal reliability is not relevant for our analysis.
2. $a = s$ $\forall d_I$ and $\forall \sigma_I$ (suddenware equilibrium). In this equilibrium, the entrant's posterior beliefs are $prob(s_I = high \mid s_E = high, a = s) = E(\sigma_I)$, $prob(s_I = high \mid s_E = low,\ a = s) = \frac{x(1-\sigma_E)}{1-x\sigma_E}E(\sigma_I)$, and $prob(\sigma_I = \overline{\sigma}_I \mid a = s) = y_I$. The entrant's off-the-equilibrium-path belief is $prob(s_I = high \mid a = p) = 1$. The β-segment's posterior belief is $prob(s_I = high \mid \text{market potential} = high, a = s) = E(\sigma_I)$ and off-the-equilibrium-path belief is $prob(s_I = high \mid \text{market potential} = high, a = p) = 1$. Note that since $prob(s_I = high \mid a = p) = 1$ and $prob(s_I = high \mid \text{market potential} = high, a = p) = 1$ the entrant's and the β-segment's off-the-equilibrium-path beliefs regarding the incumbent's signal quality do not matter.
3. $a = p$ when $d_I = p$ and $a = s$ when $d_I = f$ $\forall \sigma_I$ (trueware equilibrium). In this equilibrium, the entrant's posterior beliefs are $prob(s_I = high \mid a = p) = 1$, $prob(s_I = low \mid a = s) = 1$, and $prob(\sigma_I = \overline{\sigma}_I \mid a = s) = y_I$. The β-segment's posterior beliefs are $prob(s_I = high \mid \text{market potential} = high, a = p) = 1$ and $prob(s_I = low \mid \text{market potential} = high, a = s) = 1$. Note that since $prob(s_I = high \mid a = p) = 1$ and $prob(s_I = high \mid \text{market potential} = high, a = p) = 1$ the entrant's and the β-segment's posterior beliefs regarding the incumbent's signal quality when $a = p$ do not matter.

1. In this equilibrium the entrant's expected R&D level is $\tilde{\phi}_E^{v*} = \frac{\mu_E(\pi_m - E(\sigma_I)(\pi_m - \pi_d))}{c_E}$, where $\mu_E = y_E(\overline{\sigma}_E + \frac{x(1-\overline{\sigma}_E)^2}{(1-x\overline{\sigma}_E)}) + (1-y_E)(\underline{\sigma}_E + \frac{x(1-\underline{\sigma}_E)^2}{(1-x\underline{\sigma}_E)})$. If the incumbent deviates to $a = s$, then based on its off-the-equilibrium-path-beliefs given above the entrant's expected R&D level would be $\tilde{\phi}_E^{v\prime} = \mu_E^{updated}\frac{\pi_m}{c_E}$, where $\mu_E^{updated} = y_E(\overline{\sigma}_E + \frac{x(1-\overline{\sigma}_E)^2(1-E(\sigma_I))}{1-x+x(1-\overline{\sigma}_E)(1-E(\sigma_I))}) + (1-y_E)(\underline{\sigma}_E + \frac{x(1-\underline{\sigma}_E)^2(1-E(\sigma_I))}{1-x+x(1-\underline{\sigma}_E)(1-E(\sigma_I))})$. Since $\frac{\partial EV_I}{\partial \tilde{\phi}_E} < 0$ the incumbent would deviate from the vaporware equilibrium if $\tilde{\phi}_E^{v*} > \tilde{\phi}_E^{v\prime}$. For $\pi_m(1 - \frac{x}{\mu_E}(\frac{y_E(1-\overline{\sigma}_E)^2}{(1-x\overline{\sigma}_E)} + \frac{(1-y_E)(1-\underline{\sigma}_E)^2}{(1-x\underline{\sigma}_E)})) < \pi_d < \pi_m(1 - \frac{x(1-x)}{\mu_E}(\frac{y_E(1-\overline{\sigma}_E)^2}{(1-x\overline{\sigma}_E)^2} + \frac{(1-y_E)(1-\underline{\sigma}_E)^2}{(1-x\underline{\sigma}_E)^2}))$ there exists a $E(\sigma_I)_1 \in (0,1)$ such that then $\tilde{\phi}_E^{v*}(E(\sigma_I) \geq E(\sigma_I)_1) \geq \mu_E^{updated}(E(\sigma_I) \geq E(\sigma_I)_1)\frac{\pi_m}{c_E}$ and as a result, the vaporware equilibrium cannot exist for $E(\sigma_I) > E(\sigma_I)_1$. Note that $\pi_m(1 - \frac{x(1-x)}{\mu_E}(\frac{y_E(1-\overline{\sigma}_E)^2}{(1-x\overline{\sigma}_E)^2} + \frac{(1-y_E)(1-\underline{\sigma}_E)^2}{(1-x\underline{\sigma}_E)^2})) > \pi_m(1 - \frac{x}{\mu_E}(\frac{y_E(1-\overline{\sigma}_E)^2}{(1-x\overline{\sigma}_E)} + \frac{(1-y_E)(1-\underline{\sigma}_E)^2}{(1-x\underline{\sigma}_E)}))$.

