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RESEARCH NOTE

REVEALING OR NON-REVEALING: THE IMPACT OF REVIEW DISCLOSURE POLICY ON FIRM PROFITABILITY

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Appendix A

Derivation of Optimal Profit Under the Revealing Policy

The profit function of the firm under the revealing policy is

$$\pi^1(p_1,p_2)=\begin{cases}\left(\begin{array}{l}\frac{3}{4}p_1\frac{\bar{v}_1+a_1-p_1}{2a_1}+\frac{1}{4}p_2\frac{\bar{v}_2+a_2-p_2}{2a_2}\\ +\frac{1}{2}\left(\frac{1}{2}\left(1-\frac{\bar{v}_1+a_1-p_1}{2a_1}\right)\right)p_2\frac{\bar{v}_2+a_2-p_2}{2a_2}\end{array}\right) & \text{if } \bar{v}_1-p_1>\bar{v}_2-p_2 \text{ or if } \bar{v}_1-p_1=\bar{v}_2-p_2 \text{ and Product 1 is on the top of the list} \quad \text{(A1)}\\[2ex] \left(\begin{array}{l}\frac{1}{4}p_1\frac{\bar{v}_1+a_1-p_1}{2a_1}+\frac{3}{4}p_2\frac{\bar{v}_2+a_2-p_2}{2a_2}\\ +\frac{1}{2}\left(\frac{1}{2}\left(1-\frac{\bar{v}_2+a_2-p_2}{2a_2}\right)\right)p_1\frac{\bar{v}_1+a_1-p_1}{2a_1}\end{array}\right) & \text{if } \bar{v}_1-p_1<\bar{v}_2-p_2 \text{ or if } \bar{v}_1-p_1=\bar{v}_2-p_2 \text{ and Product 2 is on the top of the list} \quad \text{(A2)}\end{cases}$$

The first-order condition and negative second-order derivatives suggest that the profit-maximizing prices are $p_1=\frac{a_2(24a_1+a_2+24\bar{v}_1+2\bar{v}_2)+\bar{v}_2^{\,2}}{48a_2}$ and $p_2=\frac{\bar{v}_2+a_2}{2}$ for (A1) and $p_1=\frac{\bar{v}_1+a_1}{2}$ and $p_2=\frac{a_1(a_1+24a_2+2\bar{v}_1+24\bar{v}_2)+\bar{v}_1^{\,2}}{48a_1}$ for (A2). We derive the optimal profit by analyzing three cases.

Case A1. If the profit-maximizing prices for (A1) fall in the region of $\bar{v}_1-p_1>\bar{v}_2-p_2$, that is, if $\frac{\bar{v}_1}{\bar{v}_2}>\frac{\frac{24a_1}{\bar{v}_2}-\frac{23a_2}{\bar{v}_2}+26+1/\frac{a_2}{\bar{v}_2}}{24}$, the firm will compare $\pi^1\left(\frac{a_2(24a_1+a_2+24\bar{v}_1+2\bar{v}_2)+\bar{v}_2^{\,2}}{48a_2},\frac{\bar{v}_2+a_2}{2}\right)_{(A1)}$ and $\max_{p_2>0}\pi^1(\bar{v}_1-\bar{v}_2+p_2,p_2)_{(A2)}$ to decide if it is profitable to induce explorative consumers to visit Product 2 first by setting $p_1=\bar{v}_1-\bar{v}_2+p_2$ and placing Product 2 on top, as in (A2).

After substituting $p_1=\bar{v}_1-\bar{v}_2+p_2$, $\pi^1(\bar{v}_1-\bar{v}_2+p_2,p_2)_{(A2)}$ is a function of p_2. The first-order condition and the negative second-order derivative suggest that the profit-maximizing price is $p_2=\frac{(3+\Omega_1)\bar{v}_2-5a_1-3a_2-\bar{v}_1}{3}$, where

$$\Omega_1=\sqrt{\left(\frac{5a_1}{\bar{v}_2}\right)^2+\frac{57a_1}{\bar{v}_2}\frac{a_2}{\bar{v}_2}+\left(\frac{3a_2}{\bar{v}_2}\right)^2+\frac{13a_1}{\bar{v}_2}\frac{\bar{v}_1}{\bar{v}_2}-\frac{3a_2}{\bar{v}_2}\frac{\bar{v}_1}{\bar{v}_2}+\left(\frac{\bar{v}_1}{\bar{v}_2}\right)^2-\frac{18a_1}{\bar{v}_2}}\,.$$

By substituting the optimal prices into the profit functions, we get

$$\frac{\pi^1\left(\frac{a_2(24a_1+a_2+24\bar{v}_1+2\bar{v}_2)+\bar{v}_2{}^2}{48a_2},\frac{\bar{v}_2+a_2}{2}\right)_{(A1)}}{\bar{v}_2}=\frac{\left(\frac{24a_1}{\bar{v}_2}\right)^2\left(\frac{a_2}{\bar{v}_2}\right)^2+\frac{48a_1a_2}{\bar{v}_2\ \bar{v}_2}\left(7\left(1+\frac{a_2}{\bar{v}_2}\right)^2+\frac{24a_2\bar{v}_1}{\bar{v}_2\ \bar{v}_2}\right)+\left(\left(\frac{a_2}{\bar{v}_2}\right)^2+1+\frac{2a_2}{\bar{v}_2}\left(1-\frac{12\bar{v}_1}{\bar{v}_2}\right)\right)^2}{\frac{6144a_1}{\bar{v}_2}\left(\frac{a_2}{\bar{v}_2}\right)^2} \tag{A3}$$

$$\frac{\max\limits_{p_2>0}\pi^1(\bar{v}_1-\bar{v}_2+p_2,p_2)_{(A2)}}{\bar{v}_2}=\frac{\frac{3a_2\bar{v}_1}{\bar{v}_2\ \bar{v}_2}\left(\frac{3\bar{v}_1}{\bar{v}_2}-2\Omega_1\right)-250\left(\frac{a_1}{\bar{v}_2}\right)^3-54\left(\frac{a_2}{\bar{v}_2}\right)^3+2\left(\frac{\bar{v}_1}{\bar{v}_2}\right)^2\left(\Omega_1-\frac{\bar{v}_1}{\bar{v}_2}\right)+\left(\frac{3a_2}{\bar{v}_2}\right)^2\left(\frac{3\bar{v}_1}{\bar{v}_2}+2\Omega_1\right)}{\frac{432a_1a_2}{\bar{v}_2\ \bar{v}_2}}+$$
$$\frac{5\left(\frac{a_1}{\bar{v}_2}\right)^2\left(10\Omega_1-\frac{171a_2}{\bar{v}_2}-\frac{39\bar{v}_1}{\bar{v}_2}+54\right)+\frac{a_1}{\bar{v}_2}\left(\left(\frac{13\bar{v}_1}{\bar{v}_2}-18\right)\left(2\Omega_1-\frac{3\bar{v}_1}{\bar{v}_2}\right)+6a_2\left(54-\frac{12\bar{v}_1}{\bar{v}_2}+19\Omega_1\right)-513\left(\frac{a_2}{\bar{v}_2}\right)^2\right)}{\frac{432a_1a_2}{\bar{v}_2\ \bar{v}_2}} \tag{A4}$$

The comparison of the two profits in (A3) and (A4) depends on $\frac{\bar{v}_1}{\bar{v}_2}$, $\frac{a_1}{\bar{v}_2}$, and $\frac{a_2}{\bar{v}_2}$. We are not able to solve for the closed-form solution, but for a given value of $\frac{a_2}{\bar{v}_2}=\frac{3}{2}$, we can prove that the difference between the two profits in (A3) and (A4) increases with $\frac{\bar{v}_1}{\bar{v}_2}$, and there exists a unique solution $\frac{\bar{v}_1}{\bar{v}_2}=\bar{Q}_{11}$ to the equation in which the two profits in (A3) and (A4) are equal, where $\bar{Q}_{11}$ is a function of $\frac{a_1}{\bar{v}_2}$. We can then summarize the optimal prices and profit as $p_1^*=\begin{cases}\frac{a_2(24a_1+a_2+24\bar{v}_1+2\bar{v}_2)+\bar{v}_2{}^2}{48a_2} & if\ \frac{\bar{v}_1}{\bar{v}_2}\geq\bar{Q}_{11}\\ \frac{2\bar{v}_1-5a_1-3a_2+\Omega_1\bar{v}_2}{3} & if\ \frac{\bar{v}_1}{\bar{v}_2}<\bar{Q}_{11}\end{cases}$, $p_2^*=\begin{cases}\frac{\bar{v}_2+a_2}{2} & if\ \frac{\bar{v}_1}{\bar{v}_2}\geq\bar{Q}_{11}\\ \frac{(3+\Omega_1)\bar{v}_2-5a_1-3a_2-\bar{v}_1}{3} & if\ \frac{\bar{v}_1}{\bar{v}_2}<\bar{Q}_{11}\end{cases}$, and $\pi^{1*}=\begin{cases}\pi^1(p_1^*,p_2^*)_{(A1)} & if\ \frac{\bar{v}_1}{\bar{v}_2}\geq\bar{Q}_{11}\\ \pi^1(\bar{v}_1-\bar{v}_2+p_2^*,p_2^*)_{(A2)} & if\ \frac{\bar{v}_1}{\bar{v}_2}<\bar{Q}_{11}\end{cases}$.

The explorative consumers' browsing behaviors under optimal prices are as follows: if $\frac{\bar{v}_1}{\bar{v}_2}\geq\bar{Q}_{11}$, $\bar{v}_1-p_1^*>\bar{v}_2-p_2^*$, so explorative consumers first visit Product 1; if $\frac{\bar{v}_1}{\bar{v}_2}<\bar{Q}_{11}$, $\bar{v}_1-p_1^*=\bar{v}_2-p_2^*$ and Product 2 is on the top of the product list, so explorative consumers first visit Product 2.

Case A2. If the profit-maximizing prices for (A2) fall in the region of $\bar{v}_1-p_1<\bar{v}_2-p_2$, that is, if $\frac{\bar{v}_1}{\bar{v}_2}<2\sqrt{\frac{6a_1}{\bar{v}_2}\left(\frac{8a_1}{\bar{v}_2}-\frac{a_2}{\bar{v}_2}+1\right)}-\frac{13a_1}{\bar{v}_2}$, the firm will compare $\pi^1\left(\frac{\bar{v}_1+a_1}{2},\frac{a_1(a_1+24a_2+2\bar{v}_1+24\bar{v}_2)+\bar{v}_1{}^2}{48a_1}\right)_{(A2)}$ and $\max\limits_{p_1>0}\pi^1(p_1,\bar{v}_2-\bar{v}_1+p_1)_{(A1)}$ to decide if it is profitable to induce explorative consumers to visit Product 1 first by setting $p_2=\bar{v}_2-\bar{v}_1+p_1$ and placing Product 1 on top, as in (A1).

By substituting $p_2=\bar{v}_2-\bar{v}_1+p_1$, we get $\pi^1(p_1,\bar{v}_2-\bar{v}_1+p_1)_{(A1)}$ as a function of p_1. The first-order condition and negative second-order derivative suggest that the profit-maximizing price is $p_1=\frac{3\bar{v}_1-5a_2-3a_1-(1-\Omega_2)\bar{v}_2}{3}$, where $\Omega_2=\sqrt{\left(\frac{5a_2}{\bar{v}_2}\right)^2+\frac{57a_1}{\bar{v}_2}\frac{a_2}{\bar{v}_2}+\left(\frac{3a_1}{\bar{v}_2}\right)^2+\frac{13a_2}{\bar{v}_2}-\frac{3a_1}{\bar{v}_2}+1-\frac{18a_2}{\bar{v}_2}\frac{\bar{v}_1}{\bar{v}_2}}$.

By substituting the optimal prices into the profit functions, we get

$$\frac{\pi^1\left(\frac{\bar{v}_1+a_1}{2},\frac{a_1(a_1+24a_2+2\bar{v}_1+24\bar{v}_2)+\bar{v}_1{}^2}{48a_1}\right)_{(A2)}}{\bar{v}_2}=\frac{\left(\frac{a_1}{\bar{v}_2}\right)^2\left(\frac{24a_2}{\bar{v}_2}\right)^2+\frac{48a_1a_2}{\bar{v}_2\ \bar{v}_2}\left(7\left(\frac{a_1}{\bar{v}_2}+\frac{\bar{v}_1}{\bar{v}_2}\right)^2+\frac{24a_1}{\bar{v}_2}\right)+\left(\left(\frac{a_1}{\bar{v}_2}\right)^2+\left(\frac{\bar{v}_1}{\bar{v}_2}\right)^2+\frac{2a_1}{\bar{v}_2}\left(\frac{\bar{v}_1}{\bar{v}_2}-12\right)\right)^2}{\frac{6144a_2}{\bar{v}_2}\left(\frac{a_1}{\bar{v}_2}\right)^2} \tag{A5}$$

$$\frac{\max\limits_{p_1>0}\pi^1(p_1,\bar{v}_2-\bar{v}_1+p_1)_{(A1)}}{\bar{v}_2}=\frac{\frac{3a_1}{\bar{v}_2}(3-2\Omega_2)-250\left(\frac{a_2}{\bar{v}_2}\right)^3-54\left(\frac{a_1}{\bar{v}_2}\right)^3+2(\Omega_2-1)+\left(\frac{3a_1}{\bar{v}_2}\right)^2(3+2\Omega_2)}{\frac{432a_1a_2}{\bar{v}_2\ \bar{v}_2}}+$$
$$\frac{5\left(\frac{a_2}{\bar{v}_2}\right)^2\left(10\Omega_2-\frac{171a_1}{\bar{v}_2}-39+\frac{54\bar{v}_1}{\bar{v}_2}\right)+\frac{a_2}{\bar{v}_2}\left(\left(13-\frac{18\bar{v}_1}{\bar{v}_2}\right)(-3+2\Omega_2)+6a_2\left(\frac{54\bar{v}_1}{\bar{v}_2}-12+19\Omega_2\right)-513\left(\frac{a_1}{\bar{v}_2}\right)^2\right)}{\frac{432a_1a_2}{\bar{v}_2\ \bar{v}_2}} \tag{A6}$$

We can prove that there is no solution to the equation in which the two profits in (A5) and (A6) are equal; the profit in (A6) is always higher. We can then summarize the optimal prices and profit as $p_1^* = \frac{3\bar{v}_1 - 5a_2 - 3a_1 - (1-\Omega_2)\bar{v}_2}{3}$, $p_2^* = \frac{(2+\Omega_2)\bar{v}_2 - 5a_2 - 3a_1}{3}$, and $\pi^{1^*} = \pi^1(p_1^*, \bar{v}_2 - \bar{v}_1 + p_1^*)_{(\mathrm{A1})}$. With optimal prices, $\bar{v}_1 - p_1^* = \bar{v}_2 - p_2^*$ and Product 1 is placed on the top of the list, so explorative consumers first visit Product 1.

Case A3. If the profit-maximizing prices for (A1) do not fall in the region $\bar{v}_1 - p_1 > \bar{v}_2 - p_2$ and the profit-maximizing prices for (A2) do not fall in the region of $\bar{v}_1 - p_1 < \bar{v}_2 - p_2$, that is, if $2\sqrt{\frac{6a_1}{\bar{v}_2}\left(\frac{8a_1}{\bar{v}_2} - \frac{a_2}{\bar{v}_2} + 1\right)} - \frac{13a_1}{\bar{v}_2} \le \frac{\bar{v}_1}{\bar{v}_2} \le \frac{\frac{24a_1}{\bar{v}_2} - \frac{23a_2}{\bar{v}_2} + 26 + 1/\frac{a_2}{\bar{v}_2}}{24}$, the firm will compare $\max_{p_1>0} \pi^1(p_1, \bar{v}_2 - \bar{v}_1 + p_1)_{(\mathrm{A1})}$ and $\max_{p_2>0} \pi^1(\bar{v}_1 - \bar{v}_2 + p_2, p_2)_{(\mathrm{A2})}$ to decide if it is profitable to induce explorative consumers to buy Product 1 or Product 2, with the profits given by (A6) and (A4), respectively. Similar to Case A1, we can prove that there exists a unique solution $\frac{\bar{v}_1}{\bar{v}_2} = \bar{Q}_{12}$ to the equation in which the two profits in (A6) and (A4) are equal, where $\bar{Q}_{12}$ is a function of $\frac{a_1}{\bar{v}_2}$. We then summarize the optimal prices and profit as $p_1^* = \begin{cases} \frac{3\bar{v}_1 - 5a_2 - 3a_1 - (1-\Omega_2)\bar{v}_2}{3} & if\ \frac{\bar{v}_1}{\bar{v}_2} \ge \bar{Q}_{12} \\ \frac{2\bar{v}_1 - 5a_1 - 3a_2 + \Omega_1\bar{v}_2}{3} & if\ \frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}_{12} \end{cases}$, $p_2^* = \begin{cases} \frac{(2+\Omega_2)\bar{v}_2 - 5a_2 - 3a_1}{3} & if\ \frac{\bar{v}_1}{\bar{v}_2} \ge \bar{Q}_{12} \\ \frac{(3+\Omega_1)\bar{v}_2 - 5a_1 - 3a_2 - \bar{v}_1}{3} & if\ \frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}_{12} \end{cases}$, and $\pi^{1^*} = \begin{cases} \pi^1(p_1^*, \bar{v}_2 - \bar{v}_1 + p_1^*)_{(\mathrm{A1})} & if\ \frac{\bar{v}_1}{\bar{v}_2} \ge \bar{Q}_{12} \\ \pi^1(\bar{v}_1 - \bar{v}_2 + p_2^*, p_2^*)_{(\mathrm{A2})} & if\ \frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}_{12} \end{cases}$.

Explorative consumers' browsing behaviors under optimal prices are as follows: if $\frac{\bar{v}_1}{\bar{v}_2} \ge \bar{Q}_{12}$, $\bar{v}_1 - p_1^* = \bar{v}_2 - p_2^*$ and Product 1 is placed on the top of the list, so explorative consumers first visit Product 1; if $\frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}_{12}$, $\bar{v}_1 - p_1^* = \bar{v}_2 - p_2^*$ and Product 2 is placed on the top of the list, so explorative consumers first visit Product 2.

