Online Appendix (not for publication)

Claim: *The highest level of data accuracy is attained when market shares are of equal size, i.e., at $\alpha = 1/2$.*

We can say that data are most precise if it allows a firm to extract the highest rents from the consumers located closer to it on a given address for any price of the rival. The latter condition allows to abstract from the competition effect. Consider some x on the turf of Firm A and let the rival's price be p_B. To serve all consumers on α and $1-\alpha$ Firm A has to charge prices $p_{A,\alpha}(x) = \underline{t}\,(1-2x) + p_B$ and $p_{A,1-\alpha}(x) = (\alpha + \underline{t}\,(1-\alpha))\,(1-2x) + p_B$, respectively, which yield the total profit of Firm A at location x: $\Pi_A(x) = p_B + (1-2x)\,\underline{t}\left[(1-\alpha)^2 + \alpha l\,(1-\alpha) + \alpha\right]$. This profit gets its maximum $\alpha = 1/2$ for any ratio of transport costs l and any p_B.

Proof of proposition 2. *Part 1.* Consider first $l \leq 2$, in which case Firm A chooses p_A^x to maximize the profits:

$$\begin{aligned}
&(l - p_A^x + p_B^x)\,p_A^x + \delta\,(l-1)\,[\alpha + (1-\alpha)\,(1+\alpha\,(l-1))] \\
&= (l - p_A^x + p_B^x)\,p_A^x + \delta\,[p_A^x - p_B^x - 1 + (l - p_A^x + p_B^x)\,(p_A^x - p_B^x)]\,.
\end{aligned} \tag{10}$$

Firm B chooses p_B^x to maximize the profits:

$$(p_A^x - p_B^x - 1)\,p_B^x. \tag{11}$$

Solving firms' first-order conditions we arrive at the prices:

$$p_A^{x*} = \tfrac{2l(1+\delta)-1}{2\delta+3} \text{ and } p_B^{x*} = \tfrac{l-2-\delta(1-l)}{2\delta+3}. \tag{12}$$

Note that second-order conditions are also fulfilled. For the prices (12) to constitute the equilibrium, it must hold that $\underline{t} < t^{\alpha}\left((1-2x)\,\underline{t}p_A^{x*}, (1-2x)\,\underline{t}p_B^{x*}\right) \leq 1$, which yields the condition:

$$\tfrac{1}{1+l} < \tfrac{1+\delta}{3+2\delta} \leq \tfrac{l}{1+l}. \tag{13}$$

Note that $l/(1+l) > 0.5$ for any ratio of transport costs l and $(1+\delta)/(3+2\delta) \leq 0.4$ for any δ, such that the right-hand side of (13) is fulfilled for any δ and any ratio of transport costs l. The left-hand side of (13) is fulfilled if

$$l > \bar{l}_1(\delta) := \tfrac{2+\delta}{1+\delta}. \tag{14}$$

It holds that $1.5 \leq \bar{l}_1(\delta) \leq 2$ for any δ and $\partial \bar{l}(\delta)/\partial\delta < 0$. Note finally that if (14) holds, then $p_A^{x*} > 0$ and $p_B^{x*} > 0$.

If $l \leq \bar{l}_1(\delta)$, then the monopoly equilibrium emerges, where Firm A serves all consumers at x. In this equilibrium Firm A charges the highest price at which it can gain all consumers:

$$p_A(x, p_B(x)) = p_B(x) + \underline{t}(1-2x). \tag{15}$$

It follows from (15) that $p_B^*(x) = 0$, because Firm B would have an incentive to deviate downwards from any positive price. Hence,

$$p_A^{x*}(x) = \underline{t}(1-2x) \text{ and } p_B^{x*}(x) = 0. \tag{16}$$

For the prices (16) to constitute the equilibrium, none of the firms should have an incentive to deviate. Precisely, Firm A should not have an incentive to increase its price: The derivative of (10) evaluated at $p_A^x = \underline{t}(1-2x)$ and $p_B^x = 0$ must be non-positive yielding the condition $l \leq \bar{l}_1(\delta)$, which is the opposite of (14).