2. In this equilibrium when $s_I = high$, $EV_{I|_H}^{s*} = \pi_m - \tilde{\phi}_E^{s*}(\pi_m - \pi_d) - \frac{c_I}{2}$ and when $s_I = low$, $EV_{I|_L}^{s*} = (1 - \mu_I\tilde{\phi}_E^{s*})\pi_0 + \pi^{\varnothing}$, where $\tilde{\phi}_E^{s*} = \frac{\mu_E(\pi_m - E(\sigma_I)(\pi_m - \pi_d))}{c_E}$ and $\mu_I = \frac{x(1-\sigma_I)}{1-x\sigma_I}$. If the incumbent deviates to $a = p$ the entrant thinks that $s_I = high$ and its expected R&D level would be equal to $\frac{(1+\beta)\pi_d}{c_E}$. Note that in this case the β-segment consumers delay their purchase too. Since $\frac{\partial EV_I}{\partial \tilde{\phi}_E} < 0$ the incumbent with $s_I = low$ would not deviate if $\tilde{\phi}_E^{s*} < \frac{(1+\beta)\pi_d}{c_E}$. On the other hand, the incumbent with $s_I = high$ would not deviate if $\frac{(1+\beta)^2\pi_d}{c_E} - \frac{\beta\pi_m}{(\pi_m - \pi_d)} > \tilde{\phi}_E^{s*}$. Since $\frac{(1+\beta)^2\pi_d}{c_E} - \frac{\beta\pi_m}{(\pi_m - \pi_d)} < \frac{(1+\beta)\pi_d}{c_E}$, $\frac{\partial(\frac{(1+\beta)^2\pi_d}{c_E} - \frac{\beta\pi_m}{(\pi_m - \pi_d)})}{\partial\beta} < 0$, $\left(\frac{(1+\beta)^2\pi_d}{c_E} - \frac{\beta\pi_m}{(\pi_m - \pi_d)}\right)|_{\beta = \frac{\pi_m - \pi_d}{\pi_d}} < 0$, for $E(\sigma_I) > E(\sigma_I)_2 \equiv \frac{\mu_E\pi_m - \pi_d}{\mu_E(\pi_m - \pi_d)}$ there exists a $\tilde{\beta}^s$ such that $\left(\frac{(1+\beta)^2\pi_d}{c_E} - \frac{\beta\pi_m}{(\pi_m - \pi_d)}\right)|_{\beta \geq \beta^s} \leq \tilde{\phi}_E^{s*}$ and suddenware equilibrium exists only for $E(\sigma_I) > E(\sigma_I)_2$ and $\beta < \tilde{\beta}^s$. Note that $E(\sigma_I)_2 \in (0,1)$ if $\pi_d < \mu_E\pi_m$. Since $\mu_E < 1 - \frac{x(1-x)}{\mu_E}(\frac{y_E(1-\overline{\sigma}_E)^2}{(1-x\overline{\sigma}_E)^2} + \frac{(1-y_E)(1-\underline{\sigma}_E)^2}{(1-x\underline{\sigma}_E)^2})$ if $\pi_m(1 - \frac{x}{\mu_E}(\frac{y_E(1-\overline{\sigma}_E)^2}{(1-x\overline{\sigma}_E)} + \frac{(1-y_E)(1-\underline{\sigma}_E)^2}{(1-x\underline{\sigma}_E)})) < \pi_d < \mu_E\pi_m$ then $E(\sigma_I)_1, E(\sigma_I)_2 \in (0,1)$. Following the numerical example in the proof of Proposition 1 one can see that such π_d can exist.