Combining Cases (A1–A3) yields Figure A1, which depicts the optimal profit in each parameter region of $\frac{a_1}{\bar{v}_2} \in (1,2)$ and $\frac{\bar{v}_1}{\bar{v}_2} \in \left(1, \frac{a_1}{\bar{v}_2}\right)$. We can summarize the optimal prices and profit as

$$p_1^* = \begin{cases} \frac{a_2(24a_1 + a_2 + 24\bar{v}_1 + 2\bar{v}_2) + \bar{v}_2^2}{48a_2} & if\ \frac{\bar{v}_1}{\bar{v}_2} \ge Max\left\{\bar{Q}_1, \frac{\frac{24a_1}{\bar{v}_2} - \frac{23a_2}{\bar{v}_2} + 26 + 1/\frac{a_2}{\bar{v}_2}}{24}\right\} \\ \frac{3\bar{v}_1 - 5a_2 - 3a_1 - (1-\Omega_2)\bar{v}_2}{3} & if\ \bar{Q}_1 \le \frac{\bar{v}_1}{\bar{v}_2} < \frac{\frac{24a_1}{\bar{v}_2} - \frac{23a_2}{\bar{v}_2} + 26 + 1/\frac{a_2}{\bar{v}_2}}{24} \\ \frac{2\bar{v}_1 - 5a_1 - 3a_2 + \Omega_1\bar{v}_2}{3} & if\ \frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}_1 \end{cases},$$

$$p_2^* = \begin{cases} \frac{\bar{v}_2 + a_2}{2} & if\ \frac{\bar{v}_1}{\bar{v}_2} \ge Max\left\{\bar{Q}_1, \frac{\frac{24a_1}{\bar{v}_2} - \frac{23a_2}{\bar{v}_2} + 26 + 1/\frac{a_2}{\bar{v}_2}}{24}\right\} \\ \frac{(2+\Omega_2)\bar{v}_2 - 5a_2 - 3a_1}{3} & if\ \bar{Q}_1 \le \frac{\bar{v}_1}{\bar{v}_2} < \frac{\frac{24a_1}{\bar{v}_2} - \frac{23a_2}{\bar{v}_2} + 26 + 1/\frac{a_2}{\bar{v}_2}}{24} \\ \frac{(3+\Omega_1)\bar{v}_2 - 5a_1 - 3a_2 - \bar{v}_1}{3} & if\ \frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}_1 \end{cases}, \text{ and}$$

$$\pi^{1^*} = \begin{cases} \pi^1(p_1^*, p_2^*)_{(\mathrm{A1})} & if\ \frac{\bar{v}_1}{\bar{v}_2} \ge Max\left\{\bar{Q}_1, \frac{\frac{24a_1}{\bar{v}_2} - \frac{23a_2}{\bar{v}_2} + 26 + \frac{1}{\frac{a_2}{\bar{v}_2}}}{24}\right\}\ (Area\ II\ in\ Figure\ A1) \\ \pi^1(p_1^*, \bar{v}_2 - \bar{v}_1 + p_1^*)_{(\mathrm{A1})} & if\ \bar{Q}_1 \le \frac{\bar{v}_1}{\bar{v}_2} < \frac{\frac{24a_1}{\bar{v}_2} - \frac{23a_2}{\bar{v}_2} + 26 + \frac{1}{\frac{a_2}{\bar{v}_2}}}{24}\ (Area\ III\ in\ Figure\ A1) \\ \pi^1(\bar{v}_1 - \bar{v}_2 + p_2^*, p_2^*)_{(\mathrm{A2})} & if\ \frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}_1\ (Area\ I\ in\ Figure\ A1) \end{cases},$$

$$where\ \bar{Q}_1 = \begin{cases} \bar{Q}_{11} & if\ \frac{\bar{v}_1}{\bar{v}_2} \geq \frac{\frac{24a_1}{\bar{v}_2} - \frac{23a_2}{\bar{v}_2} + 26 + 1/\frac{a_2}{\bar{v}_2}}{24} \\ \bar{Q}_{12} & if\ \frac{\bar{v}_1}{\bar{v}_2} < \frac{\frac{24a_1}{\bar{v}_2} - \frac{23a_2}{\bar{v}_2} + 26 + 1/\frac{a_2}{\bar{v}_2}}{24} \end{cases}.$$

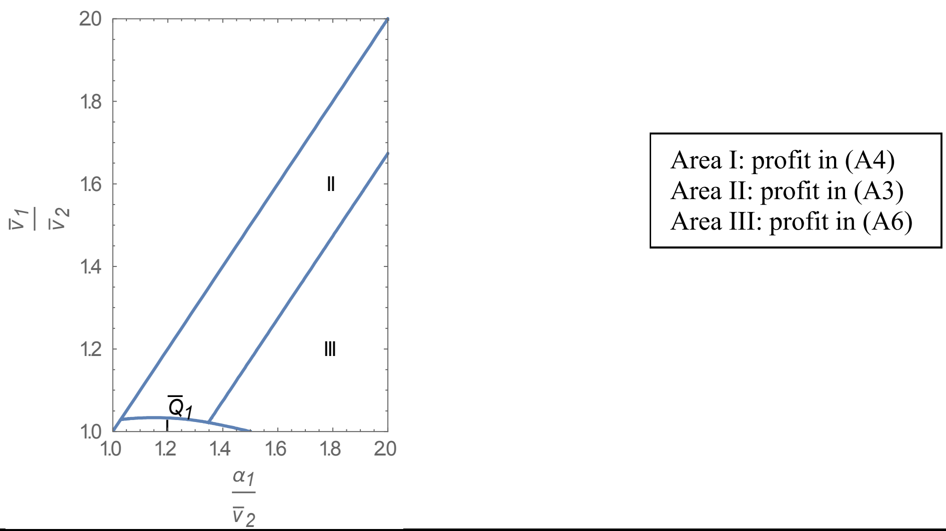


Figure A1. Optimal Profit under Revealing Policy

In all cases, the firm will not find it profitable to deviate to selling only one product if we restrict $\frac{a_1}{\bar{v}_2} < 2$. If the firm sells only one product, its profit either equals $\frac{3}{4}p_1\frac{\bar{v}_1+a_1-p_1}{2a_1}$, with p_1 replaced by $\frac{\bar{v}_1+a_1}{2}$, or it equals $\frac{3}{4}p_2\frac{\bar{v}_2+a_2-p_2}{2a_2}$, with p_2 replaced by $\frac{\bar{v}_2+a_2}{2}$. These values are always smaller than the optimal profits given $\frac{a_1}{\bar{v}_2} < 2$.

Appendix B

Derivation of Optimal Profit under the Non-Revealing Policy

The profit function of the firm under the non-revealing policy is

$$\pi^2(p_1, p_2) = \begin{cases} \left(\begin{array}{c} \frac{3}{4}p_1\frac{\bar{v}_1+a_1-p_1}{2a_1} + \frac{1}{4}p_2\frac{\bar{v}_2+a_2-p_2}{2a_2} \\ +\frac{1}{2}\left(\frac{1}{2}\left(1 - \frac{\bar{v}_1+a_1-p_1}{2a_1}\right)\right)p_2\frac{\bar{v}_2+a_2-p_2}{2a_2} \end{array} \right) & \begin{array}{c} if\ p_1 < p_2\ or \\ if\ p_1 = p_2 \text{ and Product 1} \\ \text{is on the top of the list} \end{array} \quad \text{(B1)} \\ \left(\begin{array}{c} \frac{1}{4}p_1\frac{\bar{v}_1+a_1-p_1}{2a_1} + \frac{3}{4}p_2\frac{\bar{v}_2+a_2-p_2}{2a_2} \\ +\frac{1}{2}\left(\frac{1}{2}\left(1 - \frac{\bar{v}_2+a_2-p_2}{2a_2}\right)\right)p_1\frac{\bar{v}_1+a_1-p_1}{2a_1} \end{array} \right) & \begin{array}{c} if\ p_1 > p_2\ or \\ if\ p_1 = p_2 \text{ and Product 2} \\ \text{is on the top of the list} \end{array} \quad \text{(B2)} \end{cases}$$

Because the profit functions are the same as in (A1) and (A2) in Appendix A, except for the boundary conditions, we get the same profit-maximizing prices: $p_1 = \frac{a_2(24a_1+a_2+24\bar{v}_1+2\bar{v}_2)+\bar{v}_2^2}{48a_2}$ and $p_2 = \frac{\bar{v}_2+a_2}{2}$ for (B1) and $p_1 = \frac{\bar{v}_1+a_1}{2}$ and $p_2 = \frac{a_1(a_1+24a_2+2\bar{v}_1+24\bar{v}_2)+\bar{v}_1^2}{48a_1}$ for (B2). We then derive the optimal profit by analyzing three cases.

Case B1. If the profit-maximizing prices for (B1) fall in the region of $p_1 < p_2$, that is, if $\frac{\bar{v}_1}{\bar{v}_2} < \frac{\frac{23a_2}{\bar{v}_2}-\frac{24a_1}{\bar{v}_2}+22-\frac{1}{\frac{a_2}{\bar{v}_2}}}{24}$, the firm will compare $\pi^2\left(\frac{a_2(24a_1+a_2+24\bar{v}_1+2\bar{v}_2)+\bar{v}_2^2}{48a_2}, \frac{\bar{v}_2+a_2}{2}\right)_{(\mathrm{B1})}$ and $\max_{p_2>0} \pi^2(p_2,p_2)_{(\mathrm{B2})}$ to decide if it is profitable to induce explorative consumers to buy Product 2 by setting $p_1 = p_2$ and placing Product 2 on top, as in (B2).

After substituting $p_1 = p_2$, $\pi^1(p_2,p_2)_{(\mathrm{B2})}$ is a function of p_2. The first-order condition and the negative second-order derivative suggest a profit-maximizing price: $p_2 = \frac{(1+\Omega_3)\bar{v}_2-5a_1-3a_2+\bar{v}_1}{3}$, where $\Omega_3 = \sqrt{\left(\frac{5a_1}{\bar{v}_2}\right)^2+\frac{57a_1}{\bar{v}_2}\frac{a_2}{\bar{v}_2}+\left(\frac{3a_2}{\bar{v}_2}\right)^2-\frac{10a_1}{\bar{v}_2}\frac{\bar{v}_1}{\bar{v}_2}+\frac{3a_2}{\bar{v}_2}\frac{\bar{v}_1}{\bar{v}_2}+\left(\frac{\bar{v}_1}{\bar{v}_2}\right)^2+\frac{5a_1}{\bar{v}_2}-\frac{6a_2}{\bar{v}_2}-\frac{\bar{v}_1}{\bar{v}_2}+1}$.

By substituting the optimal prices into the profit functions, we get

$$\frac{\pi^2\left(\frac{a_2(24a_1+a_2+24\bar{v}_1+2\bar{v}_2)+\bar{v}_2^2}{48a_2}, \frac{\bar{v}_2+a_2}{2}\right)_{(\mathrm{B1})}}{\bar{v}_2} = \frac{\left(\frac{24a_1}{\bar{v}_2}\right)^2\left(\frac{a_2}{\bar{v}_2}\right)^2+\frac{48a_1}{\bar{v}_2}\frac{a_2}{\bar{v}_2}\left(7\left(1+\frac{a_2}{\bar{v}_2}\right)^2+\frac{24a_2}{\bar{v}_2}\frac{\bar{v}_1}{\bar{v}_2}\right)+\left(\left(\frac{a_2}{\bar{v}_2}\right)^2+1+\frac{2a_2}{\bar{v}_2}\left(1-\frac{12\bar{v}_1}{\bar{v}_2}\right)\right)^2}{\frac{6144a_1}{\bar{v}_2}\left(\frac{a_2}{\bar{v}_2}\right)^2} \tag{B3}$$

$$\frac{\max_{p_2>0}\pi^2(p_2,p_2)_{(\mathrm{B2})}}{\bar{v}_2} = \frac{\left(1+\Omega_3-\frac{5a_1}{\bar{v}_2}-\frac{3a_2}{\bar{v}_2}+\frac{\bar{v}_1}{\bar{v}_2}\right)\left(50\left(\frac{a_1}{\bar{v}_2}\right)^2+\left(\frac{3a_2}{\bar{v}_2}+\frac{2\bar{v}_1}{\bar{v}_2}-1-\Omega_3\right)\left(\frac{6a_2}{\bar{v}_2}+\frac{\bar{v}_1}{\bar{v}_2}-2+\Omega_3\right)+\frac{a_1}{\bar{v}_2}\left(\frac{141a_2}{\bar{v}_2}-\frac{20\bar{v}_1}{\bar{v}_2}+25-5\Omega_3\right)\right)}{\frac{432a_1}{\bar{v}_2}\frac{a_2}{\bar{v}_2}} \tag{B4}$$

To compare the two profits in (B3) and (B4), as in Appendix A, for a given value of $\frac{a_2}{\bar{v}_2} = \frac{3}{2}$, we can prove that there exists a unique solution $\frac{\bar{v}_1}{\bar{v}_2} = \bar{Q}_{21}$ to the equation in which the two profits in (B3) and (B4) are equal, where $\bar{Q}_{21}$ is a function of $\frac{a_1}{\bar{v}_2}$, and we can summarize the optimal prices and profit: $p_1^* = \begin{cases} \frac{a_2(24a_1+a_2+24\bar{v}_1+2\bar{v}_2)+\bar{v}_2^2}{48a_2} & if\ \frac{\bar{v}_1}{\bar{v}_2} \geq \bar{Q}_{21} \\ \frac{(1+\Omega_3)\bar{v}_2-5a_1-3a_2+\bar{v}_1}{3} & if\ \frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}_{21} \end{cases}$, $p_2^* = \begin{cases} \frac{\bar{v}_2+a_2}{2} & if\ \frac{\bar{v}_1}{\bar{v}_2} \geq \bar{Q}_{21} \\ \frac{(1+\Omega_3)\bar{v}_2-5a_1-3a_2+\bar{v}_1}{3} & if\ \frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}_{21} \end{cases}$, and $\pi^{2^*} = \begin{cases} \pi^2(p_1^*,p_2^*)_{(\mathrm{B1})} & if\ \frac{\bar{v}_1}{\bar{v}_2} \geq \bar{Q}_{21} \\ \pi^2(p_2^*,p_2^*)_{(\mathrm{B2})} & if\ \frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}_{21} \end{cases}$.

Explorative consumers' browsing behaviors under optimal prices are as follows: if $\frac{\bar{v}_1}{\bar{v}_2} \geq \bar{Q}_{21}$, $p_1^* < p_2^*$, so explorative consumers first visit Product 1; if $\frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}_{11}$, $p_1^* = p_2^*$, and Product 2 is placed on the top, so explorative consumers first visit Product 2.

Case B2. If the profit-maximizing prices for (B2) fall in the region of $p_1 > p_2$, that is, if $\frac{\bar{v}_1}{\bar{v}_2} > \frac{11a_1}{\bar{v}_2} - 2\sqrt{\frac{6a_1}{\bar{v}_2}\left(\frac{6a_1}{\bar{v}_2}-\frac{a_2}{\bar{v}_2}-1\right)}$, the firm will compare $\pi^2\left(\frac{\bar{v}_1+a_1}{2}, \frac{a_1(a_1+24a_2+2\bar{v}_1+24\bar{v}_2)+\bar{v}_1^2}{48a_1}\right)_{(\mathrm{B2})}$ and $\max_{p_1>0}\pi^2(p_1,p_1)_{(\mathrm{B1})}$ to decide if it is profitable to induce explorative consumers to buy Product 1 by setting $p_2 = p_1$ and placing Product 1 on top, as in (B1).

After substituting $p_2 = p_1$, $\pi^2(p_1,p_1)_{(\mathrm{B1})}$ is a function of p_1. The first-order condition and the negative second-order derivative suggest a profit-maximizing price: $p_1 = \frac{(1+\Omega_4)\bar{v}_2-5a_2-3a_1+\bar{v}_1}{3}$, where $\Omega_4 =$

$$\sqrt{\left(\frac{5a_2}{\bar{v}_2}\right)^2+\frac{57a_1}{\bar{v}_2}\frac{a_2}{\bar{v}_2}+\left(\frac{3a_1}{\bar{v}_2}\right)^2-\frac{10a_2}{\bar{v}_2}+\frac{3a_1}{\bar{v}_2}+\left(\frac{\bar{v}_1}{\bar{v}_2}\right)^2+\frac{5a_2}{\bar{v}_2}\frac{\bar{v}_1}{\bar{v}_2}-\frac{6a_1}{\bar{v}_2}\frac{\bar{v}_1}{\bar{v}_2}-\frac{\bar{v}_1}{\bar{v}_2}+1}.$$

By substituting the optimal prices into the profit functions, we get

$$\frac{\pi^2\left(\frac{\bar{v}_1+a_1}{2},\frac{a_1(a_1+24a_2+2\bar{v}_1+24\bar{v}_2)+\bar{v}_1{}^2}{48a_1}\right)_{(\mathrm{B2})}}{\bar{v}_2}=\frac{\left(\frac{24a_1}{\bar{v}_2}\right)^2\left(\frac{a_2}{\bar{v}_2}\right)^2+\frac{48a_1}{\bar{v}_2}\frac{a_2}{\bar{v}_2}\left(7\left(\frac{a_1}{\bar{v}_2}+\frac{\bar{v}_1}{\bar{v}_2}\right)^2+\frac{24a_1}{\bar{v}_2}\right)+\left(\left(\frac{a_1}{\bar{v}_2}\right)^2+\left(\frac{\bar{v}_1}{\bar{v}_2}\right)^2+\frac{2a_1}{\bar{v}_2}\left(\frac{\bar{v}_1}{\bar{v}_2}-12\right)\right)^2}{\frac{6144a_2}{\bar{v}_2}\left(\frac{a_1}{\bar{v}_2}\right)^2} \tag{B5}$$

$$\frac{\max_{p_1>0}\pi^2(p_1,p_1)_{(\mathrm{B1})}}{\bar{v}_2}=\frac{\left(1+\Omega_4-\frac{3a_1}{\bar{v}_2}-\frac{5a_2}{\bar{v}_2}+\frac{\bar{v}_1}{\bar{v}_2}\right)\left(50\left(\frac{a_2}{\bar{v}_2}\right)^2+\left(\frac{3a_1}{\bar{v}_2}-\frac{\bar{v}_1}{\bar{v}_2}+2-\Omega_4\right)\left(\frac{6a_1}{\bar{v}_2}-\frac{2\bar{v}_1}{\bar{v}_2}+1+\Omega_4\right)+\frac{a_2}{\bar{v}_2}\left(\frac{141a_1}{\bar{v}_2}+\frac{25\bar{v}_1}{\bar{v}_2}-20-5\Omega_4\right)\right)}{\frac{432a_1}{\bar{v}_2}\frac{a_2}{\bar{v}_2}} \tag{B6}$$

We can prove that there is no solution to the equation in which the two profits in (B5) and (B6) are equal; the profit in (B6) is always higher. We thus summarize the optimal prices and profit as $p_1^*=\frac{(1+\Omega_4)\bar{v}_2-5a_2-3a_1+\bar{v}_1}{3}$, $p_2^*=\frac{(1+\Omega_4)\bar{v}_2-5a_2-3a_1+\bar{v}_1}{3}$, and $\pi^{2^*}=\pi^2(p_1^*,p_1^*)_{(\mathrm{B1})}$. With optimal prices, $p_1^*=p_2^*$, and Product 1 is at the top of the list, so explorative consumers first visit Product 1.