Part 2. Consider now $2 \leq l \leq 4$, in which case second-period profits are given by different functions depending on α.

i) Consider first $\alpha \leq (l-2)/[2(l-1)]$. The profits of the second period are given by

(5). Firm A chooses p_A^x to maximize the profits:

$$
\begin{aligned}
&\left(l - p_A^x + p_B^x\right) p_A^x + \tfrac{\delta}{9}\left[9\alpha\left(l-1\right) + \left(2l - 1 - \alpha\left(l-1\right)\right)^2\right] \\
&= \left(l - p_A^x + p_B^x\right) p_A^x + \tfrac{\delta}{9}\left[9\left(p_A^x - p_B^x - 1\right) + \left(2l - p_A^x + p_B^x\right)^2\right].
\end{aligned} \tag{17}
$$

Firm B chooses p_B^x to maximize the profits:

$$
\left(p_A^x - p_B^x - 1\right) p_B^x + \tfrac{\delta\left[l-2-2\alpha(l-1)\right]^2}{9} = \left(p_A^x - p_B^x - 1\right) p_B^x + \tfrac{\delta\left(l-2p_A^x+2p_B^x\right)^2}{9}. \tag{18}
$$

It is straightforward to show that no monopoly equilibrium (where Firm A serves all consumers at x) in the first period exists. In the sharing equilibrium first-order conditions have to be fulfilled. Solving them simultaneously, we arrive at the prices:

$$
\begin{aligned}
p_A^{x*} &= \tfrac{54l+60\delta-36l\delta-24\delta^2+8l\delta^2-27}{81-30\delta}, \\
p_B^{x*} &= \tfrac{27l+33\delta-12l\delta-24\delta^2+8l\delta^2-54}{81-30\delta}, \text{ which yield}
\end{aligned} \tag{19}
$$

$$
\alpha\left(p_A^{x*}, p_B^{x*}\right) = \tfrac{9l+19\delta-8l\delta-18}{(l-1)(27-10\delta)}. \tag{20}
$$

Note that second-order conditions are fulfilled, and for any δ and any $l \geq 2$ it holds that $\alpha\left(p_A^{x*}, p_B^{x*}\right) \geq 0$. Imposing $\alpha\left(p_A^{x*}, p_B^{x*}\right) \leq \left(l-2\right)/\left[2\left(l-1\right)\right]$, we arrive at

$$
l \geq \bar{l}_2\left(\delta\right) := \tfrac{6(1+\delta)}{3+2\delta}.
$$

Note that $\partial \bar{l}_2\left(\delta\right)/\partial\delta > 0$, $\bar{l}_2\left(0\right) = 2$ and $\bar{l}_2\left(1\right) = 2.4$. The condition $p_A^{x*} \geq 0$ stated in (19) requires

$$
l \geq f_1(\delta) := \tfrac{24\delta^2-60\delta+27}{2(4\delta^2-18\delta+27)},
$$

which is true for any δ and any ratio of transport costs l, because for any δ it holds that

$f_1(\delta) < 1$. Finally, $p_B^{x*} \geq 0$ stated in (19) requires

$$l \geq f_2(\delta) := \tfrac{24\delta^2 - 33\delta + 54}{8\delta^2 - 12\delta + 27},$$

which is true for any δ and any $l \geq 2$, because for any δ it holds that $f_2(\delta) \leq 2$.

ii) Consider now $(l-2)/[2(l-1)] \leq \alpha < 1/(l-1)$. In this case the (adjusted) profits over two periods are given by (10) and (11), which yields the equilibrium prices (12) and the share of Firm B in the first period:

$$\alpha\left(p_A^{x*}, p_B^{x*}\right) = \tfrac{p_A^{x*} - p_B^{x*} - 1}{l-1} = \tfrac{l(1+\delta) - (2+\delta)}{(3+2\delta)(l-1)}.$$