3. In this equilibrium, when $s_I = high$, $EV^{t*}_{I|_H} = (1+\beta)(\pi_m - \frac{(1+\beta)\pi_d}{c_E}(\pi_m - \pi_d)) - \frac{c_I}{2}$ and when $s_I = low$, $EV^{t*}_{I|_L} = (1 - \mu_I \mu_E^{updated} \frac{\pi_m}{c_E})\pi_0 + \pi^{\varnothing}$. If the incumbent with $s_I = high$ deviates to $a = s$, then the entrant thinks that $s_I = low$ and its expected R&D level would be equal to $\mu_E^{updated}\frac{\pi_m}{c_E}$. In this case, $EV^{t\prime}_{I|_H} = (\pi_m - \mu_E^{updated}\frac{\pi_m}{c_E}(\pi_m - \pi_d)) - \frac{c_I}{2}$. If the incumbent with $s_I = low$ deviates to $a = p$ the entrant thinks that $s_I = high$ and its expected R&D level would be equal to $\frac{(1+\beta)\pi_d}{c_E}$. In this case, $EV^{t\prime}_{I|_L} = (1 - \mu_I \frac{(1+\beta)\pi_d}{c_E})\pi_0 + \pi^{\varnothing}$. Since $\frac{\partial EV_I}{\partial \tilde{\phi}_E} < 0$ the incumbent would not deviate from the trueware equilibrium if $\frac{(1+\beta)\pi_d}{c_E} > \mu_E^{updated}\frac{\pi_m}{c_E}$ and $\mu_E^{updated}\frac{\pi_m}{c_E} > \frac{(1+\beta)^2\pi_d}{c_E} - \frac{\beta\pi_m}{(\pi_m - \pi_d)}$. Recall that $\left(\frac{(1+\beta)^2\pi_d}{c_E} - \frac{\beta\pi_m}{(\pi_m-\pi_d)}\right)|_{\beta = \frac{\pi_m - \pi_d}{\pi_d}} < 0$, $\mu_E^{updated}(E(\sigma_I) = 1)\frac{\pi_m}{c_E} = (y_E\overline{\sigma}_E + (1 - y_E)\underline{\sigma}_E)\frac{\pi_m}{c_E}$, and $\mu_E^{updated}(E(\sigma_I) = 0)\frac{\pi_m}{c_E} = \mu_E\frac{\pi_m}{c_E}$. Given that $\mu_E\frac{\pi_m}{c_E} < \frac{(1+\beta)\pi_d}{c_E}$ for $\beta > \frac{\mu_E\pi_m - \pi_d}{\pi_d}$, where $\frac{\mu_E\pi_m - \pi_d}{\pi_d} < \frac{\pi_m - \pi_d}{\pi_d}$ for any $E(\sigma_I)$ there exists a $\tilde{\beta}^t$ such that the trueware equilibrium can exist for $\beta > \tilde{\beta}^t$.

Therefore, for $E(\sigma_I) < E^v(\sigma_I) \equiv \min\{E(\sigma_I)_1, E(\sigma_I)_2\}$ and $\beta < \tilde{\beta}^t$ only the vaporware equilibrium can exist. Note that since $\mu_E^{updated}\frac{\pi_m}{c_E} < \tilde{\phi}_E^{s*} < \frac{\pi d}{c_E}$ for $E(\sigma_I) > E^s(\sigma_I) \equiv \max\{E(\sigma_I)_1, E(\sigma_I)_2\}$ and $\frac{\partial(\frac{(1+\beta)^2\pi_d}{c_E} - \frac{\beta\pi_m}{(\pi_m-\pi_d)})}{\partial\beta} < 0$, $\tilde{\beta}^t > \tilde{\beta}^s$ for $E(\sigma_I) > E^s(\sigma_I)$. Thus, for $E(\sigma_I) > E^s(\sigma_I)$ and $\beta < \tilde{\beta}^s$ only the suddenware equilibrium can exist, and for $E(\sigma_I) > E^s(\sigma_I)$ and $\beta > \tilde{\beta}^t$ only the trueware equilibrium can exist.■

TA3.3 Endogenizing Signal Qualities: Firms Can Invest in Improving Their Signal Qualities

We assumed that firms' signal qualities are exogenous. To check whether we can get the same results in Proposition 2 even if firms can improve their signal qualities we extended our basic model as follows. Let firms' initial signal qualities be $\underline{\sigma}_k$. Before firms receive their private signals at t=0, they decide whether to incur a fixed cost of Q_k, $k \in \{I, E\}$, to improve their signal quality from $\underline{\sigma}_k$ to $\overline{\sigma}_k$.

In the following we will solve the Nash Equilibrium of the following game:

I/E	Not Improve	Improve
Not Improve	$(\sigma_I, \sigma_E) = (\underline{\sigma}_I, \underline{\sigma}_E)$	$(\sigma_I, \sigma_E) = (\underline{\sigma}_I, \overline{\sigma}_E)$
Improve	$(\sigma_I, \sigma_E) = (\overline{\sigma}_I, \underline{\sigma}_E)$	$(\sigma_I, \sigma_E) = (\overline{\sigma}_I, \overline{\sigma}_E)$