Case B3. If the profit-maximizing prices for (B1) do not fall in the region of $p_1<p_2$ and the profit-maximizing prices for (B2) do not fall in the region of $p_1>p_2$, that is, if $\frac{\frac{23a_2}{\bar{v}_2}-\frac{24a_1}{\bar{v}_2}+22-1/\frac{a_2}{\bar{v}_2}}{24}\le\frac{\bar{v}_1}{\bar{v}_2}\le\frac{11a_1}{\bar{v}_2}-2\sqrt{\frac{6a_1}{\bar{v}_2}\left(\frac{6a_1}{\bar{v}_2}-\frac{a_2}{\bar{v}_2}-1\right)}$, the firm will compare $\max_{p_1>0}\pi^2(p_1,p_1)_{(\mathrm{B1})}$ and $\max_{p_2>0}\pi^2(p_2,p_2)_{(\mathrm{B2})}$ to decide if it is profitable to induce explorative consumers to buy Product 1 or Product 2, with the profits given by (B6) and (B4), respectively.

We can prove that there exists a unique solution $\frac{\bar{v}_1}{\bar{v}_2}=\bar{Q}_{22}$ to the equation in which the two profits in (B6) and (B4) are equal, where $\bar{Q}_{22}$ is a function of $\frac{a_1}{\bar{v}_2}$. Then the optimal prices and profit are $p_1^*=\begin{cases}\frac{(1+\Omega_4)\bar{v}_2-5a_2-3a_1+\bar{v}_1}{3} & if\ \frac{\bar{v}_1}{\bar{v}_2}\ge\bar{Q}_{22}\\ \frac{(1+\Omega_3)\bar{v}_2-5a_1-3a_2+\bar{v}_1}{3} & if\ \frac{\bar{v}_1}{\bar{v}_2}<\bar{Q}_{22}\end{cases}$, $p_2^*=\begin{cases}\frac{(1+\Omega_4)\bar{v}_2-5a_2-3a_1+\bar{v}_1}{3} & if\ \frac{\bar{v}_1}{\bar{v}_2}\ge\bar{Q}_{22}\\ \frac{(1+\Omega_3)\bar{v}_2-5a_1-3a_2+\bar{v}_1}{3} & if\ \frac{\bar{v}_1}{\bar{v}_2}<\bar{Q}_{22}\end{cases}$, and $\pi^{2^*}=\begin{cases}\pi^2(p_1^*,p_1^*)_{(\mathrm{B1})} & if\ \frac{\bar{v}_1}{\bar{v}_2}\ge\bar{Q}_{22}\\ \pi^2(p_2^*,p_2^*)_{(\mathrm{B2})} & if\ \frac{\bar{v}_1}{\bar{v}_2}<\bar{Q}_{22}\end{cases}$.

Explorative consumers' browsing behaviors under optimal prices are as follows: if $\frac{\bar{v}_1}{\bar{v}_2}\ge\bar{Q}_{22}$, $p_1^*=p_2^*$ and Product 1 is placed on the top of the list, so explorative consumers first visit Product 1; if $\frac{\bar{v}_1}{\bar{v}_2}<\bar{Q}_{22}$, $p_1^*=p_2^*$ and Product 2 is placed on the top of the list, so they first visit Product 2.

Combining Cases (B1–B3) yields Figure B1, depicting the optimal profit in each parameter region of $\frac{a_1}{\bar{v}_2}\in(1,2)$ and $\frac{\bar{v}_1}{\bar{v}_2}\in\left(1,\frac{a_1}{\bar{v}_2}\right)$. Accordingly, we summarize the optimal prices and profit as:

$$p_1^*=\begin{cases}\frac{(1+\Omega_4)\bar{v}_2-5a_2-3a_1+\bar{v}_1}{3} & if\ \frac{\bar{v}_1}{\bar{v}_2}\ge Max\left\{\bar{Q}_2,\frac{\frac{23a_2}{\bar{v}_2}-\frac{24a_1}{\bar{v}_2}+22-1/\frac{a_2}{\bar{v}_2}}{24}\right\}\\ \frac{a_2(24a_1+a_2+24\bar{v}_1+2\bar{v}_2)+\bar{v}_2{}^2}{48a_2} & if\ \bar{Q}_2\le\frac{\bar{v}_1}{\bar{v}_2}<\frac{\frac{23a_2}{\bar{v}_2}-\frac{24a_1}{\bar{v}_2}+22-1/\frac{a_2}{\bar{v}_2}}{24}\\ \frac{(1+\Omega_3)\bar{v}_2-5a_1-3a_2+\bar{v}_1}{3} & if\ \frac{\bar{v}_1}{\bar{v}_2}<\bar{Q}_2\end{cases},$$

$$p_2^* = \begin{cases} \frac{(1+\Omega_4)\bar{v}_2 - 5a_2 - 3a_1 + \bar{v}_1}{3} & if\ \frac{\bar{v}_1}{\bar{v}_2} \geq Max\left\{\bar{Q}_2, \frac{\frac{23a_2}{\bar{v}_2} - \frac{24a_1}{\bar{v}_2} + 22 - 1/\frac{a_2}{\bar{v}_2}}{24}\right\} \\ \frac{\bar{v}_2 + a_2}{2} & if\ \bar{Q}_2 \leq \frac{\bar{v}_1}{\bar{v}_2} < \frac{\frac{23a_2}{\bar{v}_2} - \frac{24a_1}{\bar{v}_2} + 22 - 1/\frac{a_2}{\bar{v}_2}}{24} \\ \frac{(1+\Omega_3)\bar{v}_2 - 5a_1 - 3a_2 + \bar{v}_1}{3} & if\ \frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}_2 \end{cases}, and$$

$$\pi^{2^*} = \begin{cases} \pi^2(p_1^*, p_1^*)_{(B1)} & if\ \frac{\bar{v}_1}{\bar{v}_2} \geq Max\left\{\bar{Q}_2, \frac{\frac{23a_2}{\bar{v}_2} - \frac{24a_1}{\bar{v}_2} + 22 - \frac{1}{\frac{a_2}{\bar{v}_2}}}{24}\right\} (Area\ III\ in\ Figure\ B1) \\ \pi^2(p_1^*, p_2^*)_{(B1)} & if\ \bar{Q}_2 \leq \frac{\bar{v}_1}{\bar{v}_2} < \frac{\frac{23a_2}{\bar{v}_2} - \frac{24a_1}{\bar{v}_2} + 22 - \frac{1}{\frac{a_2}{\bar{v}_2}}}{24} (Area\ II\ in\ Figure\ B1) \\ \pi^2(p_2^*, p_2^*)_{(B2)} & if\ \frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}_2\ (Area\ I\ in\ Figure\ B1) \end{cases},$$

$$where\ \bar{Q}_2 = \begin{cases} \bar{Q}_{21} & if\ \frac{\bar{v}_1}{\bar{v}_2} \geq \frac{\frac{23a_2}{\bar{v}_2} - \frac{24a_1}{\bar{v}_2} + 22 - 1/\frac{a_2}{\bar{v}_2}}{24} \\ \bar{Q}_{22} & if\ \frac{\bar{v}_1}{\bar{v}_2} < \frac{\frac{23a_2}{\bar{v}_2} - \frac{24a_1}{\bar{v}_2} + 22 - 1/\frac{a_2}{\bar{v}_2}}{24} \end{cases}.$$

In all cases, the firm will not find it profitable to deviate to selling only one product if we restrict $\frac{a_1}{\bar{v}_2} < 2$, which is the necessary condition to ensure that the firm will not find it profitable to deviate to selling only one product for all values of $\frac{a_2}{\bar{v}_2} > 1$. If the firm sells only one product, its profit either equals $\frac{3}{4}p_1\frac{\bar{v}_1 + a_1 - p_1}{2a_1}$ with p_1 replaced by $\frac{\bar{v}_1 + a_1}{2}$, or else it equals $\frac{3}{4}p_2\frac{\bar{v}_2 + a_2 - p_2}{2a_2}$ with p_2 replaced by $\frac{\bar{v}_2 + a_2}{2}$. They are always smaller than the optimal profits given $\frac{a_1}{\bar{v}_2} < 2$.

Under optimal prices, $p_1^* = p_2^*$ except in Area II in Figure B1. In Area II, the high quality product (Product 1) has the lower price, $p_1^* < p_2^*$, so it is optimal for consumers to visit the product with the lower price first. When $p_1^* = p_2^*$, in Area I, the firm places Product 2 on top. In Area III, the firm places Product 1 on top. The high-value product thus has a higher chance of being listed on top when $p_1^* = p_2^*$, and it is also optimal for consumers to visit the product shown on the top of the list when they observe that $p_1^* = p_2^*$. In this case, price cannot signal product value in a way (in contrast with our model assumption) that would induce consumers to visit first the product with a higher price or on bottom of the list if price is equal.

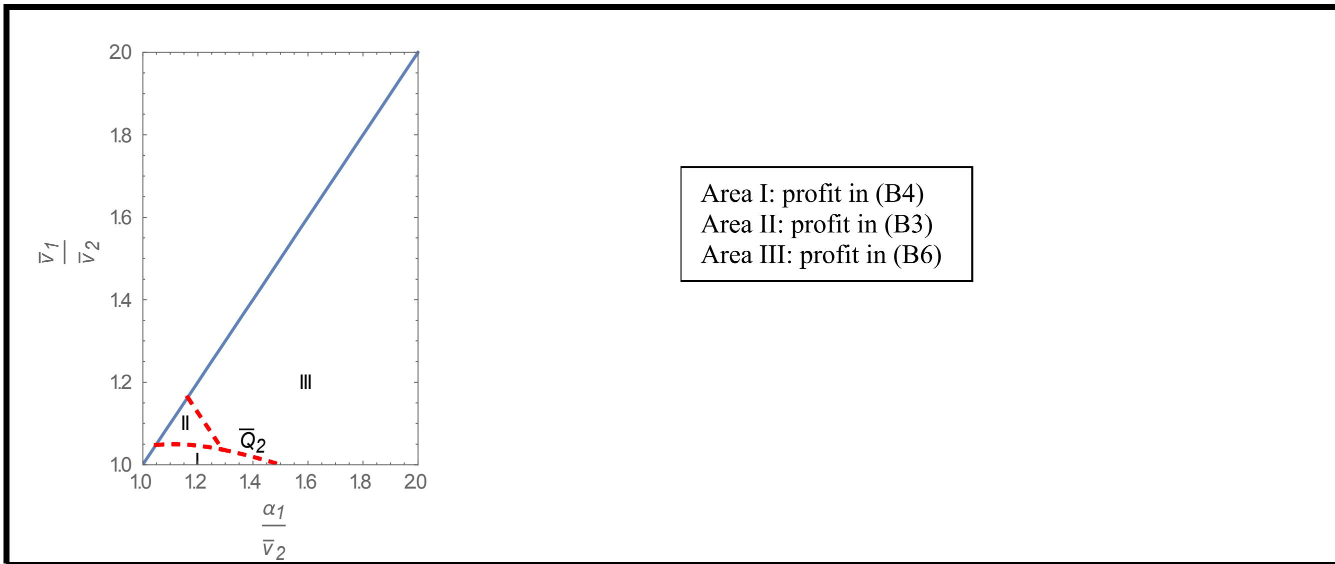


Figure B1. Optimal Profit under Non-Revealing Policy

Appendix C

Comparison of Revealing and Non-Revealing Policies

We compare π^1 and π^2 in Figure C1a, which combines Figure A1 and Figure B1. Figure C1b enlarges the lower left corner in Figure C1a to depict the boundaries more clearly. We compare π^1 and π^2 in each area in the parameter region of $\frac{a_1}{\bar{v}_2} \in (1,2)$ and $\frac{\bar{v}_1}{\bar{v}_2} \in \left(1, \frac{a_1}{\bar{v}_2}\right)$ in Figure C1. Specifically,

1. In Area I ($\frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}_1$), we compare the profit in (A4) in Area I of Figure A1 and the profit in (B4) in Area I of Figure B1; the profit in (B4) is always higher.
2. In Area II ($Max\left\{\bar{Q}_1, \frac{\frac{24a_1}{\bar{v}_2} - \frac{23a_2}{\bar{v}_2} + 26 + 1/\frac{a_2}{\bar{v}_2}}{24}\right\} \leq \frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}_2$), we compare the profit in (A3) in Area II of Figure A1 and the profit in (B4) in Area I of Figure B1; the profit in (B4) is higher if $\frac{\bar{v}_1}{\bar{v}_2} < Min\{\bar{Q}_2, \bar{Q}_{31}\}$, where $\bar{Q}_{31}$ is a function of $\frac{a_1}{\bar{v}_2}$ and is the solution to the equation in which the two profits in (A3) and (B4) are equal.
3. In Area III ($\bar{Q}_1 \leq \frac{\bar{v}_1}{\bar{v}_2} < Min\left\{\bar{Q}_2, \frac{\frac{24a_1}{\bar{v}_2} - \frac{23a_2}{\bar{v}_2} + 26 + 1/\frac{a_2}{\bar{v}_2}}{24}\right\}$), we compare the profit in (A6) in Area III of Figure A1 and the profit in (B4) in Area I of Figure B1 and find that the profit in (B4) is higher if $\frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}_{32}$, where $\bar{Q}_{32}$ is a function of $\frac{a_1}{\bar{v}_2}$ and is the solution to the equation in which the two profits in (A6) and (B4) are equal.
4. In Area IV ($\bar{Q}_2 \leq \frac{\bar{v}_1}{\bar{v}_2} < \frac{\frac{23a_2}{\bar{v}_2} - \frac{24a_1}{\bar{v}_2} + 22 - 1/\frac{a_2}{\bar{v}_2}}{24}$), we compare the profit in (A3) in Area II of Figure A1 and the profit in (B3) in Area II of Figure B1 and find that they are equal.
5. In Area V ($\frac{\bar{v}_1}{\bar{v}_2} \geq Max\left\{\frac{\frac{24a_1}{\bar{v}_2} - \frac{23a_2}{\bar{v}_2} + 26 + 1/\frac{a_2}{\bar{v}_2}}{24}, \bar{Q}_2, \frac{\frac{23a_2}{\bar{v}_2} - \frac{24a_1}{\bar{v}_2} + 22 - 1/\frac{a_2}{\bar{v}_2}}{24}\right\}$), we compare the profit in (A3) in Area II of Figure A1 and the profit in (B6) in Area III of Figure B1; the profit in (A3) is always higher.
6. In Area VI ($\bar{Q}_2 \leq \frac{\bar{v}_1}{\bar{v}_2} < \frac{\frac{24a_1}{\bar{v}_2} - \frac{23a_2}{\bar{v}_2} + 26 + 1/\frac{a_2}{\bar{v}_2}}{24}$), we compare the profit in (A6) in Area III of Figure A1 and the profit in (B6) in Area III of Figure B1 and find that the profit in (A6) is always higher.

The result can thus be summarized as: ${\pi^1}^* \geq {\pi^2}^*$ if $\frac{\bar{v}_1}{\bar{v}_2} \geq \bar{Q}$, and ${\pi^1}^* < {\pi^2}^*$ if $\frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}$, where $\bar{Q} = \begin{cases} Min\{\bar{Q}_2, \bar{Q}_{31}\} & if\ \frac{\bar{v}_1}{\bar{v}_2} \geq \frac{\frac{24a_1}{\bar{v}_2} - \frac{23a_2}{\bar{v}_2} + 26 + 1/\frac{a_2}{\bar{v}_2}}{24} \\ \bar{Q}_{32} & if\ \frac{\bar{v}_1}{\bar{v}_2} < \frac{\frac{24a_1}{\bar{v}_2} - \frac{23a_2}{\bar{v}_2} + 26 + 1/\frac{a_2}{\bar{v}_2}}{24} \end{cases}$. The result is shown in Figure C2: ${\pi^1}^* < {\pi^2}^*$ in the dark gray area ($\frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}$) and ${\pi^1}^* \geq {\pi^2}^*$ in the light gray area ($\frac{\bar{v}_1}{\bar{v}_2} \geq \bar{Q}$). The dark gray area appears only if $\frac{a_1}{\bar{v}_2} < \frac{a_2}{\bar{v}_2}$.

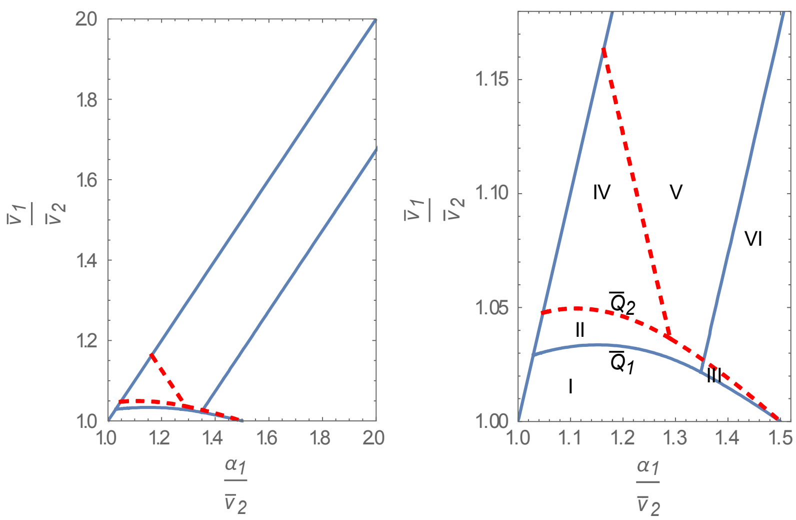
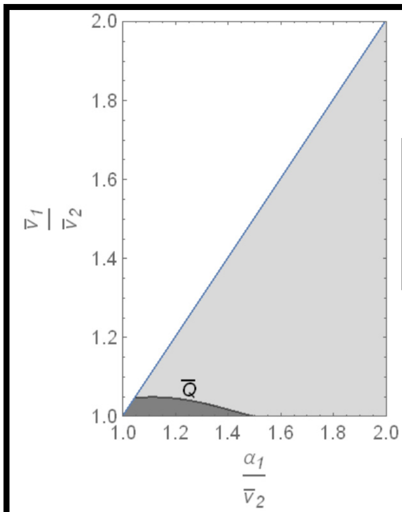


Figure C1a **Figure C1b**

Area I: profit in (A4) vs. profit in (B4)
Area II: profit in (A3) vs. profit in (B4)
Area III: profit in (A6) vs. profit in (B4)
Area IV: profit in (A3) vs. profit in (B3)
Area V: profit in (A3) vs. profit in (B6)
Area VI: profit in (A6) vs. profit in (B6)

Figure C1. Comparison between Revealing Policy and Non-Revealing Policy



In dark grey area, non-revealing policy is more profitable for the firm; in light grey area, revealing policy is (weakly) more profitable.