The condition $\alpha\left(p_A^{x*}, p_B^{x*}\right) < 1/(l-1)$ requires $l < (5+3\delta)/(1+\delta)$, which is fulfilled for any δ, because $(5+3\delta)/(1+\delta) \geq 4$ for any δ. The condition $\alpha\left(p_A^{x*}, p_B^{x*}\right) \geq (l-2)/[2(l-1)]$ requires $l \leq \bar{l}_3(\delta) := 2(1+\delta)$. Note that $\partial\bar{l}_3(\delta)/\partial\delta > 0$, $\bar{l}_3(0) = 2$ and $\bar{l}_3(1) = 4$. Note finally that for any $2 \leq l \leq 4$ and any δ, it holds that $p_A^{x*} > 0$ and $p_B^{x*} \geq 0$.

iii) Consider finally $\alpha \geq 1/(l-1)$, in which case the profits of the second period are given by (6). Then Firm A chooses p_A^x to maximize the profits:

$$\begin{aligned} &\left(l - p_A^x + p_B^x\right)p_A^x + \tfrac{\delta[2\alpha(l-1)+1]^2}{9} + \delta(1-\alpha)(l-1)[1+\alpha(l-1)] \\ &= \left(l - p_A^x + p_B^x\right)p_A^x + \tfrac{\delta\left(2p_A^x - 2p_B^x - 1\right)^2}{9} + \delta\left(l - p_A^x + p_B^x\right)\left(p_A^x - p_B^x\right). \end{aligned} \tag{21}$$

Firm B chooses p_B^x to maximize the profits:

$$\begin{aligned} &\left(p_A^x - p_B^x - 1\right)p_B^x + \tfrac{\delta[\alpha(l-1)-1]^2}{9} \\ &= \left(p_A^x - p_B^x - 1\right)p_B^x + \tfrac{\delta\left(p_A^x - p_B^x - 2\right)^2}{9}. \end{aligned} \tag{22}$$

Solving simultaneously first-order conditions of the firms, we arrive at the prices:

$$p_A^{x*} = -\frac{-54l+42\delta-48l\delta-16\delta^2+6l\delta^2+27}{24\delta+81}, \tag{23}$$
$$p_B^{x*} = -\frac{-27l+18\delta-21l\delta-16\delta^2+6l\delta^2+54}{24\delta+81},$$

which yield the share of Firm B in the first period:

$$\alpha\left(p_A^{x*}, p_B^{x*}\right) = \frac{p_A^{x*}-p_B^{x*}-1}{l-1} = \frac{9l(1+\delta)-16\delta-18}{(27+8\delta)(l-1)}. \tag{24}$$

Note that for any $l \geq 2$ and any δ, $p_A^{x*} > 0$ and $p_B^{x*} \geq 0$ hold. The condition $\alpha\left(\cdot\right) \geq 1/\left(l-1\right)$ requires that

$$l \geq \bar{l}_4\left(\delta\right) := \frac{15+8\delta}{3(1+\delta)}.$$

Note that $\partial \bar{l}_4\left(\delta\right)/\partial\delta < 0$ and $\bar{l}_4\left(\delta\right) \leq 4$ if $\delta \geq 0.75$. The condition $\alpha\left(\cdot\right) \leq 1$ requires that

$$l \geq \frac{9-8\delta}{18-\delta}. \tag{25}$$

Since the right-hand side of (25) is for any δ smaller than 1, then $\alpha\left(\cdot\right) \leq 1$ holds for any δ and any $l \geq 2$. Finally, it can be checked that second-order conditions are fulfilled.