As in the proof of Proposition 2 we will solve for the case in which c_I is low enough that the incumbent with $s_I = high$ prefers to set its R&D level equal to one. We know from the proof of Proposition 2 that the incumbent prefers to engage in vaporware if $\sigma_I < \min\{\sigma_{I1}, \sigma_{I2}\}$ and $\beta < \beta^t$, engage in suddenware if $\sigma_I > \max\{\sigma_{I1}, \sigma_{I2}\}$ and $\beta < \beta^s$, and engage in trueware if $\sigma_I > \max\{\sigma_{I1}, \sigma_{I2}\}$ and $\beta > \beta^t$. Given that $\frac{\partial\sigma_{I2}}{\partial\sigma_E} > 0$, in our analysis we will assume that $\underline{\sigma}_I < \min\{\sigma_{I1}(\underline{\sigma}_E), \sigma_{I1}(\overline{\sigma}_E), \sigma_{I2}(\underline{\sigma}_E)\}$ and $\overline{\sigma}_I > \max\{\sigma_{I1}(\underline{\sigma}_E), \sigma_{I1}(\overline{\sigma}_E), \sigma_{I2}(\overline{\sigma}_E)\}$ so that both the vaporware and suddenware equilibrium can exist. Moreover, $\frac{\partial\beta^t}{\partial\sigma_I} > 0$ and $\frac{\partial\beta^s}{\partial\sigma_I} > 0$. Thus, the incumbent prefers to engage in vaporware when $\sigma_I = \underline{\sigma}_I$ and $\beta < \beta^s(\sigma_I = \underline{\sigma}_I)$, engage in suddenware when $\sigma_I = \overline{\sigma}_I$ and $\beta < \beta^s(\sigma_I = \overline{\sigma}_I)$, and engage in trueware if $\sigma_I = \overline{\sigma}_I$ and $\beta > \beta^t(\sigma_I = \overline{\sigma}_I)$. Since for $\sigma_I = \overline{\sigma}_I$ and $\beta^s(\sigma_I = \overline{\sigma}_I) < \beta < \beta^t(\sigma_I = \overline{\sigma}_I)$ no pure strategy exists we will not consider this range. Finally, it is ambiguous whether $\beta^s(\sigma_I = \overline{\sigma}_I) < \beta^t(\sigma_I = \underline{\sigma}_I)$ or $\beta^s(\sigma_I = \overline{\sigma}_I) > \beta^t(\sigma_I = \underline{\sigma}_I)$. If $\beta^s(\sigma_I = \overline{\sigma}_I) > \beta^t(\sigma_I = \underline{\sigma}_I)$, then for $\beta^t(\sigma_I = \underline{\sigma}_I) < \beta < \beta^s(\sigma_I = \overline{\sigma}_I)$ and $\sigma_I = \underline{\sigma}_I$ both the vaporware and the trueware equilibrium can exist. As a result, the vaporware equilibrium cannot exist alone for $\sigma_I = \underline{\sigma}_I$ and $\beta^t(\sigma_I = \underline{\sigma}_I) < \beta < \beta^s(\sigma_I = \overline{\sigma}_I)$. If $\beta^s(\sigma_I = \overline{\sigma}_I) < \beta^t(\sigma_I = \underline{\sigma}_I)$, then for $\beta^s(\sigma_I = \overline{\sigma}_I) < \beta < \beta^t(\sigma_I = \underline{\sigma}_I)$ and $\sigma_I = \overline{\sigma}_I$ the suddenware equilibrium cannot exist. Therefore, we will solve only for $\beta > \beta^t(\sigma_I = \overline{\sigma}_I)$ and $\beta < \min\left\{\beta^s(\sigma_I = \overline{\sigma}_I), \beta^t(\sigma_I = \underline{\sigma}_I)\right\}$.

Case of $\beta > \beta^t(\sigma_I = \overline{\sigma}_I)$: First of all, note that when $\sigma_I = \underline{\sigma}_I$ and $\beta > \beta^t(\sigma_I = \overline{\sigma}_I)$, both the vaporware and the trueware equilibrium can exist. Hence, we will consider both equilibria. For a given σ_E, when the incumbent chooses not to improve its signal quality at t=0, its payoff is $EV_I^v(\underline{\sigma}_I) = x\underline{\sigma}_I(\tilde{\phi}_E^{v*}\pi_d + (1-\tilde{\phi}_E^{v*})\pi_m - \frac{c_I}{2}) + x(1-\underline{\sigma}_I)(\pi^{\varnothing} + \pi_0(1-\tilde{\phi}_E^{v*})) + (1-x)(\pi^{\varnothing}+\pi_0)$, where $\tilde{\phi}_E^{v*} = \frac{\mu_E(\pi_m - \underline{\sigma}_I(\pi_m-\pi_d))}{c_E}$ and $\mu_E = \sigma_E + \frac{x(1-\sigma_E)^2}{(1-x\sigma_E)}$, if the incumbent pursues the vaporware strategy. $EV_I^t(\underline{\sigma}_I) = x\underline{\sigma}_I((1+\beta)(\pi_m - \frac{(1+\beta)\pi_d}{c_E}(\pi_m-\pi_d)) - \frac{c_I}{2}) + x(1-\underline{\sigma}_I)((1-\mu_E^{updated}\frac{\pi_m}{c_E})\pi_0 + \pi^{\varnothing}) + (1-x)(\pi^{\varnothing}+\pi_0)$, where $\mu_E^{updated} = \sigma_E + \frac{x(1-\sigma_E)^2(1-\underline{\sigma}_I)}{1-x+x(1-\sigma_E)(1-\underline{\sigma}_I)}$, if the incumbent pursues the trueware strategy.