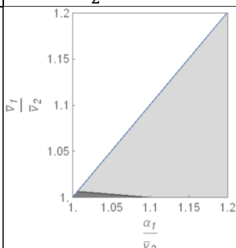
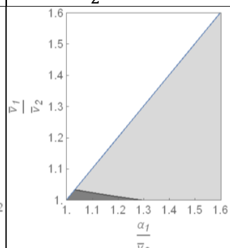
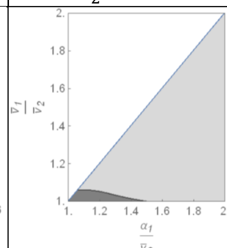
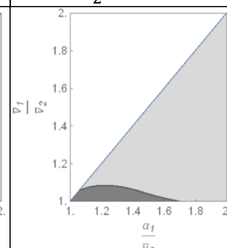
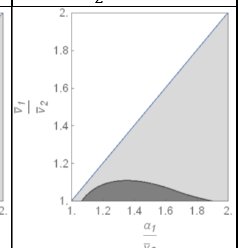
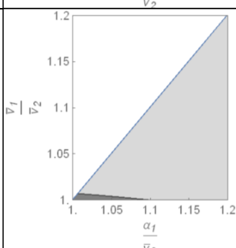
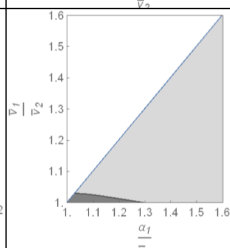
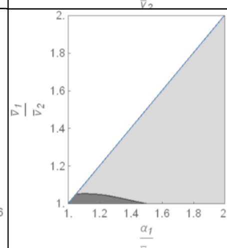
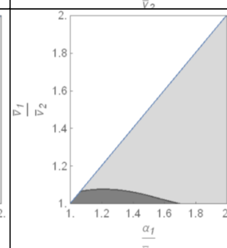
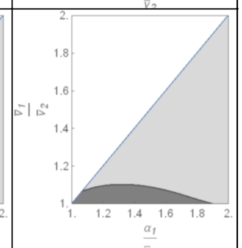
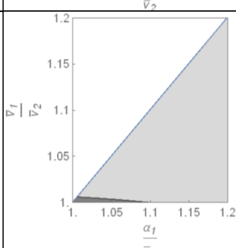
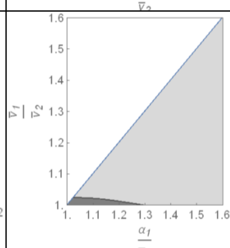
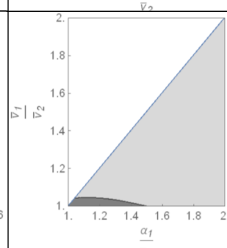
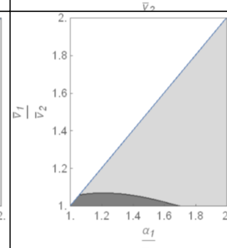
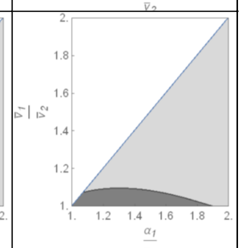
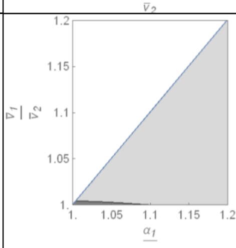
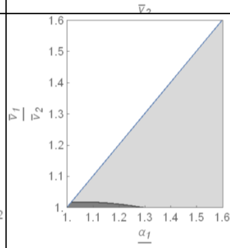
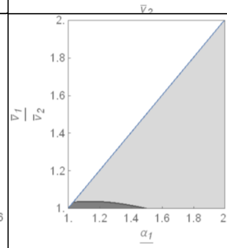
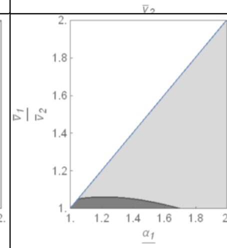
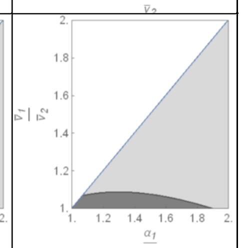
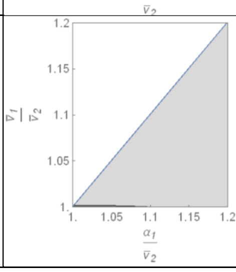
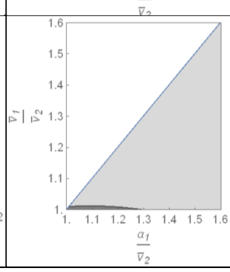
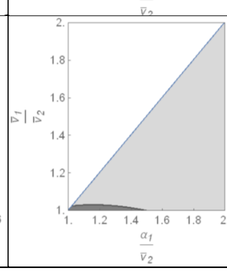
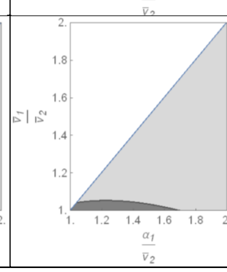
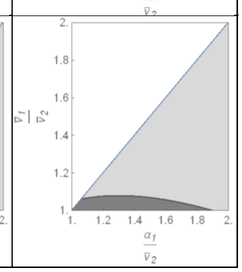
Figure C2. Comparison between Revealing and Non-Revealing Policies

Appendix D

Sensitivity Analysis

We repeat our analysis in Appendices A–C for different values of $k \in (0,1]$ and $\frac{a_2}{\bar{v}_2} \in (1,2)$, and we reproduce Figure C2 for each combination of k and $\frac{a_2}{\bar{v}_2}$. Some key results are listed in Table D1, showing that our result is robust to different values of k and $\frac{a_2}{\bar{v}_2}$.

Table D1. Comparison between Revealing Policy and Non-Revealing Policy

	$\frac{a_2}{\bar{v}_2} = 1.1$	$\frac{a_2}{\bar{v}_2} = 1.3$	$\frac{a_2}{\bar{v}_2} = 1.5$	$\frac{a_2}{\bar{v}_2} = 1.7$	$\frac{a_2}{\bar{v}_2} = 1.9$
$k = 0.2$					
$k = 0.4$					
$k = 0.6$					
$k = 0.8$					
$k = 1$					

Notes: In dark grey area, the non-revealing policy is more profitable for the firm; in light grey area, the revealing policy is (weakly) more profitable. In the first two columns, the range of the horizontal axes is reduced to improve visibility.

Appendix E

Model Extension: Third-Party Control of Prices [redacted]

Revealing Policy

The profit functions of the third-party sellers (S1 and S2) under the revealing policy are

$$\pi_{S1}^1(p_1) = \begin{cases} (1-\beta)\left(\frac{1}{4}+\frac{1}{2}\right)p_1\frac{\bar{v}_1+a_1-p_1}{2a_1} & \begin{array}{c} if\ \bar{v}_1-p_1>\bar{v}_2-p_2\ or \\ if\ \bar{v}_1-p_1=\bar{v}_2-p_2 \text{ and Product 1} \\ \text{is on the top of the list} \end{array} \quad \text{(E1)} \\ (1-\beta)\frac{1}{4}p_1\frac{\bar{v}_1+a_1-p_1}{2a_1} & \begin{array}{c} if\ \bar{v}_1-p_1<\bar{v}_2-p_2\ or \\ if\ \bar{v}_1-p_1=\bar{v}_2-p_2 \text{ and Product 2} \\ \text{is on the top of the list} \end{array} \quad \text{(E2)} \end{cases}$$

$$\pi_{S2}^1(p_2) = \begin{cases} (1-\beta)\frac{1}{4}p_2\frac{\bar{v}_2+a_2-p_2}{2a_2} & \begin{array}{c} if\ \bar{v}_1-p_1>\bar{v}_2-p_2\ or \\ if\ \bar{v}_1-p_1=\bar{v}_2-p_2 \text{ and Product 1} \\ \text{is on the top of the list} \end{array} \quad \text{(E3)} \\ (1-\beta)\left(\frac{1}{4}+\frac{1}{2}\right)p_2\frac{\bar{v}_2+a_2-p_2}{2a_2} & \begin{array}{c} if\ \bar{v}_1-p_1<\bar{v}_2-p_2\ or \\ if\ \bar{v}_1-p_1=\bar{v}_2-p_2 \text{ and Product 2} \\ \text{is on the top of the list} \end{array} \quad \text{(E4)} \end{cases}$$

The profit of the firm that owns the website under the revealing policy is $\pi^1 = \frac{\beta}{1-\beta}\left(\pi_{S1}^1(p_1)+\pi_{S2}^1(p_2)\right)$.

Seller 1 selects p_1, and Seller 2 selects p_2 simultaneously to maximize their own profits. The first-order condition and the negative second-order derivatives suggest that the profit-maximizing prices are $p_1 = \frac{\bar{v}_1+a_1}{2}$ and $p_2 = \frac{\bar{v}_2+a_2}{2}$. Note that $\bar{v}_1-p_1=\bar{v}_2-p_2$ can never be the equilibrium, because the seller of the product not shown on the top of the list could always lower its price by a very small amount (ε) and increase its profit. We thus derive the equilibrium by analyzing two cases.

Case E1. If the profit-maximizing prices for (E1) and (E3) fall in the region of $\bar{v}_1-p_1>\bar{v}_2-p_2$, that is, if $\frac{\bar{v}_1}{\bar{v}_2}>1+\frac{a_1}{\bar{v}_2}-\frac{a_2}{\bar{v}_2}$, Seller 2 will compare $\pi_{S2}^1\left(\frac{\bar{v}_2+a_2}{2}\right)_{(E3)}$ and $\pi_{S2}^1\left(\bar{v}_2-\bar{v}_1+\frac{\bar{v}_1+a_1}{2}-\varepsilon\right)_{(\text{E4})}$ to decide if it is profitable to deviate by undercutting Seller 1 to induce explorative consumers to buy Product 2. Given $1+\frac{a_1}{\bar{v}_2}-\frac{a_2}{\bar{v}_2}<\frac{\bar{v}_1}{\bar{v}_2}<\frac{a_1}{\bar{v}_2}$, $\pi_{S2}^1\left(\bar{v}_2-\bar{v}_1+\frac{\bar{v}_1+a_1}{2}-\varepsilon\right)_{(\text{E4})}$ is always larger. Therefore, Seller 2 will undercut Seller 1 to attract consumers to visit Product 2, and Seller 1 will respond by lowering Product 1's price to prevent it from happening. The resulting mixed strategy equilibrium can be derived as follows. Let pn_1 be the lowest price of Seller 1 that Seller 2 is willing to undercut. Depending on whether there is probability mass at $\frac{\bar{v}_2+a_2}{2}$ in Seller 2's price support, there are two possible equilibriums:

1) Seller 1's price support is $(pn_1, \frac{\bar{v}_1+a_1}{2}]$ with probability mass at $\frac{\bar{v}_1+a_1}{2}$; Seller 2's price support is $(pn_1+\bar{v}_2-\bar{v}_1, \frac{\bar{v}_1+a_1}{2}+\bar{v}_2-\bar{v}_1)\cup\frac{\bar{v}_2+a_2}{2}$ with probability mass at $\frac{\bar{v}_2+a_2}{2}$.
2) Seller 1's price support is $(pn_1, \frac{\bar{v}_1+a_1}{2}]$ with probability mass at $\frac{\bar{v}_1+a_1}{2}$; Seller 2's price support is $(pn_1+\bar{v}_2-\bar{v}_1, \frac{\bar{v}_1+a_1}{2}+\bar{v}_2-\bar{v}_1)$.

We define the cumulative density function as $G_j(p)=\Pr\{p_j\le p\}$. The profit-invariant nature of the mixed strategy equilibrium suggests the following equations:

$$\pi_{S1}^1(p_1)_{E1}\left(1-G_2(p_1+\bar{v}_2-\bar{v}_1)\right)+\pi_{S1}^1(p_1)_{E2}G_2(p_1+\bar{v}_2-\bar{v}_1)=\pi_{S1}^1(pn_1)_{E1} \quad \text{(E5)}$$

$$\pi_{S2}^1(p_2)_{E4}\left(1-G_1(p_2+\bar{v}_1-\bar{v}_2)\right)+\pi_{S2}^1(p_2)_{E3}G_1(p_2+\bar{v}_1-\bar{v}_2)=\pi_{S2}^1(pn_1+\bar{v}_2-\bar{v}_1)_{E4} \quad \text{(E6)}$$

For the first equilibrium, by replacing p_1 in (E5) with different values and replacing p_2 in (E6) with different values, we can derive

$$pn_1 = \frac{6\bar{v}_1-(3+\sqrt{6})\bar{v}_2+(3-\sqrt{6})a_2}{6}$$

$$G_1(p) = \begin{cases} 1 & if\ p = \frac{\bar{v}_1 + a_1}{2} \\ 1 - \frac{(2p + \bar{v}_2 - 2\bar{v}_1 - a_2)^2}{8(p + \bar{v}_2 - \bar{v}_1)(a_2 + \bar{v}_1 - p)} & if\ pn_1 < p < \frac{\bar{v}_1 + a_1}{2} \end{cases}$$

$$G_2(p) = \begin{cases} 1 & if\ p = \frac{\bar{v}_2 + a_2}{2} \\ \Gamma_1 & if\ pn_1 + \bar{v}_2 - \bar{v}_1 < p < \frac{\bar{v}_1 + a_1}{2} + \bar{v}_2 - \bar{v}_1 \end{cases}$$

where $\Gamma_1 = \frac{(5-2\sqrt{6})a_2^2 - 12p(p+\bar{v}_1-2\bar{v}_2) + 2(3-\sqrt{6})\bar{v}_1\bar{v}_2 - (7-2\sqrt{6})\bar{v}_2^2 - 2a_2(\bar{v}_2-(3-\sqrt{6})\bar{v}_1) + 2a_1(6p-(3-\sqrt{6})(a_2+\bar{v}_2))}{8(p+\bar{v}_1-\bar{v}_2)(a_1+\bar{v}_2-p)}$. The expected equilibrium profits are: $E[\pi_{S1}^{1\ *}] = \frac{(1-\beta)(6a_1+(3+\sqrt{6})\bar{v}_2-(3-\sqrt{6})a_2)(6\bar{v}_1-(3+\sqrt{6})\bar{v}_2+(3-\sqrt{6})a_2)}{96a_1}$ and $E[\pi_{S2}^{1\ *}] = \frac{(1-\beta)(\bar{v}_2+a_2)^2}{32a_2}$.

For the second equilibrium, after replacing p_1 in (E5) with different values and replacing p_2 in (E6) with different values, we find that the equilibrium does not exist. Therefore, the first equilibrium applies for $1 + \frac{a_1}{\bar{v}_2} - \frac{a_2}{\bar{v}_2} < \frac{\bar{v}_1}{\bar{v}_2} < \frac{a_1}{\bar{v}_2}$.

Because $1 + \frac{a_1}{\bar{v}_2} - \frac{a_2}{\bar{v}_2} \le 1$ if $a_1 \le a_2$, we can summarize the equilibrium in this case: If $a_1 \le a_2$ and $1 < \frac{\bar{v}_1}{\bar{v}_2} < \frac{a_1}{\bar{v}_2}$, or if $a_1 > a_2$ and $1 + \frac{a_1}{\bar{v}_2} - \frac{a_2}{\bar{v}_2} < \frac{\bar{v}_1}{\bar{v}_2} < \frac{a_1}{\bar{v}_2}$, $E[\pi_{S1}^{1\ *}] = \frac{(1-\beta)(6a_1+(3+\sqrt{6})\bar{v}_2-(3-\sqrt{6})a_2)(6\bar{v}_1-(3+\sqrt{6})\bar{v}_2+(3-\sqrt{6})a_2)}{96a_1}$ and $E[\pi_{S2}^{1\ *}] = \frac{(1-\beta)(\bar{v}_2+a_2)^2}{32a_2}$.

Case E2. If the profit-maximizing prices for (E2) and (E4) fall in the region of $\bar{v}_1 - p_1 < \bar{v}_2 - p_2$, that is, if $\frac{\bar{v}_1}{\bar{v}_2} < 1 + \frac{a_1}{\bar{v}_2} - \frac{a_2}{\bar{v}_2}$, Seller 1 will compare $\pi_{S1}^1\left(\frac{\bar{v}_1+a_1}{2}\right)_{(E2)}$ and $\pi_{S1}^1\left(\bar{v}_1 - \bar{v}_2 + \frac{\bar{v}_2+a_2}{2} - \varepsilon\right)_{(E1)}$ to decide if it is profitable to deviate by undercutting Seller 2 to induce explorative consumers to buy Product 1. This condition $\frac{\bar{v}_1}{\bar{v}_2} < 1 + \frac{a_1}{\bar{v}_2} - \frac{a_2}{\bar{v}_2}$ holds only if $a_1 > a_2$, and in this condition, $\pi_1^1\left(\bar{v}_1 - \bar{v}_2 + \frac{\bar{v}_2+a_2}{2} - \varepsilon\right)_{(E1)}$ is always larger. Therefore, Seller 1 will undercut Seller 2 to attract consumers to visit Product 1, and Seller 2 will respond by lowering Product 2's price to prevent it from happening. The mixed strategy equilibrium then can be derived as follows. Let pn_2 be the lowest price of Seller 2 that Seller 1 is willing to undercut. Depending on whether there is probability mass at $\frac{\bar{v}_1+a_1}{2}$ in Seller 1's price support, there are two possible equilibriums:

1) Seller 2's price support is $(pn_2, \frac{\bar{v}_2+a_2}{2}]$ with probability mass at $\frac{\bar{v}_2+a_2}{2}$; Seller 1's price support is $(pn_2 + \bar{v}_1 - \bar{v}_2, \frac{\bar{v}_2+a_2}{2} + \bar{v}_1 - \bar{v}_2) \cup \frac{\bar{v}_1+a_1}{2}$ with probability mass at $\frac{\bar{v}_1+a_1}{2}$.
2) Seller 2's price support is $(pn_2, \frac{\bar{v}_2+a_2}{2}]$ with probability mass at $\frac{\bar{v}_2+a_2}{2}$; Seller 1's price support is $(pn_2 + \bar{v}_1 - \bar{v}_2, \frac{\bar{v}_2+a_2}{2} + \bar{v}_1 - \bar{v}_2)$.