We use the following notation:

$$h_1\left(\delta\right) := \frac{2+\delta}{1+\delta},\; h_2\left(\delta\right) := \frac{24\delta^3+124\delta^2+176\delta+76+4(\delta+1)(2\delta+3)\sqrt{(\delta+1)(9-\delta)}}{2(4\delta^3+24\delta^2+49\delta+28)},$$
$$h_3\left(\delta\right) := \frac{-120\delta^3+276\delta^2+6552\delta+6156+36(27-10\delta)(1+\delta)\sqrt{(\delta+1)(9-\delta)}}{2(-100\delta^3+372\delta^2+531\delta+2268)},$$
$$h_4\left(\delta\right) := \frac{\left(6464\delta^3-74376\delta^2+155844\delta-90396\right)-12\left(80\delta^2-306\delta+243\right)\sqrt{5\delta^2-54\delta+81}}{2(1024\delta^3-11520\delta^2+22032\delta-11664)},$$
$$h_5\left(\delta\right) := \frac{\left(31\,360\delta^3-136\,368\delta^2+194\,076\delta-90\,396\right)-12\left(160\delta^2-396\delta+243\right)\sqrt{5\delta^2-54\delta+81}}{2(5120\delta^3-20\,736\delta^2+27\,216\delta-11\,664)}.$$

To derive the equilibria for any δ and l we have to check firms' incentives to deviate. This analysis yields the results stated in the proposition and all the technical details can be found in Baye *et al.* (2018). Precisely, we show that if $l \leq h_1(\delta)$, then in equilibrium in the first period firms charge prices (16) and realize profits (10) and (11). If $h_1(\delta) < l \leq h_2(\delta)$, then firms realize the same profits but charge the prices (12). If $h_3(\delta) \leq l \leq \min\{h_4(\delta), h_5(\delta)\}$, then in equilibrium firms charge prices (19) and realize profits (17) and (18). Finally, if $l \geq \max\{h_4(\delta), h_5(\delta)\}$, then in equilibrium firms charge prices:

$$p_A^{x*} = \tfrac{l(18-14\delta)+6\delta-9}{27-20\delta} \text{ and } p_B^{x*} = \tfrac{l(9-6\delta)+14\delta-18}{27-20\delta}, \tag{26}$$

the profits of firms A and B are

$$(l - p_A^x + p_B^x)\, p_A^x + \tfrac{\delta}{9}\left[(2p_A^x - 2p_B^x - 1)^2 + (2l - p_A^x + p_B^x)^2\right] \text{ and} \tag{27}$$

$$(p_A^x - p_B^x - 1)\, p_B^x + \tfrac{\delta}{9}\left[(p_A^x - p_B^x - 2)^2 + (l - 2p_A^x + 2p_B^x)^2\right], \tag{28}$$

respectively. Note finally that if $\delta \lesssim 0.98$, then $\min\{h_4(\delta), h_5(\delta)\} = h_4(\delta)$ and the other way around if $\delta > 0.98$. Our results show that if $h_2(\delta) < l < h_3(\delta)$ and $h_4(\delta) < l < h_5(\delta)$, then no equilibrium in pure strategies in the first period exists. If $h_5(\delta) < l < h_4(\delta)$, then two equilibria exist, where in the first period firms charge prices (19) or (26). *Q.E.D.*

Figure 4 depicts the critical values of the ratio of transport costs l as a function of δ that give rise to the equilibria stated in proposition 2.