When the incumbent chooses to improve its signal quality, its payoff is $EV_I(\overline{\sigma}_I) = x\overline{\sigma}_I((1+\beta)(\frac{(1+\beta)\pi_d}{c_E}\pi_d + (1-\frac{(1+\beta)\pi_d}{c_E})\pi_m) - \frac{c_I}{2}) + x(1-\overline{\sigma}_I)((1-\mu_E^{updated}\frac{\pi_m}{c_E})\pi_0 + \pi^{\varnothing}) + (1-x)(\pi^{\varnothing}+\pi_0) - Q_I$, where $\mu_E^{updated} = \sigma_E + \frac{x(1-\sigma_E)^2(1-\overline{\sigma}_I)}{1-x+x(1-\sigma_E)(1-\overline{\sigma}_I)}$. Since $\frac{\partial \mu_E^{updated}}{\partial \sigma_I} < 0$, $\tilde{\phi}_E^{v*}(\sigma_I = \underline{\sigma}_I) > \tilde{\phi}_E^{v*}(\sigma_I = \overline{\sigma}_I) > \mu_E^{updated}(\sigma_I = \overline{\sigma}_I)\frac{\pi_m}{c_E}$, $(1+\beta)(\frac{(1+\beta)\pi_d}{c_E}\pi_d + (1-\frac{(1+\beta)\pi_d}{c_E})\pi_m) > \tilde{\phi}_E^{v*}\pi_d + (1-\tilde{\phi}_E^{v*})\pi_m$, and $((1+\beta)(\pi_m - \frac{(1+\beta)\pi_d}{c_E}(\pi_m - \pi_d)) - \frac{c_I}{2}) > (1-\mu_E^{updated}\frac{\pi_m}{c_E})\pi_0 + \pi^{\varnothing}$, $EV_I(\overline{\sigma}_I) > EV_I^t(\underline{\sigma}_I)$ and $EV_I(\overline{\sigma}_I) > EV_I^v(\underline{\sigma}_I)$ unless Q_I is too high.

If $\sigma_I = \underline{\sigma}_I$ and the entrant chooses not to improve its signal quality, then its payoff is $EV_E^v(\underline{\sigma}_I, \underline{\sigma}_E) = x(\underline{\sigma}_E\frac{(\pi_m - \underline{\sigma}_I(\pi_m-\pi_d))^2}{2c_E} + (1-\underline{\sigma}_E)\mu_E\frac{(\pi_m - \underline{\sigma}_I(\pi_m-\pi_d))^2}{c_E}) - (1-x\underline{\sigma}_E)\frac{\mu_E^2(\pi_m - \underline{\sigma}_I(\pi_m-\pi_d))^2}{2c_E}$, where $\mu_E = \frac{x(1-\underline{\sigma}_E)}{(1-x\underline{\sigma}_E)}$, if the incumbent pursues the vaporware strategy and $EV_E^t(\underline{\sigma}_I, \underline{\sigma}_E) = x\underline{\sigma}_I\frac{(1+\beta)^2\pi_d^2}{2c_E} + x(1-\underline{\sigma}_I)\underline{\sigma}_E\frac{\pi_m^2}{2c_E} + x(1-\underline{\sigma}_I)(1-\underline{\sigma}_E)\mu_E^{updated}\frac{\pi_m^2}{c_E} - (1-x+x(1-\underline{\sigma}_I)(1-\underline{\sigma}_E))\frac{(\mu_E^{updated}\pi_m)^2}{2c_E}$, where $\mu_E^{updated} = \frac{x(1-\underline{\sigma}_E)(1-\underline{\sigma}_I)}{1-x+x(1-\underline{\sigma}_E)(1-\underline{\sigma}_I)}$, if the incumbent pursues the trueware strategy.

If $\sigma_I = \underline{\sigma}_I$ and the entrant chooses to improve its signal quality, then its payoff is $EV_E^v(\underline{\sigma}_I, \overline{\sigma}_E) = x(\overline{\sigma}_E\frac{(\pi_m - \underline{\sigma}_I(\pi_m-\pi_d))^2}{2c_E} + (1-\overline{\sigma}_E)\mu_E\frac{(\pi_m - \underline{\sigma}_I(\pi_m-\pi_d))^2}{c_E}) - (1-x\overline{\sigma}_E)\frac{\mu_E^2(\pi_m - \underline{\sigma}_I(\pi_m-\pi_d))^2}{2c_E} - Q_E$, where $\mu_E = \frac{x(1-\overline{\sigma}_E)}{(1-x\overline{\sigma}_E)}$, if the incumbent pursues the vaporware strategy and $EV_E^t(\underline{\sigma}_I, \overline{\sigma}_E) = x\underline{\sigma}_I\frac{(1+\beta)^2\pi_d^2}{2c_E} + x(1-\underline{\sigma}_I)\overline{\sigma}_E\frac{\pi_m^2}{2c_E} + x(1-\underline{\sigma}_I)(1-\overline{\sigma}_E)\mu_E^{updated}\frac{\pi_m^2}{c_E} - (1-x+x(1-\underline{\sigma}_I)(1-\overline{\sigma}_E))\frac{(\mu_E^{updated}\pi_m)^2}{2c_E}$, where $\mu_E^{updated} = \frac{x(1-\overline{\sigma}_E)(1-\underline{\sigma}_I)}{1-x+x(1-\overline{\sigma}_E)(1-\underline{\sigma}_I)}$, if the incumbent pursues the trueware strategy. Since $\frac{\partial(\sigma_E + (1-\sigma_E)\mu_E(2-\mu_E))}{\partial \sigma_E} > 0$ and $\frac{\partial\left(\sigma_E + (1-\sigma_E)\mu_E^{updated}(2-\mu_E^{updated})\right)}{\partial \sigma_E} > 0$, where $\mu_E = \frac{x(1-\sigma_E)}{(1-x\sigma_E)}$ and $\mu_E^{updated} = \frac{x(1-\sigma_E)(1-\sigma_I)}{1-x+x(1-\sigma_E)(1-\sigma_I)}$, $EV_E^v(\underline{\sigma}_I, \overline{\sigma}_E) > EV_E^v(\underline{\sigma}_I, \underline{\sigma}_E)$ and $EV_E^t(\underline{\sigma}_I, \overline{\sigma}_E) > EV_E^t(\underline{\sigma}_I, \underline{\sigma}_E)$ unless Q_E is too high. Note that we do not consider the case in which the equilibrium strategy of the incumbent with $\underline{\sigma}_I$ depends on the entrant's signal quality. In other words we only consider cases in which the incumbent pursues the vaporware strategy both when $(\underline{\sigma}_I, \underline{\sigma}_E)$ and when $(\underline{\sigma}_I, \overline{\sigma}_E)$ and the incumbent pursues the trueware strategy both when $(\underline{\sigma}_I, \underline{\sigma}_E)$ and when $(\underline{\sigma}_I, \overline{\sigma}_E)$.