Define the cumulative density function as $M_j(p) = \Pr\{p_j <= p\}$. The profit-invariant nature of the mixed strategy equilibrium suggests the following equations:

$$\pi_1^1(p_1)_{E1}\big(1 - M_2(p_1 + \bar{v}_2 - \bar{v}_1)\big) + \pi_1^1(p_1)_{E2} M_2(p_1 + \bar{v}_2 - \bar{v}_1) = \pi_1^1(pn_2 + \bar{v}_1 - \bar{v}_2)_{E1} \tag{E7}$$

$$\pi_2^1(p_2)_{E4}\big(1 - M_1(p_2 + \bar{v}_1 - \bar{v}_2)\big) + \pi_2^1(p_2)_{E3} M_1(p_2 + \bar{v}_1 - \bar{v}_2) = \pi_2^1(pn_2)_{E4} \tag{E8}$$

For the first equilibrium, by replacing p_1 in (E7) with different values and replacing p_2 in (E8) with different values, we derive that

$$pn_2 = \frac{6\bar{v}_2 - (3+\sqrt{6})\bar{v}_1 + (3-\sqrt{6})a_1}{6}$$

$$M_1(p) = \begin{cases} 1 & if\ p = \frac{\bar{v}_1 + a_1}{2} \\ \Gamma_2 & if\ pn_2 + \bar{v}_1 - \bar{v}_2 < p < \frac{\bar{v}_2 + a_2}{2} + \bar{v}_1 - \bar{v}_2 \end{cases}$$

$$M_2(p) = \begin{cases} 1 & if\ p = \frac{\bar{v}_2 + a_2}{2} \\ 1 - \frac{(2p + \bar{v}_1 - 2\bar{v}_2 - a_1)^2}{8(p + \bar{v}_1 - \bar{v}_2)(a_1 + \bar{v}_2 - p)} & if\ pn_2 < p < \frac{\bar{v}_2 + a_2}{2} \end{cases}$$

where $\Gamma_2 = \frac{(5-2\sqrt{6})a_1^2-12p(p+\bar{v}_2-2\bar{v}_1)+2(3-\sqrt{6})\bar{v}_1\bar{v}_2-(7-2\sqrt{6})\bar{v}_1^2-2a_1(\bar{v}_1-(3-\sqrt{6})\bar{v}_2)+2a_2(6p-(3-\sqrt{6})(a_1+\bar{v}_1))}{8(p+\bar{v}_2-\bar{v}_1)(a_2+\bar{v}_1-p)}$. The expected equilibrium profits are $E[\pi_{S1}^{1\,*}] = \frac{(1-\beta)(\bar{v}_1+a_1)^2}{32a_1}$ and $E[\pi_{S2}^{1\,*}] = \frac{(1-\beta)(6a_2+(3+\sqrt{6})\bar{v}_2-(3-\sqrt{6})a_1)(6\bar{v}_2-(3+\sqrt{6})\bar{v}_1+(3-\sqrt{6})a_1)}{96a_2}$.

This equilibrium is valid only if $\frac{\bar{v}_1}{\bar{v}_2} < (5-2\sqrt{6})\left(\frac{a_1}{\bar{v}_2}-\frac{a_2}{\bar{v}_2}\right)+1$, which ensures that the cumulative density is always between 0 and 1.

For the second equilibrium, by replacing p_1 in (E7) with different values and replacing p_2 in (E8) with different values, we derive that

$$pn_2 = \frac{(3-\sqrt{6})(a_2+\bar{v}_2)}{6}$$
$$M_1(p) = \begin{cases} 1 & if\ p = \frac{\bar{v}_2+a_2}{2}+\bar{v}_1-\bar{v}_2 \\ 1-\frac{(2p+\bar{v}_1-2\bar{v}_2-a_1)^2}{8(p+\bar{v}_1-\bar{v}_2)(a_1+\bar{v}_2-p)} & if\ pn_2+\bar{v}_1-\bar{v}_2 < p < \frac{\bar{v}_2+a_2}{2}+\bar{v}_1-\bar{v}_2 \end{cases}$$
$$M_2(p) = \begin{cases} 1 & if\ p = \frac{\bar{v}_2+a_2}{2} \\ \Gamma_1 & if\ pn_2 < p < \frac{\bar{v}_2+a_2}{2} \end{cases}$$

The expected equilibrium profits are

$E[\pi_{S1}^{1\,*}] = \frac{(1-\beta)(6a_1+(3+\sqrt{6})\bar{v}_2-(3-\sqrt{6})a_2)(6\bar{v}_1-(3+\sqrt{6})\bar{v}_2+(3-\sqrt{6})a_2)}{96a_1}$ and $E[\pi_{S2}^{1\,*}] = \frac{(1-\beta)(\bar{v}_2+a_2)^2}{32a_2}$.

This equilibrium is valid only if $\frac{\bar{v}_1}{\bar{v}_2} > \frac{(\sqrt{6}-2)\frac{a_1a_2}{\bar{v}_2\bar{v}_2}-(\sqrt{6}-2)\left(\frac{a_2}{\bar{v}_2}\right)^2+(2+\sqrt{6})\left(\frac{a_1}{\bar{v}_2}+1\right)}{4\frac{a_1}{\bar{v}_2}+(\sqrt{6}-2)\frac{a_2}{\bar{v}_2}+(2+\sqrt{6})}$, which ensures that the cumulative density is always between 0 and 1.

For $\frac{(\sqrt{6}-2)\frac{a_1a_2}{\bar{v}_2\bar{v}_2}-(\sqrt{6}-2)\left(\frac{a_2}{\bar{v}_2}\right)^2+(2+\sqrt{6})\left(\frac{a_1}{\bar{v}_2}+1\right)}{4\frac{a_1}{\bar{v}_2}+(\sqrt{6}-2)\frac{a_2}{\bar{v}_2}+(2+\sqrt{6})} < \frac{\bar{v}_1}{\bar{v}_2} < (5-2\sqrt{6})\left(\frac{a_1}{\bar{v}_2}-\frac{a_2}{\bar{v}_2}\right)+1$, both equilibriums are valid, but both sellers have higher profits under the first rather than the second equilibrium. Therefore, if $\frac{\bar{v}_1}{\bar{v}_2} < (5-2\sqrt{6})\left(\frac{a_1}{\bar{v}_2}-\frac{a_2}{\bar{v}_2}\right)+1$, the equilibrium is the one listed first, and if $(5-2\sqrt{6})\left(\frac{a_1}{\bar{v}_2}-\frac{a_2}{\bar{v}_2}\right)+1 \le \frac{\bar{v}_1}{\bar{v}_2} < 1+\frac{a_1}{\bar{v}_2}-\frac{a_2}{\bar{v}_2}$, the equilibrium is the one listed second. We summarize the equilibrium in this case under condition $a_1 > a_2$ as follows:

$$E[\pi_{S1}^{1\,*}] = \begin{cases} \frac{(1-\beta)(6a_1+(3+\sqrt{6})\bar{v}_2-(3-\sqrt{6})a_2)(6\bar{v}_1-(3+\sqrt{6})\bar{v}_2+(3-\sqrt{6})a_2)}{96a_1} & if\ (5-2\sqrt{6})\left(\frac{a_1}{\bar{v}_2}-\frac{a_2}{\bar{v}_2}\right)+1 \le \frac{\bar{v}_1}{\bar{v}_2} < 1+\frac{a_1}{\bar{v}_2}-\frac{a_2}{\bar{v}_2} \\ \frac{(1-\beta)(\bar{v}_1+a_1)^2}{32a_1} & if\ \frac{\bar{v}_1}{\bar{v}_2} < (5-2\sqrt{6})\left(\frac{a_1}{\bar{v}_2}-\frac{a_2}{\bar{v}_2}\right)+1 \end{cases}$$
$$E[\pi_{S2}^{1\,*}] = \begin{cases} \frac{(1-\beta)(\bar{v}_2+a_2)^2}{32a_2} & if\ (5-2\sqrt{6})\left(\frac{a_1}{\bar{v}_2}-\frac{a_2}{\bar{v}_2}\right)+1 \le \frac{\bar{v}_1}{\bar{v}_2} < 1+\frac{a_1}{\bar{v}_2}-\frac{a_2}{\bar{v}_2} \\ \frac{(1-\beta)(6a_2+(3+\sqrt{6})\bar{v}_2-(3-\sqrt{6})a_1)(6\bar{v}_2-(3+\sqrt{6})\bar{v}_1+(3-\sqrt{6})a_1)}{96a_2} & if\ \frac{\bar{v}_1}{\bar{v}_2} < (5-2\sqrt{6})\left(\frac{a_1}{\bar{v}_2}-\frac{a_2}{\bar{v}_2}\right)+1 \end{cases}$$

Combining the equilibriums in Case E1 and Case E2 for the parameter region of $\frac{a_1}{\bar{v}_2} \in (1,2)$ and $\frac{\bar{v}_1}{\bar{v}_2} \in \left(1, \frac{a_1}{\bar{v}_2}\right)$ yields Lemma E1.

Lemma E1. *If products are priced by two separate third-party sellers and average ratings are revealed on the product list, sellers follow a mixed strategy equilibrium, using probabilistic price discounts to undercut each other. The expected optimal profits are as follows:*
If $a_1 \le a_2$,

$$E[\pi_{S1}^{1\,*}] = \frac{(1-\beta)(6a_1+(3+\sqrt{6})\bar{v}_2-(3-\sqrt{6})a_2)(6\bar{v}_1-(3+\sqrt{6})\bar{v}_2+(3-\sqrt{6})a_2)}{96a_1}$$
$$E[\pi_{S2}^{1\,*}] = \frac{(1-\beta)(\bar{v}_2+a_2)^2}{32a_2}$$
$$E[\pi^{1*}] = \frac{\beta}{1-\beta}\left(E[\pi_{S1}^{1\,*}]+E[\pi_{S2}^{1\,*}]\right)$$

If $a_1 > a_2$,

$$E\left[{\pi_{S1}^{1}}^{*}\right]=\begin{cases}\frac{(1-\beta)\left(6a_1+(3+\sqrt{6})\bar{v}_2-(3-\sqrt{6})a_2\right)\left(6\bar{v}_1-(3+\sqrt{6})\bar{v}_2+(3-\sqrt{6})a_2\right)}{96a_1} & if\ \frac{\bar{v}_1}{\bar{v}_2}\geq\left(5-2\sqrt{6}\right)\left(\frac{a_1}{\bar{v}_2}-\frac{a_2}{\bar{v}_2}\right)+1\\ \frac{(1-\beta)(\bar{v}_1+a_1)^2}{32a_1} & if\ \frac{\bar{v}_1}{\bar{v}_2}<\left(5-2\sqrt{6}\right)\left(\frac{a_1}{\bar{v}_2}-\frac{a_2}{\bar{v}_2}\right)+1\end{cases}$$

$$E\left[{\pi_{S2}^{1}}^{*}\right]=\begin{cases}\frac{(1-\beta)(\bar{v}_2+a_2)^2}{32a_2} & if\ \frac{\bar{v}_1}{\bar{v}_2}\geq\left(5-2\sqrt{6}\right)\left(\frac{a_1}{\bar{v}_2}-\frac{a_2}{\bar{v}_2}\right)+1\\ \frac{(1-\beta)\left(6a_2+(3+\sqrt{6})\bar{v}_2-(3-\sqrt{6})a_1\right)\left(6\bar{v}_2-(3+\sqrt{6})\bar{v}_1+(3-\sqrt{6})a_1\right)}{96a_2} & if\ \frac{\bar{v}_1}{\bar{v}_2}<\left(5-2\sqrt{6}\right)\left(\frac{a_1}{\bar{v}_2}-\frac{a_2}{\bar{v}_2}\right)+1\end{cases}$$

$$E\left[{\pi^{1}}^{*}\right]=\frac{\beta}{1-\beta}\left(E\left[{\pi_{S1}^{1}}^{*}\right]+E\left[{\pi_{S2}^{1}}^{*}\right]\right)$$

Non-Revealing Policy

The profit functions of the third-party sellers under the non-revealing policy are

$$\pi_{S1}^{2}(p_1)=\begin{cases}(1-\beta)\left(\frac{1}{4}+\frac{1}{2}\right)p_1\frac{\bar{v}_1+a_1-p_1}{2a_1} & \begin{array}{c}if\ p_1<p_2\ or\\ if\ p_1=p_2 \text{ and Product 1}\\ \text{is on the top of the list}\end{array} \quad (E9)\\ (1-\beta)\frac{1}{4}p_1\frac{\bar{v}_1+a_1-p_1}{2a_1} & \begin{array}{c}if\ p_1>p_2\ or\\ if\ p_1=p_2 \text{ and Product 2}\\ \text{is on the top of the list}\end{array} \quad (E10)\end{cases}$$

$$\pi_{S2}^{2}(p_2)=\begin{cases}(1-\beta)\frac{1}{4}p_2\frac{\bar{v}_2+a_2-p_2}{2a_2} & \begin{array}{c}if\ p_1<p_2\ or\\ if\ p_1=p_2 \text{ and Product 1}\\ \text{is on the top of the list}\end{array} \quad (E11)\\ (1-\beta)\left(\frac{1}{4}+\frac{1}{2}\right)p_2\frac{\bar{v}_2+a_2-p_2}{2a_2} & \begin{array}{c}if\ p_1>p_2\ or\\ if\ p_1=p_2 \text{ and Product 2}\\ \text{is on the top of the list}\end{array} \quad (E12)\end{cases}$$

The profit of the firm that owns the website under the non-revealing policy is

$$\pi^2=\frac{\beta}{1-\beta}\left(\pi_{S1}^{2}(p_1)+\pi_{S2}^{2}(p_2)\right)$$

The first-order condition and the negative second-order derivatives suggest that the profit-maximizing prices are $p_1=\frac{\bar{v}_1+a_1}{2}$ and $p_2=\frac{\bar{v}_2+a_2}{2}$. Note that $p_1=p_2$ can never be the equilibrium, because the seller of the product not shown on the top of the list could always lower its price by a very small amount (ε) and increase its profit. We thus derive the equilibrium by analyzing two cases.

Case EE1. If the profit-maximizing prices for (E9) and (E11) fall in the region of $p_1<p_2$, that is, if $\frac{\bar{v}_1}{\bar{v}_2}<1-\frac{a_1}{\bar{v}_2}+\frac{a_2}{\bar{v}_2}$, Seller 2 will compare $\pi_{S2}^{2}\left(\frac{\bar{v}_2+a_2}{2}\right)_{(\text{E11})}$ and $\pi_{S2}^{2}\left(\frac{\bar{v}_1+a_1}{2}-\varepsilon\right)_{(\text{E12})}$ to decide if it is profitable to deviate by undercutting Seller 1 to induce explorative consumers to buy Product 2. This condition $\frac{\bar{v}_1}{\bar{v}_2}<1-\frac{a_1}{\bar{v}_2}+\frac{a_2}{\bar{v}_2}$ holds only if $a_1<a_2$. In this condition, $\pi_{S2}^{2}\left(\frac{\bar{v}_1+a_1}{2}-\varepsilon\right)_{(\text{E12})}$ is always larger. Therefore, Seller 2 will undercut Seller 1 to attract consumers to visit Product 1, and Seller 1 will respond by lowering Product 1's price to prevent that from happening. Then the resulting mixed strategy equilibrium can be derived as follows. Let pn_3 be the lowest price of Seller 1 that Seller 2 is willing to undercut. Depending on whether there is probability mass at $\frac{\bar{v}_2+a_2}{2}$ in Seller 2's price support, there are two possible equilibriums:

1) Seller 1's price support is $(pn_3,\frac{\bar{v}_1+a_1}{2}]$ with probability mass at $\frac{\bar{v}_1+a_1}{2}$; Seller 2's price support is $(pn_3,\frac{\bar{v}_1+a_1}{2})\cup\frac{\bar{v}_2+a_2}{2}$ with probability mass at $\frac{\bar{v}_2+a_2}{2}$.
2) Seller 1's price support is $(pn_3,\frac{\bar{v}_1+a_1}{2}]$ with probability mass at $\frac{\bar{v}_1+a_1}{2}$; Seller 2's price support is $(pn_3,\frac{\bar{v}_1+a_1}{2})$.

Here we define the cumulative density function as $H_j(p)=\Pr\{p_j\leq p\}$. The profit-invariant nature of the mixed strategy equilibrium suggests the following equations:

$$\pi_{S1}^{2}(p_1)_{E9}\left(1-H_2(p_1)\right)+\pi_{S1}^{2}(p_1)_{E10}H_2(p_1)=\pi_{S1}^{2}(pn_3)_{E9} \quad \text{(E13)}$$

$$\pi_{S2}^2(p_2)_{E12}\big(1 - H_1(p_2)\big) + \pi_{S2}^2(p_2)_{E11}H_1(p_2) = \pi_{S2}^2(pn_3)_{E12} \tag{E14}$$

For the first equilibrium, by replacing p_1 in (E13) with different values and replacing p_2 in (D14) with different values, we can derive

$$pn_3 = \frac{(3-\sqrt{6})(\bar{v}_2 + a_2)}{6}$$

$$H_1(p) = \begin{cases} 1 & if\ p = \frac{\bar{v}_1 + a_1}{2} \\ \frac{1}{8}\left(11 - \frac{a_2 + \bar{v}_2 + \frac{p^2}{a_2 + \bar{v}_2 - p}}{p}\right) & if\ pn_3 < p < \frac{\bar{v}_1 + a_1}{2} \end{cases}$$

$$H_2(p) = \begin{cases} 1 & if\ p = \frac{\bar{v}_2 + a_2}{2} \\ \Gamma_3 & if\ pn_3 < p < \frac{\bar{v}_1 + a_1}{2} \end{cases}$$

where $\Gamma_3 = \frac{6p(a_1 - p + \bar{v}_1) - (3-\sqrt{6})(a_2+\bar{v}_2)\left(a_1 + \bar{v}_1 - \frac{1}{6}(3-\sqrt{6})(a_2+\bar{v}_2)\right)}{4p(a_1 + \bar{v}_1 - p)}$. The expected equilibrium profits are

$E[\pi_{S1}^{2\ *}] = \frac{(1-\beta)(3-\sqrt{6})(a_2+\bar{v}_2)\left(a_1 + \bar{v}_1 - \frac{1}{6}(3-\sqrt{6})(a_2+\bar{v}_2)\right)}{16a_1}$ and $E[\pi_{S2}^{2\ *}] = \frac{(1-\beta)(\bar{v}_2 + a_2)^2}{32a_2}$.

For the second equilibrium, after replacing p_1 in (E13) and p_2 in (E14) with different values, we find that the equilibrium does not exist. Therefore, the first equilibrium applies for $\frac{\bar{v}_1}{\bar{v}_2} < 1 - \frac{a_1}{\bar{v}_2} + \frac{a_2}{\bar{v}_2}$. We can summarize the equilibrium in this case as follows: if $a_1 < a_2$, for $1 < \frac{\bar{v}_1}{\bar{v}_2} < Min\left\{1 - \frac{a_1}{\bar{v}_2} + \frac{a_2}{\bar{v}_2}, \frac{a_1}{\bar{v}_2}\right\}$, $E[\pi_{S1}^{1\ *}] = \frac{(1-\beta)(3-\sqrt{6})(a_2+\bar{v}_2)\left(a_1 + \bar{v}_1 - \frac{1}{6}(3-\sqrt{6})(a_2+\bar{v}_2)\right)}{16a_1}$ and $E[\pi_{S2}^{1\ *}] = \frac{(1-\beta)(\bar{v}_2 + a_2)^2}{32a_2}$.