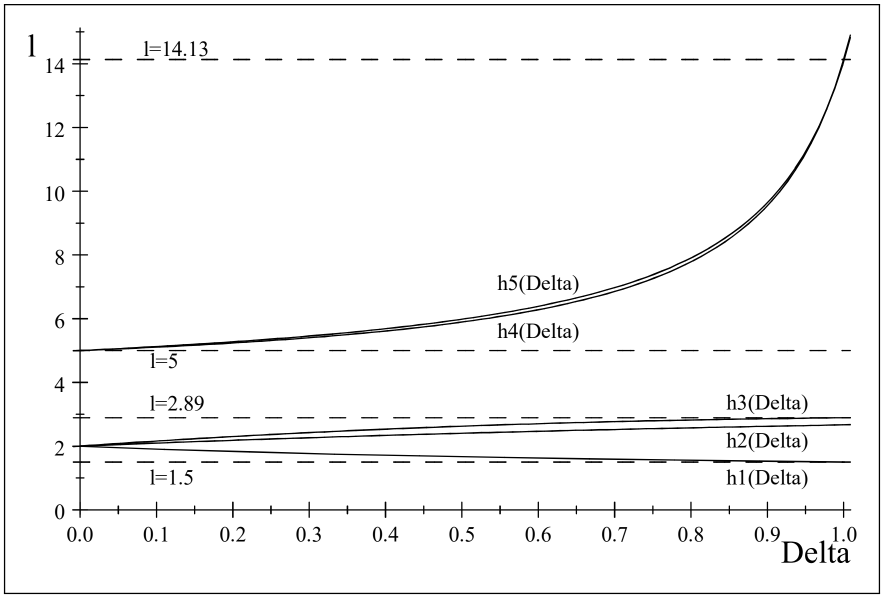

Figure 4: Critical values of parameter l giving rise to the equilibria stated in proposition 2.

Proof of proposition 4. For any l and δ we first calculate the equilibrium discounted social welfare over two periods and then subtract equilibrium profits to derive consumer surplus.

i) If $l \leq h_1(\delta)$, then each firm serves all consumers at any location on its turf in both periods, such that social welfare is

$$SW_1^{1+2}(l,\delta) = v(1+\delta) - \frac{2(1+\delta)}{1-\underline{t}} \int_{\underline{t}}^{1} \int_{0}^{1/2} (tx)\, dx dt = v(1+\delta) - \frac{(1+\delta)(l+1)\underline{t}}{8}.$$

The discounted profits of a firm over two periods are given by the sum of (10) and (11) evaluated at (16), multiplied by $\underline{t}(1-2x)/(l-1))$ and integrated over $x \in [0,1/2]$, which yields the discounted profits of both firms over two periods: $\Pi_1^{1+2}(l,\delta) = (1+\delta)\underline{t}/2$. The difference between $SW_1^{1+2}(l,\delta)$ and $\Pi_1^{1+2}(l,\delta)$ yields consumer surplus: $CS_1^{1+2}(l,\delta) = v(1+\delta) - (1+\delta)(l+5)\underline{t}/8$.

ii) If $h_1(\delta) < l \leq h_2(\delta)$, then the discounted profits of a firm over two periods are given by the sum of (10) and (11) evaluated at (12), multiplied by $\underline{t}(1-2x)/(l-1)$ and integrated over $x \in [0,1/2]$, which yields the discounted profits of both firms over two periods:

$$\Pi_2^{1+2}(l,\delta) = \frac{\underline{t}\left[l^2\left(\delta^3+6\delta^2+10\delta+5\right)-l\left(-2\delta^3-2\delta^2+7\delta+8\right)-3\delta^3-8\delta^2-2\delta+5\right]}{2(2\delta+3)^2(l-1)}.$$

We calculate now social welfare. At each location on its turf a firm serves consumers with $t \geq t^\alpha(\cdot) = \underline{t}(1+\delta)(l+1)/(2\delta+3)$ (we used (8) to compute $t^\alpha(\cdot)$) in the first period and all consumers in the second period, which yields the discounted social welfare over two periods, $SW_2^{1+2}(l,\delta) =$

$$= v(1+\delta) - \frac{2}{1-\underline{t}}\int_{\frac{\underline{t}(1+\delta)(l+1)}{2\delta+3}}^{1}\int_0^{1/2}(tx)\,dxdt - \frac{2}{1-\underline{t}}\int_{\underline{t}}^{\frac{\underline{t}(1+\delta)(l+1)}{2\delta+3}}\int_0^{1/2}\left[t(1-x)\right]dxdt - \frac{2\delta}{1-\underline{t}}\int_{\underline{t}}^{1}\int_0^{1/2}(tx)\,dxdt$$
$$= v(1+\delta) - \frac{\underline{t}\left[l^2\left(4\delta^3+18\delta^2+25\delta+11\right)+l\left(4\delta^2+8\delta+4\right)-4\delta^3-22\delta^2-41\delta-25\right]}{8(l-1)(2\delta+3)^2}.$$