If $\sigma_I = \overline{\sigma}_I$ and the entrant chooses not to improve its signal quality, then its payoff is $EV_E(\overline{\sigma}_I, \underline{\sigma}_E) = x\overline{\sigma}_I \frac{(1+\beta)\pi_d^2}{2c_E} + x(1-\overline{\sigma}_I)\underline{\sigma}_E \frac{\pi_m^2}{2c_E} + x(1-\overline{\sigma}_I)(1-\underline{\sigma}_E)\mu_E^{updated}\frac{\pi_m^2}{c_E} - (1-x+x(1-\overline{\sigma}_I)(1-\underline{\sigma}_E))\frac{(\mu_E^{updated}\pi_m)^2}{2c_E}$, where $\mu_E^{updated} = \frac{x(1-\underline{\sigma}_E)(1-\overline{\sigma}_I)}{1-x+x(1-\underline{\sigma}_E)(1-\overline{\sigma}_I)}$. If $\sigma_I = \overline{\sigma}_I$ and the entrant chooses to improve its signal quality, then its payoff is $EV_E(\overline{\sigma}_I, \overline{\sigma}_E) = x\overline{\sigma}_I \frac{(1+\beta)\pi_d^2}{2c_E} + x(1-\overline{\sigma}_I)\overline{\sigma}_E \frac{\pi_m^2}{2c_E} + x(1-\overline{\sigma}_I)(1-\overline{\sigma}_E)\mu_E^{updated}\frac{\pi_m^2}{c_E} - (1-x+x(1-\overline{\sigma}_I)(1-\overline{\sigma}_E))\frac{(\mu_E^{updated}\pi_m)^2}{2c_E} - Q_E$, where $\mu_E^{updated} = \frac{x(1-\overline{\sigma}_E)(1-\overline{\sigma}_I)}{1-x+x(1-\overline{\sigma}_E)(1-\overline{\sigma}_I)}$. Since $\frac{\partial\left(\sigma_E + (1-\sigma_E)\mu_E^{updated}(2-\mu_E^{updated})\right)}{\partial \sigma_E} > 0$, where $\mu_E^{updated} = \frac{x(1-\sigma_E)(1-\sigma_I)}{1-x+x(1-\sigma_E)(1-\sigma_I)}$, $EV_E(\overline{\sigma}_I, \overline{\sigma}_E) > EV_E(\overline{\sigma}_I, \underline{\sigma}_E)$ unless Q_E is too high.

As a result, for low Q_I values the unique equilibrium is (Improve, Improve) if Q_E is low and (Improve, Not Improve) otherwise. In equilibrium the incumbent pursues the trueware strategy. For high Q_I values the unique equilibrium is (Not Improve, Improve) if Q_E is low and (Not Improve, Not Improve) otherwise. In equilibrium the incumbent pursues either the vaporware or the trueware strategy.