Case EE2. If the profit-maximizing prices for (E10) and (E12) fall in the region of $p_1 > p_2$, that is, if $\frac{\bar{v}_1}{\bar{v}_2} > 1 - \frac{a_1}{\bar{v}_2} + \frac{a_2}{\bar{v}_2}$, Seller 1 will compare $\pi_{S1}^2\left(\frac{\bar{v}_1 + a_1}{2}\right)_{(E10)}$ and $\pi_{S1}^2\left(\frac{\bar{v}_2 + a_2}{2} - \varepsilon\right)_{(E9)}$ to decide if it is profitable to deviate by undercutting Seller 2 to induce explorative consumers to buy Product 1. Given $1 - \frac{a_1}{\bar{v}_2} + \frac{a_2}{\bar{v}_2} < \frac{\bar{v}_1}{\bar{v}_2} < \frac{a_1}{\bar{v}_2}$, $\pi_{S1}^2\left(\frac{\bar{v}_2 + a_2}{2} - \varepsilon\right)_{(E9)}$ is always larger. Therefore, Seller 1 will undercut Seller 2 to attract consumers to visit Product 1, and Seller 2 will respond by lowering Product 2's price to prevent it. The resulting mixed strategy equilibrium can be derived as follows. Let pn_4 be the lowest price of Seller 2 that Seller 1 is willing to undercut. Depending on whether there is probability mass at $\frac{\bar{v}_1 + a_1}{2}$ in Seller 1's price support, there are two possible equilibriums:

1) Seller 2's price support is $(pn_4, \frac{\bar{v}_2 + a_2}{2}]$ with probability mass at $\frac{\bar{v}_2 + a_2}{2}$; Seller 1's price support is $(pn_4, \frac{\bar{v}_2 + a_2}{2}) \cup \frac{\bar{v}_1 + a_1}{2}$ with probability mass at $\frac{\bar{v}_1 + a_1}{2}$.
2) Seller 2's price support is $(pn_4, \frac{\bar{v}_2 + a_2}{2}]$ with probability mass at $\frac{\bar{v}_2 + a_2}{2}$; Seller 1's price support is $(pn_4, \frac{\bar{v}_2 + a_2}{2})$.

We define the cumulative density function as $L_j(p) = \Pr\{p_j \le p\}$. The profit-invariant nature of the mixed strategy equilibrium suggests the following equations:

$$\pi_{S1}^2(p_1)_{E9}\big(1 - L_2(p_1)\big) + \pi_{S1}^2(p_1)_{E10}L_2(p_1) = \pi_{S1}^2(pn_4)_{E9} \tag{E15}$$

$$\pi_{S2}^2(p_2)_{E12}\big(1 - L_1(p_2)\big) + \pi_{S2}^2(p_2)_{E11}L_1(p_2) = \pi_{S2}^2(pn_4)_{E12} \tag{E16}$$

For the first equilibrium, by replacing p_1 in (E15) and p_2 in (E16) with different values, we obtain

$$pn_4 = \frac{(3-\sqrt{6})(\bar{v}_1 + a_1)}{6}$$

$$L_1(p) = \begin{cases} 1 & if\ p = \frac{\bar{v}_1 + a_1}{2} \\ \Gamma_4 & if\ pn_4 < p < \frac{\bar{v}_2 + a_2}{2} \end{cases}$$

$$L_2(p) = \begin{cases} 1 & if\ p = \frac{\bar{v}_2 + a_2}{2} \\ \frac{1}{8}\left(11 - \frac{a_1 + \bar{v}_1 + \frac{p^2}{a_1 + \bar{v}_1 - p}}{p}\right) & if\ pn_4 < p < \frac{\bar{v}_2 + a_2}{2} \end{cases}$$

where $\Gamma_4 = \frac{6p(a_2 - p + \bar{v}_2) - (3-\sqrt{6})(a_1 + \bar{v}_1)\left(a_2 + \bar{v}_2 - \frac{1}{6}(3-\sqrt{6})(a_1 + \bar{v}_1)\right)}{4p(a_2 + \bar{v}_2 - p)}$. The expected equilibrium profits are

$E[\pi_{S1}^{2\ *}] = \frac{(1-\beta)(\bar{v}_1 + a_1)^2}{32a_1}$ and $E[\pi_{S2}^{2\ *}] = \frac{(1-\beta)(3-\sqrt{6})(a_1 + \bar{v}_1)\left(a_2 + \bar{v}_2 - \frac{1}{6}(3-\sqrt{6})(a_1 + \bar{v}_1)\right)}{16a_2}$.

For the second equilibrium, by replacing p_1 in (E15) and p_2 in (E16) with different values, we find that the equilibrium does not exist. Therefore, the first equilibrium applies to $1 - \frac{a_1}{\bar{v}_2} + \frac{a_2}{\bar{v}_2} < \frac{\bar{v}_1}{\bar{v}_2} < \frac{a_1}{\bar{v}_2}$. Because $1 - \frac{a_1}{\bar{v}_2} + \frac{a_2}{\bar{v}_2} \leq 1$ if $a_1 \geq a_2$, we can summarize the equilibrium in this case as follows: if $a_1 \geq a_2$ and $1 < \frac{\bar{v}_1}{\bar{v}_2} < \frac{a_1}{\bar{v}_2}$, or if $a_1 < a_2$ and $Min\left\{1 - \frac{a_1}{\bar{v}_2} + \frac{a_2}{\bar{v}_2}, \frac{a_1}{\bar{v}_2}\right\} < \frac{\bar{v}_1}{\bar{v}_2} < \frac{a_1}{\bar{v}_2}$, then $E[\pi_{S1}^{2\ *}] = \frac{(1-\beta)(\bar{v}_1 + a_1)^2}{32a_1}$ and $E[\pi_{S2}^{2\ *}] = \frac{(1-\beta)(3-\sqrt{6})(a_1 + \bar{v}_1)\left(a_2 + \bar{v}_2 - \frac{1}{6}(3-\sqrt{6})(a_1 + \bar{v}_1)\right)}{16a_2}$.

Combining the equilibriums in Case EE1 and Case EE2 for the parameter region of $\frac{a_1}{\bar{v}_2} \in (1,2)$ and $\frac{\bar{v}_1}{\bar{v}_2} \in \left(1, \frac{a_1}{\bar{v}_2}\right)$ yields Lemma E2.

Lemma E2. *If products are priced by separate third-party sellers and average ratings are not revealed on the product list, sellers follow a mixed strategy equilibrium and use probabilistic price discounts to undercut each other. The expected optimal profits are as follows:*

If $a_1 \leq \frac{1+a_2}{2}$,

$$E\left[\pi_{S1}^{2\ *}\right] = \frac{(1-\beta)(3-\sqrt{6})(a_2 + \bar{v}_2)\left(a_1 + \bar{v}_1 - \frac{1}{6}(3-\sqrt{6})(a_2 + \bar{v}_2)\right)}{16a_1}$$
$$E\left[\pi_{S2}^{2\ *}\right] = \frac{(1-\beta)(\bar{v}_2 + a_2)^2}{32a_2}$$
$$E\left[\pi^{2*}\right] = \frac{\beta}{1-\beta}\left(E\left[\pi_{S1}^{2\ *}\right] + E\left[\pi_{S2}^{2\ *}\right]\right)$$

If $\frac{1+a_2}{2} < a_1 < a_2$,

$$E\left[\pi_{S1}^{2\ *}\right] = \begin{cases} \frac{(1-\beta)(\bar{v}_1 + a_1)^2}{32a_1} & if\ \frac{\bar{v}_1}{\bar{v}_2} \geq 1 - \frac{a_1}{\bar{v}_2} + \frac{a_2}{\bar{v}_2} \\ \frac{(1-\beta)(3-\sqrt{6})(a_2 + \bar{v}_2)\left(a_1 + \bar{v}_1 - \frac{1}{6}(3-\sqrt{6})(a_2 + \bar{v}_2)\right)}{16a_1} & if\ \frac{\bar{v}_1}{\bar{v}_2} < 1 - \frac{a_1}{\bar{v}_2} + \frac{a_2}{\bar{v}_2} \end{cases}$$
$$E\left[\pi_{S2}^{2\ *}\right] = \begin{cases} \frac{(1-\beta)(3-\sqrt{6})(a_1 + \bar{v}_1)\left(a_2 + \bar{v}_2 - \frac{1}{6}(3-\sqrt{6})(a_1 + \bar{v}_1)\right)}{16a_2} & if\ \frac{\bar{v}_1}{\bar{v}_2} \geq 1 - \frac{a_1}{\bar{v}_2} + \frac{a_2}{\bar{v}_2} \\ \frac{(1-\beta)(\bar{v}_2 + a_2)^2}{32a_2} & if\ \frac{\bar{v}_1}{\bar{v}_2} < 1 - \frac{a_1}{\bar{v}_2} + \frac{a_2}{\bar{v}_2} \end{cases}$$
$$E\left[\pi^{2*}\right] = \frac{\beta}{1-\beta}\left(E\left[\pi_{S1}^{2\ *}\right] + E\left[\pi_{S2}^{2\ *}\right]\right)$$

If $a_1 \geq a_2$,

$$E\left[\pi_{S1}^{2\ *}\right] = \frac{(1-\beta)(\bar{v}_1 + a_1)^2}{32a_1}$$
$$E\left[\pi_{S2}^{2\ *}\right] = \frac{(1-\beta)(3-\sqrt{6})(a_1 + \bar{v}_1)\left(a_2 + \bar{v}_2 - \frac{1}{6}(3-\sqrt{6})(a_1 + \bar{v}_1)\right)}{16a_2}$$
$$E\left[\pi^{2*}\right] = \frac{\beta}{1-\beta}\left(E\left[\pi_{S1}^{2\ *}\right] + E\left[\pi_{S2}^{2\ *}\right]\right)$$

Similar to the case under the non-revealing policy in the main model, price cannot signal the average value, because in the mixed strategy equilibrium, p_1^* can be higher or lower than p_2^*, and so the high-value product is not necessarily the product with a higher price. Consumers are not able to tell which product is the high-value product (i.e., Product 1) simply by looking at the two prices.

Comparison of Revealing and Non-Revealing Policies

We compare the website firm's profits in Lemma E1 and Lemma E2 for the parameter region of $\frac{a_1}{\bar{v}_2} \in (1,2)$ and $\frac{\bar{v}_1}{\bar{v}_2} \in \left(1, \frac{a_1}{\bar{v}_2}\right)$.

If $a_1 \leq a_2$,

$$E\left[\pi^{1^*}\right] = \beta\left(\frac{\left(6a_1+(3+\sqrt{6})\bar{v}_2-(3-\sqrt{6})a_2\right)\left(6\bar{v}_1-(3+\sqrt{6})\bar{v}_2+(3-\sqrt{6})a_2\right)}{96a_1}+\frac{(\bar{v}_2+a_2)^2}{32a_2}\right)$$

$$E\left[\pi^{2^*}\right] = \begin{cases} \beta\left(\frac{(\bar{v}_1+a_1)^2}{32a_1}+\frac{(3-\sqrt{6})(a_1+\bar{v}_1)\left(a_2+\bar{v}_2-\frac{1}{6}(3-\sqrt{6})(a_1+\bar{v}_1)\right)}{16a_2}\right) & if\ 1-\frac{a_1}{\bar{v}_2}+\frac{a_2}{\bar{v}_2}\leq\frac{\bar{v}_1}{\bar{v}_2}<\frac{a_1}{\bar{v}_2} \\ \beta\left(\frac{(3-\sqrt{6})(a_2+\bar{v}_2)\left(a_1+\bar{v}_1-\frac{1}{6}(3-\sqrt{6})(a_2+\bar{v}_2)\right)}{16a_1}+\frac{(\bar{v}_2+a_2)^2}{32a_2}\right) & if\ 1<\frac{\bar{v}_1}{\bar{v}_2}<1-\frac{a_1}{\bar{v}_2}+\frac{a_2}{\bar{v}_2} \end{cases}$$

In this case, we always have $E\left[\pi^{1^*}\right] > E\left[\pi^{2^*}\right]$.

If $a_1 > a_2$,

$$E\left[\pi^{1^*}\right] = \begin{cases} \beta\left(\frac{\left(6a_1+(3+\sqrt{6})\bar{v}_2-(3-\sqrt{6})a_2\right)\left(6\bar{v}_1-(3+\sqrt{6})\bar{v}_2+(3-\sqrt{6})a_2\right)}{96a_1}+\frac{(\bar{v}_2+a_2)^2}{32a_2}\right) & if\ \frac{\bar{v}_1}{\bar{v}_2}\geq\left(5-2\sqrt{6}\right)\left(\frac{a_1}{\bar{v}_2}-\frac{a_2}{\bar{v}_2}\right)+1 \\ \beta\left(\frac{(\bar{v}_1+a_1)^2}{32a_1}+\frac{\left(6a_2+(3+\sqrt{6})\bar{v}_2-(3-\sqrt{6})a_1\right)\left(6\bar{v}_2-(3+\sqrt{6})\bar{v}_1+(3-\sqrt{6})a_1\right)}{96a_2}\right) & if\ \frac{\bar{v}_1}{\bar{v}_2}<\left(5-2\sqrt{6}\right)\left(\frac{a_1}{\bar{v}_2}-\frac{a_2}{\bar{v}_2}\right)+1 \end{cases}$$

$$E\left[\pi^{2^*}\right] = \beta\left(\frac{(\bar{v}_1+a_1)^2}{32a_1}+\frac{(3-\sqrt{6})(a_1+\bar{v}_1)\left(a_2+\bar{v}_2-\frac{1}{6}(3-\sqrt{6})(a_1+\bar{v}_1)\right)}{16a_2}\right)$$

In this case, $E\left[\pi^{1^*}\right] \geq E\left[\pi^{2^*}\right]$ if $\frac{\bar{v}_1}{\bar{v}_2} \geq \bar{Q}_E$, and $E\left[\pi^{1^*}\right] < E\left[\pi^{2^*}\right]$ if $\frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}_E$, where $\bar{Q}_E = \frac{(5-2\sqrt{6})\left(\frac{a_1}{\bar{v}_2}\right)^2+\frac{a_2}{\bar{v}_2}\left(3+\sqrt{6}-(3-\sqrt{6})\frac{a_2}{\bar{v}_2}\right)-\frac{a_1}{\bar{v}_2}\left(3-\sqrt{6}-(2+\sqrt{6})\frac{a_2}{\bar{v}_2}\right)}{\frac{a_2}{\bar{v}_2}-(5-2\sqrt{6})\frac{a_1}{\bar{v}_2}} - \frac{\sqrt{2\left(6(5-2\sqrt{6})\left(\frac{a_1}{\bar{v}_2}\right)^3\frac{a_2}{\bar{v}_2}-2\frac{a_1}{\bar{v}_2}\frac{a_2}{\bar{v}_2}\left(1-2\frac{a_2}{\bar{v}_2}\left(5+(7-3\sqrt{6})\frac{a_2}{\bar{v}_2}\right)\right)+\left(\frac{a_2}{\bar{v}_2}\right)^2\left(5+2\sqrt{6}-\frac{a_2}{\bar{v}_2}\left(2-(5-2\sqrt{6})\frac{a_2}{\bar{v}_2}\right)\right)+\left(\frac{a_1}{\bar{v}_2}\right)^2\left(5-2\sqrt{6}-\frac{a_2}{\bar{v}_2}\left(2+(55-26\sqrt{6})\frac{a_2}{\bar{v}_2}\right)\right)\right)}}{\frac{a_2}{\bar{v}_2}-(5-2\sqrt{6})\frac{a_1}{\bar{v}_2}}$ and $1 < \bar{Q}_E < \frac{a_1}{\bar{v}_2}$, given $a_1 > a_2$.

Appendix F

Model Extension: Positive Marginal Cost

In this numerical extension, we assume the marginal cost of producing a product with average value $\bar{v}$ to be $c\bar{v}$. We assume $0 < c < \frac{1}{2}$, so a reasonable margin exists to produce the product. The numerical value for $\frac{a_1}{\bar{v}_1}$ is chosen to be in the region $a_1 < a_2$, such that neither a revealing nor a non-revealing policy completely dominates the other. Specifically, we set $\frac{a_1}{\bar{v}_2} = 1.3$ and normalize $\bar{v}_2 = 1$. Another assumption we relax from the main model is that here we allow $\bar{v}_1 - a_1$ to be positive, so in this extension, we assume $\bar{v}_1 < 1.5$ instead of $\bar{v}_1 < a_1 = 1.3$.

The profit function under the revealing policy is

$$\pi^1(p_1,p_2) = \begin{cases} \left(\begin{array}{c} \frac{3}{4}(p_1-c\bar{v}_1)\frac{\bar{v}_1+a_1-p_1}{2a_1}+\frac{1}{4}(p_2-c\bar{v}_2)\frac{\bar{v}_2+a_2-p_2}{2a_2} \\ +\frac{1}{2}\left(\frac{1}{2}\left(1-\frac{\bar{v}_1+a_1-p_1}{2a_1}\right)\right)(p_2-c\bar{v}_2)\frac{\bar{v}_2+a_2-p_2}{2a_2} \end{array}\right) & \begin{array}{c} if\ \bar{v}_1-p_1>\bar{v}_2-p_2\ or \\ if\ \bar{v}_1-p_1=\bar{v}_2-p_2 \text{ and Product 1} \\ \text{is on the top of the list} \end{array} \quad \text{(F1)} \\ \left(\begin{array}{c} \frac{1}{4}(p_1-c\bar{v}_1)\frac{\bar{v}_1+a_1-p_1}{2a_1}+\frac{3}{4}(p_2-c\bar{v}_2)\frac{\bar{v}_2+a_2-p_2}{2a_2} \\ +\frac{1}{2}\left(\frac{1}{2}\left(1-\frac{\bar{v}_2+a_2-p_2}{2a_2}\right)\right)(p_1-c\bar{v}_1)\frac{\bar{v}_1+a_1-p_1}{2a_1} \end{array}\right) & \begin{array}{c} if\ \bar{v}_1-p_1<\bar{v}_2-p_2\ or \\ if\ \bar{v}_1-p_1=\bar{v}_2-p_2 \text{ and Product 2} \\ \text{is on the top of the list} \end{array} \quad \text{(F2)} \end{cases}$$

The profit function under the non-revealing policy is

$$\pi^2(p_1,p_2)=\begin{cases}\left(\begin{array}{l}\frac{3}{4}(p_1-c\bar{v}_1)\frac{\bar{v}_1+a_1-p_1}{2a_1}+\frac{1}{4}(p_2-c\bar{v}_2)\frac{\bar{v}_2+a_2-p_2}{2a_2}\\ +\frac{1}{2}\left(\frac{1}{2}\left(1-\frac{\bar{v}_1+a_1-p_1}{2a_1}\right)\right)(p_2-c\bar{v}_2)\frac{\bar{v}_2+a_2-p_2}{2a_2}\end{array}\right) & \begin{array}{c}if\ p_1<p_2\ or\\ if\ p_1=p_2 \text{ and Product 1}\\ \text{is on the top of the list}\end{array} \quad (\text{F3})\\ \left(\begin{array}{l}\frac{1}{4}(p_1-c\bar{v}_1)\frac{\bar{v}_1+a_1-p_1}{2a_1}+\frac{3}{4}(p_2-c\bar{v}_2)\frac{\bar{v}_2+a_2-p_2}{2a_2}\\ +\frac{1}{2}\left(\frac{1}{2}\left(1-\frac{\bar{v}_2+a_2-p_2}{2a_2}\right)\right)(p_1-c\bar{v}_1)\frac{\bar{v}_1+a_1-p_1}{2a_1}\end{array}\right) & \begin{array}{c}if\ p_1>p_2\ or\\ if\ p_1=p_2 \text{ and Product 2}\\ \text{is on the top of the list}\end{array} \quad (\text{F4})\end{cases}$$

Following the approach for Lemma 1, Lemma 2, and Proposition 1, we derive that $\pi^{1^*}\geq\pi^{2^*}$ when $\bar{Q}_F\leq\bar{v}_1<1.5$, and $\pi^{1^*}<\pi^{2^*}$ when $1<\bar{v}_1<\bar{Q}_F$. Here, $\bar{Q}_F$ is the solution to $\pi^1\left(\frac{1061+720\bar{v}_1+20c(c+36\bar{v}_1-5)}{1440},\frac{5+2c}{4}\right)_{(\text{F1})}=\pi^2(P_F,P_F)_{(\text{F4})}$, where $P_F=\frac{10(1+c)\bar{v}_1-100+\sqrt{5(3443+468c-2(95+134c)\bar{v}_1+20(1-(1-c)c)\bar{v}_1^2)}}{30}$ and $1<\bar{Q}_F<1.5$.