Case of $\beta < \min\left\{\beta^s(\sigma_I = \overline{\sigma}_I), \beta^t(\sigma_I = \underline{\sigma}_I)\right\}$: For a given σ_E, when the incumbent chooses not to improve its signal quality at t=0, its payoff is $EV_I(\underline{\sigma}_I) = x\underline{\sigma}_I(\tilde{\phi}_E^{v*}\pi_d + (1-\tilde{\phi}_E^{v*})\pi_m - \frac{c_I}{2}) + x(1-\underline{\sigma}_I)(\pi^{\varnothing} + \pi_0(1-\tilde{\phi}_E^{v*})) + (1-x)(\pi^{\varnothing} + \pi_0)$, where $\tilde{\phi}_E^{v*} = \frac{\mu_E(\pi_m - \underline{\sigma}_I(\pi_m - \pi_d))}{c_E}$ and $\mu_E = \sigma_E + \frac{x(1-\sigma_E)^2}{(1-x\sigma_E)}$. When the incumbent chooses to improve its signal quality, its payoff is $EV_I(\overline{\sigma}_I) = x\overline{\sigma}_I(\tilde{\phi}_E^{s*}\pi_d + (1-\tilde{\phi}_E^{s*})\pi_m - \frac{c_I}{2}) + x(1-\overline{\sigma}_I)(\pi^{\varnothing} + \pi_0(1-\tilde{\phi}_E^{s*})) + (1-x)(\pi^{\varnothing} + \pi_0) - Q_I$, where $\tilde{\phi}_E^{s*} = \frac{\mu_E(\pi_m - \overline{\sigma}_I(\pi_m - \pi_d))}{c_E}$. Since $\tilde{\phi}_E^{s*} < \tilde{\phi}_E^{v*}$ and $\pi^{\varnothing} + \pi_0(1-\tilde{\phi}_E) < \tilde{\phi}_E\pi_d + (1-\tilde{\phi}_E)\pi_m - \frac{c_I}{2}$ $\forall\tilde{\phi}_E \in (0, \frac{\pi_m}{c_E}]$, $EV_I(\overline{\sigma}_I) > EV_I(\underline{\sigma}_I)$ unless Q_I is too high.

If $\sigma_I = \underline{\sigma}_I$ and the entrant chooses not to improve its signal quality, then its payoff is $EV_E(\underline{\sigma}_I, \underline{\sigma}_E) = x(\underline{\sigma}_E\frac{(\pi_m - \underline{\sigma}_I(\pi_m-\pi_d))^2}{2c_E} + (1-\underline{\sigma}_E)\mu_E\frac{(\pi_m - \underline{\sigma}_I(\pi_m-\pi_d))^2}{c_E}) - (1-x\underline{\sigma}_E)\frac{\mu_E^2(\pi_m - \underline{\sigma}_I(\pi_m-\pi_d))^2}{2c_E}$, where $\mu_E = \frac{x(1-\underline{\sigma}_E)}{(1-x\underline{\sigma}_E)}$. If $\sigma_I = \underline{\sigma}_I$ and the entrant chooses to improve its signal quality, then its payoff is $EV_E(\underline{\sigma}_I, \overline{\sigma}_E) = x(\overline{\sigma}_E\frac{(\pi_m - \underline{\sigma}_I(\pi_m-\pi_d))^2}{2c_E} + (1-\overline{\sigma}_E)\mu_E\frac{(\pi_m - \underline{\sigma}_I(\pi_m-\pi_d))^2}{c_E}) - (1-x\overline{\sigma}_E)\frac{\mu_E^2(\pi_m - \underline{\sigma}_I(\pi_m-\pi_d))^2}{2c_E} - Q_E$, where $\mu_E = \frac{x(1-\overline{\sigma}_E)}{(1-x\overline{\sigma}_E)}$. Since $\frac{\partial(\sigma_E + (1-\sigma_E)\mu_E(2-\mu_E))}{\partial\sigma_E} > 0$, where $\mu_E = \frac{x(1-\sigma_E)}{(1-x\sigma_E)}$, $EV_E(\underline{\sigma}_I, \overline{\sigma}_E) > EV_E(\underline{\sigma}_I, \underline{\sigma}_E)$ unless Q_E is too high.

If $\sigma_I = \overline{\sigma}_I$ and the entrant chooses not improve its signal quality, then its payoff is $EV_E(\overline{\sigma}_I, \underline{\sigma}_E) = x(\underline{\sigma}_E\frac{(\pi_m - \overline{\sigma}_I(\pi_m-\pi_d))^2}{2c_E} + (1-\underline{\sigma}_E)\mu_E\frac{(\pi_m - \overline{\sigma}_I(\pi_m-\pi_d))^2}{c_E}) - (1-x\underline{\sigma}_E)\frac{\mu_E^2(\pi_m - \overline{\sigma}_I(\pi_m-\pi_d))^2}{2c_E}$, where $\mu_E = \frac{x(1-\underline{\sigma}_E)}{(1-x\underline{\sigma}_E)}$. If $\sigma_I = \overline{\sigma}_I$ and the entrant chooses to improve its signal quality, then its payoff is $EV_E(\overline{\sigma}_I, \overline{\sigma}_E) = x(\overline{\sigma}_E\frac{(\pi_m - \overline{\sigma}_I(\pi_m-\pi_d))^2}{2c_E} + (1-\overline{\sigma}_E)\mu_E\frac{(\pi_m - \overline{\sigma}_I(\pi_m-\pi_d))^2}{c_E}) - (1-x\overline{\sigma}_E)\frac{\mu_E^2(\pi_m - \overline{\sigma}_I(\pi_m-\pi_d))^2}{2c_E} - Q_E$, where $\mu_E = \frac{x(1-\overline{\sigma}_E)}{(1-x\overline{\sigma}_E)}$. Since $\frac{\partial(\sigma_E + (1-\sigma_E)\mu_E(2-\mu_E))}{\partial\sigma_E} > 0$, where $\mu_E = \frac{x(1-\sigma_E)}{(1-x\sigma_E)}$, $EV_E(\overline{\sigma}_I, \overline{\sigma}_E) > EV_E(\overline{\sigma}_I, \underline{\sigma}_E)$ unless Q_E is too high.