Appendix G

Model Extension: Variant Size of Concentrated Consumers

In this numerical extension, we assume the fraction of concentrated consumers is b, which then can be split further into equally sized sub-segments of consumers interested in Product 1 or Product 2. The numerical value for $\frac{a_1}{\bar{v}_1}$ is chosen to be in the region $a_1<a_2$, such that neither policy completely dominates. Specifically, we set $\frac{a_1}{\bar{v}_2}=1.3$ and normalize $\bar{v}_2=1$.

The profit function under the revealing policy is

$$\pi^1(p_1,p_2)=\begin{cases}\left(\begin{array}{l}\left(\frac{b}{2}+1-b\right)p_1\frac{\bar{v}_1+a_1-p_1}{2a_1}+\frac{b}{2}p_2\frac{\bar{v}_2+a_2-p_2}{2a_2}\\ +(1-b)\left(\frac{1}{2}\left(1-\frac{\bar{v}_1+a_1-p_1}{2a_1}\right)\right)p_2\frac{\bar{v}_2+a_2-p_2}{2a_2}\end{array}\right) & \begin{array}{c}if\ \bar{v}_1-p_1>\bar{v}_2-p_2\ or\\ if\ \bar{v}_1-p_1=\bar{v}_2-p_2 \text{ and Product 1}\\ \text{is on the top of the list}\end{array} \quad (\text{G1})\\ \left(\begin{array}{l}\frac{b}{2}p_1\frac{\bar{v}_1+a_1-p_1}{2a_1}+\left(\frac{b}{2}+1-b\right)p_2\frac{\bar{v}_2+a_2-p_2}{2a_2}\\ +(1-b)\left(\frac{1}{2}\left(1-\frac{\bar{v}_2+a_2-p_2}{2a_2}\right)\right)p_1\frac{\bar{v}_1+a_1-p_1}{2a_1}\end{array}\right) & \begin{array}{c}if\ \bar{v}_1-p_1<\bar{v}_2-p_2\ or\\ if\ \bar{v}_1-p_1=\bar{v}_2-p_2 \text{ and Product 2}\\ \text{is on the top of the list}\end{array} \quad (\text{G2})\end{cases}$$

The profit function under the non-revealing policy is

$$\pi^2(p_1,p_2)=\begin{cases}\left(\begin{array}{l}\left(\frac{b}{2}+1-b\right)p_1\frac{\bar{v}_1+a_1-p_1}{2a_1}+\frac{b}{2}p_2\frac{\bar{v}_2+a_2-p_2}{2a_2}\\ +(1-b)\left(\frac{1}{2}\left(1-\frac{\bar{v}_1+a_1-p_1}{2a_1}\right)\right)p_2\frac{\bar{v}_2+a_2-p_2}{2a_2}\end{array}\right) & \begin{array}{c}if\ p_1<p_2\ or\\ if\ p_1=p_2 \text{ and Product 1}\\ \text{is on the top of the list}\end{array} \quad (\text{G3})\\ \left(\begin{array}{l}\frac{b}{2}p_1\frac{\bar{v}_1+a_1-p_1}{2a_1}+\left(\frac{b}{2}+1-b\right)p_2\frac{\bar{v}_2+a_2-p_2}{2a_2}\\ +(1-b)\left(\frac{1}{2}\left(1-\frac{\bar{v}_2+a_2-p_2}{2a_2}\right)\right)p_1\frac{\bar{v}_1+a_1-p_1}{2a_1}\end{array}\right) & \begin{array}{c}if\ p_1>p_2\ or\\ if\ p_1=p_2 \text{ and Product 2}\\ \text{is on the top of the list}\end{array} \quad (\text{G4})\end{cases}$$

Following the approach from Lemma 1, Lemma 2, and Proposition 1, we derive the following result:

If $b<0.91$, $\pi^{1^*}\geq\pi^{2^*}$ when $\bar{Q}_G\leq\bar{v}_1<1.3$, and $\pi^{1^*}<\pi^{2^*}$ when $1<\bar{v}_1<\bar{Q}_G$. Here, $\bar{Q}_G$ is the solution to $\pi^1(P_{G1},P_{G1}+1-\bar{v}_1)_{(\text{G1})}=\pi^2(P_{G2},P_{G2})_{(\text{G4})}$ if $b<0.15$ and is the solution to $\pi^1\left(\frac{437-\frac{125}{2-b}+240\bar{v}_1}{480},\frac{5}{4}\right)_{(\text{G1})}=\pi^2(P_{G2},P_{G2})_{(\text{G4})}$ if $0.15\leq b<0.91$, where

$P_{G1}=\frac{30\bar{v}_1-68-6b(5\bar{v}_1-2)+\sqrt{7609-6042b+1569b^2-900(2-b)(1-b)\bar{v}_1}}{30(1-b)}$ and

$P_{G2}=\frac{10\bar{v}_1-44-2b(6+5\bar{v}_1)+\sqrt{6031+12b(373b-1338)-730\bar{v}_1+40(124-51b)b\bar{v}_1+100(1-b)^2\bar{v}_1^2}}{30(1-b)}$ and $1<\bar{Q}_G<1.3$.

If $b \geq 0.91$, then $\pi^{1^*} \geq \pi^{2^*}$.

Therefore, our main result holds qualitatively, as long as the fraction of explorative consumers is not too small (greater than approximately 9% in this case).

Appendix H

Model Extension: Heterogeneous Preferences over Search Attributes [redacted]

In this numerical extension, we allow explorative consumers to have different preferences for the two products, based on attributes that can be observed before purchase (e.g., from product pictures displayed on the product list). We assume that half of the explorative consumers prefer Product 1's observable attributes, whereas the other half prefer Product 2's observable attributes. If an explorative consumer purchases the product with less preferred observable attributes, the consumer incurs a cost of t ($t > 0$). To focus on products for which experience attributes play a more important role in determining consumers' utility than do attributes that can be observed before purchase, we further assume that $t < 0.1$. The numerical value for $\frac{a_1}{\bar{v}_1}$ is again chosen in the region $a_1 < a_2$, where neither a revealing nor a non-revealing policy completely dominates. Specifically, we set $\frac{a_1}{\bar{v}_2} = 1.3$ and normalize $\bar{v}_2 = 1$. Then the profit function under the revealing policy is

$$\pi^1(p_1,p_2) = \begin{cases} \left(\begin{array}{l} \frac{1}{2}p_1\frac{\bar{v}_1+a_1-p_1}{2a_1} + \frac{1}{4}\left(\frac{1}{2}\left(1-\frac{\bar{v}_1+a_1-p_1}{2a_1}\right)\right)p_2\frac{\bar{v}_2-t+a_2-p_2}{2a_2} + \frac{1}{4}p_2\frac{\bar{v}_2+a_2-p_2}{2a_2} \\ \quad + \frac{1}{4}p_1\frac{\bar{v}_1-t+a_1-p_1}{2a_1} + \frac{1}{4}\left(\frac{1}{2}\left(1-\frac{\bar{v}_1-t+a_1-p_1}{2a_1}\right)\right)p_2\frac{\bar{v}_2+a_2-p_2}{2a_2} \end{array} \right) & \begin{array}{c} \text{if } \bar{v}_1 - p_1 > \bar{v}_2 - p_2 + t \text{ or} \\ \text{if } \bar{v}_1 - p_1 = \bar{v}_2 - p_2 + t \text{ and Product 1} \\ \text{is on the top of the list} \end{array} \quad (H1) \\ \left(\begin{array}{l} \frac{1}{2}p_1\frac{\bar{v}_1+a_1-p_1}{2a_1} + \frac{1}{4}\left(\frac{1}{2}\left(1-\frac{\bar{v}_1+a_1-p_1}{2a_1}\right)\right)p_2\frac{\bar{v}_2-t+a_2-p_2}{2a_2} \\ + \frac{1}{2}p_2\frac{\bar{v}_2+a_2-p_2}{2a_2} + \frac{1}{4}\left(\frac{1}{2}\left(1-\frac{\bar{v}_2+a_2-p_2}{2a_2}\right)\right)p_1\frac{\bar{v}_1-t+a_1-p_1}{2a_1} \end{array} \right) & \text{if } \bar{v}_2 - p_2 - t < \bar{v}_1 - p_1 < \bar{v}_2 - p_2 + t \quad (H2) \\ \left(\begin{array}{l} \frac{1}{4}p_1\frac{\bar{v}_1+a_1-p_1}{2a_1} + \frac{1}{2}p_2\frac{\bar{v}_2+a_2-p_2}{2a_2} + \frac{1}{4}\left(\frac{1}{2}\left(1-\frac{\bar{v}_2+a_2-p_2}{2a_2}\right)\right)p_1\frac{\bar{v}_1-t+a_1-p_1}{2a_1} \\ \quad + \frac{1}{4}p_2\frac{\bar{v}_2-t+a_2-p_2}{2a_2} + \frac{1}{4}\left(\frac{1}{2}\left(1-\frac{\bar{v}_2-t+a_2-p_2}{2a_2}\right)\right)p_1\frac{\bar{v}_1+a_1-p_1}{2a_1} \end{array} \right) & \begin{array}{c} \text{if } \bar{v}_1 - p_1 < \bar{v}_2 - p_2 - t \text{ or} \\ \text{if } \bar{v}_1 - p_1 = \bar{v}_2 - p_2 - t \text{ and Product 1} \\ \text{is on the top of the list} \end{array} \quad (H3) \end{cases}.$$

The profit function under the non-revealing policy is

$$\pi^2(p_1,p_2) = \begin{cases} \left(\begin{array}{l} \frac{1}{2}p_1\frac{\bar{v}_1+a_1-p_1}{2a_1} + \frac{1}{4}\left(\frac{1}{2}\left(1-\frac{\bar{v}_1+a_1-p_1}{2a_1}\right)\right)p_2\frac{\bar{v}_2-t+a_2-p_2}{2a_2} + \frac{1}{4}p_2\frac{\bar{v}_2+a_2-p_2}{2a_2} \\ \quad + \frac{1}{4}p_1\frac{\bar{v}_1-t+a_1-p_1}{2a_1} + \frac{1}{4}\left(\frac{1}{2}\left(1-\frac{\bar{v}_1-t+a_1-p_1}{2a_1}\right)\right)p_2\frac{\bar{v}_2+a_2-p_2}{2a_2} \end{array} \right) & \begin{array}{c} \text{if } p_1 < p_2 - t \text{ or} \\ \text{if } p_1 = p_2 - t \text{ and Product 1} \\ \text{is on the top of the list} \end{array} \quad (H4) \\ \left(\begin{array}{l} \frac{1}{2}p_1\frac{\bar{v}_1+a_1-p_1}{2a_1} + \frac{1}{4}\left(\frac{1}{2}\left(1-\frac{\bar{v}_1+a_1-p_1}{2a_1}\right)\right)p_2\frac{\bar{v}_2-t+a_2-p_2}{2a_2} \\ + \frac{1}{2}p_2\frac{\bar{v}_2+a_2-p_2}{2a_2} + \frac{1}{4}\left(\frac{1}{2}\left(1-\frac{\bar{v}_2+a_2-p_2}{2a_2}\right)\right)p_1\frac{\bar{v}_1-t+a_1-p_1}{2a_1} \end{array} \right) & \text{if } p_2 - t < p_1 < p_2 + t \quad (H5) \\ \left(\begin{array}{l} \frac{1}{4}p_1\frac{\bar{v}_1+a_1-p_1}{2a_1} + \frac{1}{2}p_2\frac{\bar{v}_2+a_2-p_2}{2a_2} + \frac{1}{4}\left(\frac{1}{2}\left(1-\frac{\bar{v}_2+a_2-p_2}{2a_2}\right)\right)p_1\frac{\bar{v}_1-t+a_1-p_1}{2a_1} \\ \quad + \frac{1}{4}p_2\frac{\bar{v}_2-t+a_2-p_2}{2a_2} + \frac{1}{4}\left(\frac{1}{2}\left(1-\frac{\bar{v}_2-t+a_2-p_2}{2a_2}\right)\right)p_1\frac{\bar{v}_1+a_1-p_1}{2a_1} \end{array} \right) & \begin{array}{c} \text{if } p_1 > p_2 + t \text{ or} \\ \text{if } p_1 = p_2 + t \text{ and Product 1} \\ \text{is on the top of the list} \end{array} \quad (H6) \end{cases}.$$

Following a similar approach to that for Lemma 1, Lemma 2, and Proposition 1, we derive that $\pi^{1^*} \geq \pi^{2^*}$ when $\bar{Q}_H \leq \bar{v}_1 < 1.3$, and $\pi^{1^*} < \pi^{2^*}$ when $1 < \bar{v}_1 < \bar{Q}_H$, where $\bar{Q}_H$ is the solution to $\max_{p_1>0,p_2>0} \pi^1(p_1,p_2)_{(H1)} = \max_{p_2>0} \pi^2(p_2+t,p_2)_{(\mathrm{H6})}$ when $t \leq T$, and it is the solution to

$\max_{p_2>0} \pi^1(p_1, \bar{v}_2 - \bar{v}_1 + t + p_1)_{(\mathrm{H1})} = \max_{p_2>0} \pi^2(p_2 + t, p_2)_{(\mathrm{H6})}$ when $t > T$. Furthermore, $1 < \bar{Q}_H < 1.3$. T is the solution to $\bar{v}_1 - p_1^* = \bar{v}_2 - p_2^* + t$, where $(p_1^*, p_2^*) = \operatorname*{argmax}_{p_1>0, p_2>0} \pi^1(p_1, p_2)_{(H1)}$. Because of this complexity, $\bar{Q}_H$, T, p_1^*, and p_2^* are all obtained numerically.

Appendix I

Model Extension: Pooled Prices under the Non-Revealing Policy

In this extension, we examine a situation in which the firm pools prices of the two products under the non-revealing policy to eliminate possible signaling effects due to differential pricing. That is, under a non-revealing policy, $p_1 = p_2 = p$. Observing identical prices, explorative consumers simply select and visit the first product to appear on the list.[1] The profit function of the firm thus is

$$\pi^2(p) = \begin{cases} \left(\begin{array}{c} \frac{3}{4} p \frac{\bar{v}_1 + a_1 - p}{2a_1} + \frac{1}{4} p \frac{\bar{v}_2 + a_2 - p}{2a_2} \\ + \frac{1}{2}\left(\frac{1}{2}\left(1 - \frac{\bar{v}_1 + a_1 - p}{2a_1}\right)\right) p \frac{\bar{v}_2 + a_2 - p}{2a_2} \end{array} \right) & \text{if product 1 is on the top of the list} \quad \text{(I1)} \\ \left(\begin{array}{c} \frac{1}{4} p \frac{\bar{v}_1 + a_1 - p}{2a_1} + \frac{3}{4} p \frac{\bar{v}_2 + a_2 - p}{2a_2} \\ + \frac{1}{2}\left(\frac{1}{2}\left(1 - \frac{\bar{v}_2 + a_2 - p}{2a_2}\right)\right) p \frac{\bar{v}_1 + a_1 - p}{2a_1} \end{array} \right) & \text{if product 2 is on the top of the list} \quad \text{(I2)} \end{cases}$$

The first-order condition and the negative second-order derivatives suggest that the profit-maximizing price is $p = \frac{\bar{v}_1 + (1+\Omega_5)\bar{v}_2 - 3a_1 - 5a_2}{3}$ for (I1) and $p = \frac{\bar{v}_1 + (1+\Omega_6)\bar{v}_2 - 5a_1 - 3a_2}{3}$ for (I2), where

$$\Omega_5 = \sqrt{\left(\frac{3a_1}{\bar{v}_2}\right)^2 + \left(\frac{5a_2}{\bar{v}_2}\right)^2 + \frac{5a_2}{\bar{v}_2}\frac{\bar{v}_1}{\bar{v}_2} + \left(\frac{\bar{v}_1}{\bar{v}_2}\right)^2 - \frac{10a_2}{\bar{v}_2} - \frac{\bar{v}_1}{\bar{v}_2} + 1 + \frac{57a_1}{\bar{v}_2}\frac{a_2}{\bar{v}_2} - \frac{6a_1}{\bar{v}_2}\frac{\bar{v}_1}{\bar{v}_2} + \frac{3a_1}{\bar{v}_2}},$$
$$\Omega_6 = \sqrt{\left(\frac{3a_2}{\bar{v}_2}\right)^2 + \left(\frac{5a_1}{\bar{v}_2}\right)^2 + \frac{5a_1}{\bar{v}_2} + 1 - \frac{10a_1}{\bar{v}_2}\frac{\bar{v}_1}{\bar{v}_2} - \frac{\bar{v}_1}{\bar{v}_2} + \left(\frac{\bar{v}_1}{\bar{v}_2}\right)^2 + \frac{57a_1}{\bar{v}_2}\frac{a_2}{\bar{v}_2} - \frac{6a_2}{\bar{v}_2} + \frac{3a_2}{\bar{v}_2}\frac{\bar{v}_1}{\bar{v}_2}}.$$

By substituting the optimal prices into the profit functions, we get

$$\frac{\pi^2\left(\frac{\bar{v}_1+(1+\Omega_5)\bar{v}_2-3a_1-5a_2}{3}\right)_{(\mathrm{I1})}}{\bar{v}_2} = \frac{\left(\frac{\bar{v}_1}{\bar{v}_2}+1-\frac{3a_1}{\bar{v}_2}-\frac{5a_2}{\bar{v}_2}+\Omega_5\right)\left(\left(\frac{\bar{v}_1}{\bar{v}_2}\right)^2-\frac{4\bar{v}_1}{\bar{v}_2}+1+\left(\frac{\bar{v}_1}{\bar{v}_2}+1-\frac{3a_1}{\bar{v}_2}-\frac{5a_2}{\bar{v}_2}\right)\Omega_5-\frac{3a_1}{\bar{v}_2}\left(\frac{2\bar{v}_1}{\bar{v}_2}-\frac{3a_1}{\bar{v}_2}-\frac{28a_2}{\bar{v}_2}-4\right)-\frac{5a_2}{\bar{v}_2}\left(2-\frac{5a_2}{\bar{v}_2}-\frac{4\bar{v}_1}{\bar{v}_2}\right)\right)}{\frac{432a_1a_2}{\bar{v}_2\,\bar{v}_2}} \quad \text{(I3)}$$

$$\frac{\pi^2\left(\frac{\bar{v}_1+(1+\Omega_6)\bar{v}_2-5a_1-3a_2}{3}\right)_{(\mathrm{I2})}}{\bar{v}_2} = \frac{\left(\frac{\bar{v}_1}{\bar{v}_2}+1-\frac{5a_1}{\bar{v}_2}-\frac{3a_2}{\bar{v}_2}+\Omega_6\right)\left(\left(\frac{\bar{v}_1}{\bar{v}_2}\right)^2-\frac{4\bar{v}_1}{\bar{v}_2}+1+\left(\frac{\bar{v}_1}{\bar{v}_2}+1-\frac{5a_1}{\bar{v}_2}-\frac{3a_2}{\bar{v}_2}\right)\Omega_6-\frac{3a_2}{\bar{v}_2}\left(2-\frac{3a_2}{\bar{v}_2}-\frac{28a_1}{\bar{v}_2}-\frac{4\bar{v}_1}{\bar{v}_2}\right)-\frac{5a_1}{\bar{v}_2}\left(\frac{2\bar{v}_1}{\bar{v}_2}-\frac{5a_1}{\bar{v}_2}-4\right)\right)}{\frac{432a_1a_2}{\bar{v}_2\,\bar{v}_2}} \quad \text{(I4)}$$

The comparison of the two profits in (I3) and (I4) depends on $\frac{\bar{v}_1}{\bar{v}_2}$, $\frac{a_1}{\bar{v}_2}$, and $\frac{a_2}{\bar{v}_2}$. As in Appendix B, we can prove that for a given value of $\frac{a_2}{\bar{v}_2} = \frac{3}{2}$, there exists a unique solution $\frac{\bar{v}_1}{\bar{v}_2} = \bar{Q}_{I1}$ to the equation in which the two profits in (I3) and (I4) are equal, where $\bar{Q}_{I1}$ is a function of $\frac{a_1}{\bar{v}_2}$. We can then summarize the optimal prices and profit under the non-revealing policy as follows:

If $a_1 \geq a_2$, $p^* = \frac{\bar{v}_1 + (1+\Omega_5)\bar{v}_2 - 3a_1 - 5a_2}{3}$ *and* $\pi^{2^*} = \pi^2(p^*)_{(\mathrm{I1})}$.