As a result, for low Q_I values the unique equilibrium is (Improve, Improve) if Q_E is low and (Improve, Not Improve) otherwise. In either equilibrium the incumbent pursues the suddenware strategy. For high Q_I values the unique equilibrium is (Not Improve, Improve) if Q_E is low and (Not Improve, Not Improve) otherwise. In either equilibrium the incumbent pursues the vaporware strategy.■

TA3.4 The Market Potential State Probabilities are Endogenous

We assumed that the ex-ante prior that the market potential is high (the parameter x) is exogenous. In reality, firms may invest in activities that create better conditions for market acceptance (often referred to as "market driving" activities). To accommodate this possibility, we allowed the incumbent to invest in increasing the value of x before Nature determines the state. To preserve the common-value uncertainty property of our model, we let both firms enjoy the benefits of increased market acceptance likelihood and show that we can get the same result as in Proposition 2. Recall from the proof of Proposition 1 that since $\frac{\partial(1-\frac{x(1-\sigma_E)^2}{\mu_E(1-x\sigma_E)})}{\partial x} < 0$ and $\frac{\partial \mu_E}{\partial x} > 0$, where $\mu_E = \sigma_E + \frac{x(1-\sigma_E)^2}{(1-x\sigma_E)}$, as the incumbent invests to increase x (i.e., as x increases) there always exist π_d values such that $\pi_m(1-\frac{x(1-\sigma_E)^2}{\mu_E(1-x\sigma_E)}) < \pi_d < \pi_m\mu_E$ for which $\sigma_{I1} \in (0,1)$ and $\sigma_{I2} \in (0,1)$. This means that the vaporware equilibrium can exist for $\sigma_I < \sigma_{I1}$. From the proof of Proposition 2, the incumbent would not deviate from the trueware equilibrium if $\frac{(1+\beta)\pi_d}{c_E} > \mu_E^{updated}\frac{\pi_m}{c_E}$ and $\mu_E^{updated}\frac{\pi_m}{c_E} > \frac{(1+\beta)^2\pi_d}{c_E} - \frac{\beta\pi_m}{(\pi_m-\pi_d)}$, where $\mu_E^{updated} = \sigma_E + \frac{x(1-\sigma_E)^2(1-\sigma_I)}{1-x+x(1-\sigma_E)(1-\sigma_I)}$. We also know that $\frac{\partial(\mu_E^{updated}\frac{\pi_m}{c_E})}{\partial \sigma_I} < 0$, $\mu_E^{updated}(\sigma_I = 0)\frac{\pi_m}{c_E} = \mu_E\frac{\pi_m}{c_E}$, and $\mu_E\frac{\pi_m}{c_E} < \frac{(1+\beta)\pi_d}{c_E}$ for $\beta > \frac{\mu_E\pi_m-\pi_d}{\pi_d}$, where $\frac{\mu_E\pi_m-\pi_d}{\pi_d} < \frac{\pi_m-\pi_d}{\pi_d}$. Therefore, as x increases (so does μ_E) there always exist a β^t such that the trueware equilibrium can exist for $\beta > \beta^t$. Finally, from the proof of Proposition 2, the incumbent would not deviate from the suddenware equilibrium if $\frac{(1+\beta)^2\pi_d}{c_E} - \frac{\beta\pi_m}{(\pi_m-\pi_d)} > \tilde{\phi}_E^{s*}$, where $\tilde{\phi}_E^{s*} = \frac{\mu_E(\pi_m-\sigma_I(\pi_m-\pi_d))}{c_E}$. Note that $\frac{\partial\tilde{\phi}_E^{s*}}{\partial x} > 0$. However, $\frac{\partial(\frac{(1+\beta)^2\pi_d}{c_E}-\frac{\beta\pi_m}{(\pi_m-\pi_d)})}{\partial\beta} < 0$, $\lim_{\beta\to 0}\frac{(1+\beta)^2\pi_d}{c_E} - \frac{\beta\pi_m}{(\pi_m-\pi_d)} \to \frac{\pi_d}{c_E}$, and we know that as x increases there always exist π_d values such that $\pi_m(1-\frac{x(1-\sigma_E)^2}{\mu_E(1-x\sigma_E)}) < \pi_d < \pi_m\mu_E$ for which $\sigma_{I2} \in (0,1)$. Thus, as the incumbent invests to increase x there always exists a β^s such that the suddenware equilibrium can exist for $\sigma_I > \sigma_{I2}$ and $\beta < \beta^s$.■