If $a_1 < a_2$,

[1] Consumers expect that in equilibrium, the firm places the product that is more profitable on the top of the product list. Because the high-value product is more likely to be the more profitable product, consumers expect that the product on the top of the list also is likely to be the product with a higher average value. This belief is consistent with the firm's optimal decision. The high-value product (Product 1) appears first if $a_1 \geq a_2$ or if $a_1 < a_2$ and $\bar{v}_1 \geq \bar{Q}_I$, whereas the low-value product (Product 2) appears first only if $a_1 < a_2$ and $\bar{v}_1 < \bar{Q}_I$. Accordingly, the high-value product is significantly more likely to be placed first, and it is rational for consumers to visit the product listed first when they encounter equivalent prices.

$$p^* = \begin{cases} \frac{\bar{v}_1+(1+\Omega_5)\bar{v}_2-3a_1-5a_2}{3} & if\ \frac{\bar{v}_1}{\bar{v}_2} \geq \bar{Q}_{I1} \\ \frac{\bar{v}_1+(1+\Omega_6)\bar{v}_2-5a_1-3a_2}{3} & if\ \frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}_{I1} \end{cases}$$

$$\pi^{2^*} = \begin{cases} \pi^2(p^*)_{(\mathrm{I1})} & if\ \frac{\bar{v}_1}{\bar{v}_2} \geq \bar{Q}_{I1} \\ \pi^2(p^*)_{(\mathrm{I2})} & if\ \frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}_{I1} \end{cases}.$$

The firm will not find it profitable to deviate and sell only one product given $\frac{a_1}{\bar{v}_2} < 2$. If the firm sells only one product, its profit either equals $\frac{3}{4}p_1\frac{\bar{v}_1+a_1-p_1}{2a_1}$ with p_1 replaced by $\frac{\bar{v}_1+a_1}{2}$ or else equals $\frac{3}{4}p_2\frac{\bar{v}_2+a_2-p_2}{2a_2}$ with p_2 replaced by $\frac{\bar{v}_2+a_2}{2}$. We can prove that both values are smaller than the optimal profit given $\frac{a_1}{\bar{v}_2} < 2$.

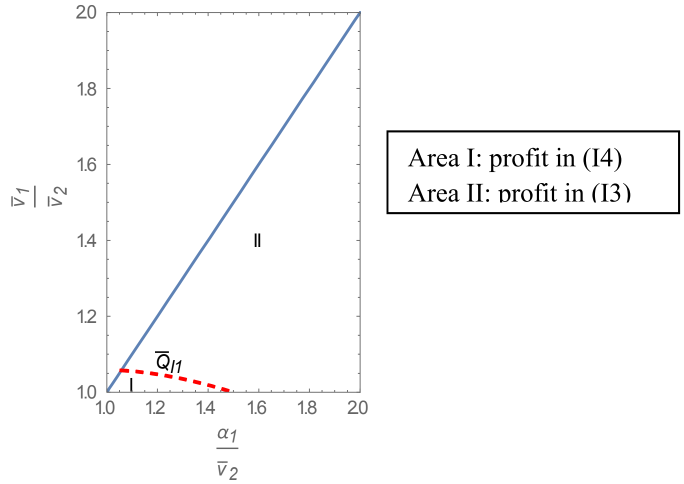


Figure I1. Optimal Profit Under Non-Revealing Policy

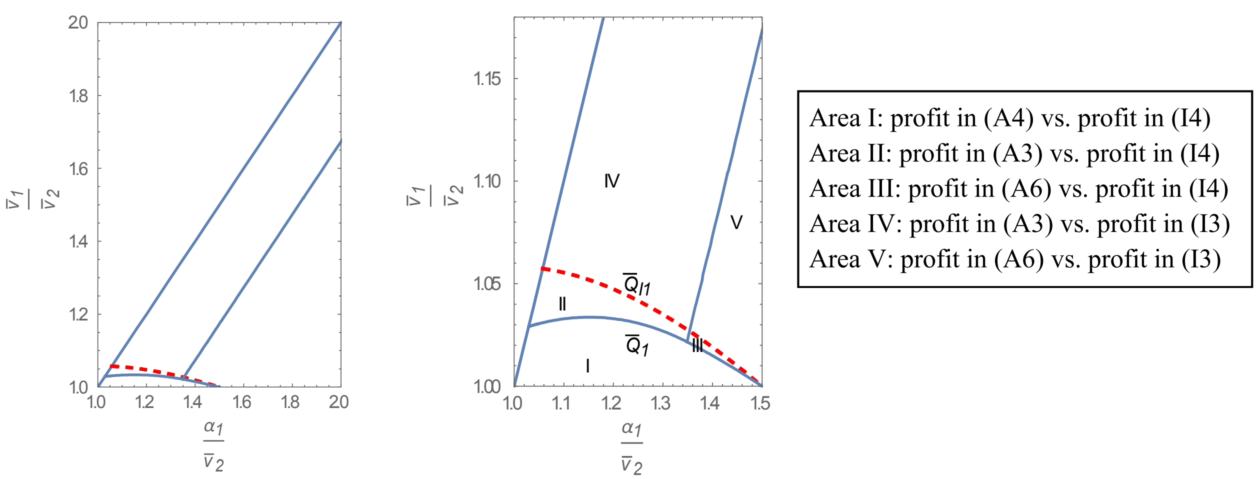


Figure 12a

Figure 12b

Figure I2. Comparison of Revealing and Non-Revealing Policies

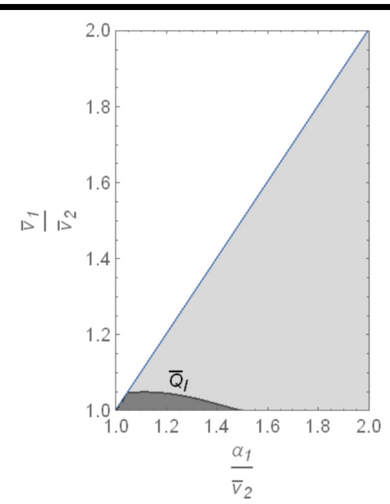
We compare the profit π^2 under the non-revealing policy here (depicted in Figure I1) and the profit π^1 under the revealing policy in Lemma 1 (Figure A1). Figure I2a combines Figure A1 and Figure I1. Figure I2b enlarges the lower left corner of Figure I2a to reveal the boundaries. We then compare π^1 and π^2 in each area in the parameter region of $\frac{a_1}{\bar{v}_2} \in (1,2)$ and $\frac{\bar{v}_1}{\bar{v}_2} \in \left(1, \frac{a_1}{\bar{v}_2}\right)$ in Figure I2 and obtain

1. In Area I ($\frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}_1$), we compare the profit in (A4) in Area I of Figure A1 and the profit in (I4) in Area I of Figure I1 and find that the profit in (I4) is always higher.
2. In Area II ($Max\left\{\bar{Q}_1, \frac{\frac{24a_1}{\bar{v}_2}-\frac{23a_2}{\bar{v}_2}+26+1/\frac{a_2}{\bar{v}_2}}{24}\right\} \le \frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}_{I1}$), we compare the profit in (A3) in Area II of Figure A1 and the profit in (I4) in Area I of Figure I1 and find that the profit in (I4) is higher if $\frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}_{I2}$, where $\bar{Q}_{I2}$ is a function of $\frac{a_1}{\bar{v}_2}$ and is the solution to the equation in which the two profits in (A3) and (I4) are equal.
3. In Area III ($\bar{Q}_1 \le \frac{\bar{v}_1}{\bar{v}_2} < Min\left\{\bar{Q}_{I1}, \frac{\frac{24a_1}{\bar{v}_2}-\frac{23a_2}{\bar{v}_2}+26+1/\frac{a_2}{\bar{v}_2}}{24}\right\}$), we compare the profit in (A6) in Area III of Figure A1 and the profit in (I4) in Area I of Figure I1 and find that the profit in (I4) is higher if $\frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}_{I3}$, where $\bar{Q}_{I3}$ is a function of $\frac{a_1}{\bar{v}_2}$ and is the solution to the equation in which the two profits in (A6) and (I4) are equal.
4. In Area IV ($\frac{\bar{v}_1}{\bar{v}_2} \ge Max\left\{\frac{\frac{24a_1}{\bar{v}_2}-\frac{23a_2}{\bar{v}_2}+26+1/\frac{a_2}{\bar{v}_2}}{24}, \bar{Q}_{I1}\right\}$), we compare the profit in (A3) in Area II of Figure A1 and the profit in (I3) in Area II of Figure I1 and find that the profit in (A3) is always higher.
5. In Area V ($\bar{Q}_{I1} < \frac{\bar{v}_1}{\bar{v}_2} < \frac{\frac{24a_1}{\bar{v}_2}-\frac{23a_2}{\bar{v}_2}+26+1/\frac{a_2}{\bar{v}_2}}{24}$), we compare the profit in (A6) in Area III of Figure A1 and the profit in (I3) in Area II of Figure I1 and find that the profit in (A6) is always higher.

We can thus summarize the result

$$\pi^{1^*} \ge \pi^{2^*} \text{ if } \frac{\bar{v}_1}{\bar{v}_2} \ge \bar{Q}_I$$
$$\pi^{1^*} < \pi^{2^*} \text{ if } \frac{\bar{v}_1}{\bar{v}_2} < \bar{Q}_I$$
$$\text{where } \bar{Q}_I = \begin{cases} \bar{Q}_{I2} & if\ \frac{\bar{v}_1}{\bar{v}_2} \ge \frac{\frac{24a_1}{\bar{v}_2}-\frac{23a_2}{\bar{v}_2}+26+1/\frac{a_2}{\bar{v}_2}}{24} \\ \bar{Q}_{I3} & if\ \frac{\bar{v}_1}{\bar{v}_2} < \frac{\frac{24a_1}{\bar{v}_2}-\frac{23a_2}{\bar{v}_2}+26+1/\frac{a_2}{\bar{v}_2}}{24} \end{cases}$$

The result is in Figure I3: $\pi^{1^*} < \pi^{2^*}$ in the dark gray area, and $\pi^{1^*} \ge \pi^{2^*}$ in the light gray area. The dark gray area appears only if $\frac{a_1}{\bar{v}_2} < \frac{a_2}{\bar{v}_2}$.



In dark grey area, non-revealing policy is more profitable for the firm; in light grey area, revealing policy is (weakly) more profitable.

Figure I3. Comparison of Revealing and Non-Revealing Policies

Appendix J

Model Extension: Alternative Approach to Model Sequential Search [redacted]

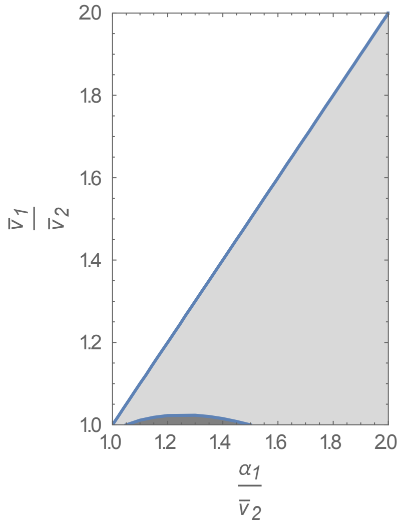
In this numerical extension, we assume that explorative consumers are heterogeneous in their search cost, in that half of them only visit one product before making a purchase decision, and the other half visit both products before making a decision. Then the profit function under the revealing policy is

$$\pi^1(p_1,p_2)=\begin{cases}\left(\begin{array}{l}\frac{1}{2}p_1\frac{\bar{v}_1+a_1-p_1}{2a_1}+\frac{1}{4}p_2\frac{\bar{v}_2+a_2-p_2}{2a_2}+\frac{1}{4}p_1\frac{(\bar{v}_1+a_1-p_1)(p_2-\bar{v}_2+a_2)+\frac{(\bar{v}_1+a_1-p_1)^2}{2}}{4a_1a_2}\\ \quad+\frac{1}{4}p_2\frac{(\bar{v}_2+a_2-p_2)(p_1-\bar{v}_1+a_1)+\frac{(\bar{v}_1+a_1-p_1)(p_1-\bar{v}_1-a_1+2(\bar{v}_2+a_2-p_2))}{2}}{4a_1a_2}\end{array}\right) & \begin{array}{c}if\ \bar{v}_1-p_1>\bar{v}_2-p_2\ or\\ if\ \bar{v}_1-p_1=\bar{v}_2-p_2\text{ and Product 1}\\ \text{is on the top of the list}\end{array} \quad (J1)\\ \left(\begin{array}{l}\frac{1}{4}p_1\frac{\bar{v}_1+a_1-p_1}{2a_1}+\frac{1}{2}p_2\frac{\bar{v}_2+a_2-p_2}{2a_2}+\frac{1}{4}p_2\frac{(\bar{v}_2+a_2-p_2)(p_1-\bar{v}_1+a_1)+\frac{(\bar{v}_2+a_2-p_2)^2}{2}}{4a_1a_2}\\ \quad+\frac{1}{4}p_2\frac{(\bar{v}_1+a_1-p_1)(p_2-\bar{v}_2+a_2)+\frac{(\bar{v}_2+a_2-p_2)(p_2-\bar{v}_2-a_2+2(\bar{v}_1+a_1-p_1))}{2}}{4a_1a_2}\end{array}\right) & \begin{array}{c}if\ \bar{v}_1-p_1<\bar{v}_2-p_2\ or\\ if\ \bar{v}_1-p_1=\bar{v}_2-p_2\text{ and Product 2}\\ \text{is on the top of the list}\end{array} \quad (J2)\end{cases}$$

The profit function under the non-revealing policy instead is

$$\pi^2(p_1,p_2)=\begin{cases}\left(\begin{array}{l}\frac{1}{2}p_1\frac{\bar{v}_1+a_1-p_1}{2a_1}+\frac{1}{4}p_2\frac{\bar{v}_2+a_2-p_2}{2a_2}+\frac{1}{4}p_1\frac{(\bar{v}_1+a_1-p_1)(p_2-\bar{v}_2+a_2)+\frac{(\bar{v}_1+a_1-p_1)^2}{2}}{4a_1a_2}\\ \quad+\frac{1}{4}p_2\frac{(\bar{v}_2+a_2-p_2)(p_1-\bar{v}_1+a_1)+\frac{(\bar{v}_1+a_1-p_1)(p_1-\bar{v}_1-a_1+2(\bar{v}_2+a_2-p_2))}{2}}{4a_1a_2}\end{array}\right) & \begin{array}{c}if\ p_1<p_2\ or\\ if\ p_1=p_2\text{ and Product 1}\\ \text{is on the top of the list}\end{array} \quad (J3)\\ \left(\begin{array}{l}\frac{1}{4}p_1\frac{\bar{v}_1+a_1-p_1}{2a_1}+\frac{1}{2}p_2\frac{\bar{v}_2+a_2-p_2}{2a_2}+\frac{1}{4}p_2\frac{(\bar{v}_2+a_2-p_2)(p_1-\bar{v}_1+a_1)+\frac{(\bar{v}_2+a_2-p_2)^2}{2}}{4a_1a_2}\\ \quad+\frac{1}{4}p_2\frac{(\bar{v}_1+a_1-p_1)(p_2-\bar{v}_2+a_2)+\frac{(\bar{v}_2+a_2-p_2)(p_2-\bar{v}_2-a_2+2(\bar{v}_1+a_1-p_1))}{2}}{4a_1a_2}\end{array}\right) & \begin{array}{c}if\ p_1>p_2\ or\\ if\ p_1=p_2\text{ and Product 2}\\ \text{is on the top of the list}\end{array} \quad (J4)\end{cases}$$

We follow the approach we took to Lemma 1, Lemma 2, and Proposition 1 to compare the optimal profits under the two policies. The complexity prevents us from deriving the optimal prices in closed form. Therefore, for each value of $\frac{a_1}{\bar{v}_2}$, we numerically search for the optimal prices and profit for each value of $\frac{\bar{v}_1}{\bar{v}_2}$ to reproduce Figure C2. The result is in Figure J1: $\pi^{1^*}<\pi^{2^*}$ in the dark gray area and $\pi^{1^*}\geq\pi^{2^*}$ in the light gray area. The dark gray area appears only if $\frac{a_1}{\bar{v}_2}<\frac{a_2}{\bar{v}_2}$.



In dark grey area, non-revealing policy is more profitable for the firm; in light grey area, revealing policy is (weakly) more profitable.

Figure J1. Comparison of Revealing and Non-Revealing Policies