Subtracting $\Pi_2^{1+2}(l,\delta)$ from $SW_2^{1+2}(l,\delta)$ we get the discounted consumer surplus over two periods:

$$CS_2^{1+2}(l,\delta) = v(1+\delta) + \frac{\underline{t}\left[-l^2\left(8\delta^3+42\delta^2+65\delta+31\right)+l\left(-8\delta^3-12\delta^2+20\delta+28\right)+16\delta^3+54\delta^2+49\delta+5\right]}{8(2\delta+3)^2(l-1)}.$$

iii) If $h_3(\delta) \leq l \leq \min\{h_4(\delta), h_5(\delta)\}$, then the discounted profits of a firm over two periods are given by the sum of (17) and (18) evaluated at the prices (19) multiplied by $\underline{t}(1-2x)/(l-1)$ and integrated over $x \in [0,1/2]$, which yields the discounted profits of both firms over two periods:

$$\Pi_3^{1+2}(l,\delta) = -\frac{\underline{t}\left[l^2\left(20\delta^3-60\delta^2+378\delta-1215\right)-l\left(560\delta^3-2448\delta^2+2781\delta-1944\right)+675\delta^3-3084\delta^2+3240\delta-1215\right]}{6(10\delta-27)^2(l-1)}.$$

We calculate now social welfare. At each location on its turf a firm serves in the first period consumers with $t \geq t^\alpha(\cdot) = \underline{t}\left[l(9-8\delta)+9(1+\delta)\right]/(27-10\delta)$ and in the second period all consumers on α and on $1-\alpha$ those with $t \geq \underline{t}\left[l+1+\alpha(l-1)\right]/3 = 3(4l+\delta-2l\delta+1)\underline{t}/(27-10\delta)$ (we used (9) to compute α), which yields the discounted social welfare over two periods, $SW_3^{1+2}(l,\delta) =$

$$= v(1+\delta) - \frac{2}{1-\underline{t}} \int\limits_{\frac{\underline{t}[l(9-8\delta)+9(1+\delta)]}{27-10\delta}}^{1} \int\limits_{0}^{1/2} (tx)\, dxdt - \frac{2}{1-\underline{t}} \int\limits_{\underline{t}}^{\frac{\underline{t}[l(9-8\delta)+9(1+\delta)]}{27-10\delta}} \int\limits_{0}^{1/2} [t(1-x)]\, dxdt$$

$$- \frac{2\delta}{1-\underline{t}} \int\limits_{\underline{t}}^{\frac{\underline{t}[l(9-8\delta)+9(1+\delta)]}{27-10\delta}} \int\limits_{0}^{1/2} (tx)\, dxdt - \frac{2\delta}{1-\underline{t}} \int\limits_{\frac{\underline{t}[l(9-8\delta)+9(1+\delta)]}{27-10\delta}}^{\frac{3(4l+\delta-2l\delta+1)\underline{t}}{27-10\delta}} \int\limits_{0}^{1/2} [t(1-x)]\, dxdt$$

$$- \frac{2\delta}{1-\underline{t}} \int\limits_{\frac{3(4l+\delta-2l\delta+1)\underline{t}}{27-10\delta}}^{1} \int\limits_{0}^{1/2} (tx)\, dxdt$$

$$= v(1+\delta) - \frac{\underline{t}\left[l^2\left(44\delta^3-312\delta^2+27\delta+891\right)-l\left(-216\delta^3+252\delta^2+144\delta-324\right)-244\delta^3+114\delta^2+1071\delta-2025\right]}{8(l-1)(10\delta-27)^2}.$$

Subtracting $\Pi_3^{1+2}(l,\delta)$ from $SW_3^{1+2}(l,\delta)$ we get the discounted consumer surplus over two periods, $CS_3^{1+2}(l,\delta) =$

$$= v(1+\delta) + \frac{\underline{t}\left[l^2\left(-52\delta^3+696\delta^2+1431\delta-7533\right)-l\left(2888\delta^3-10\,548\delta^2+10\,692\delta-6804\right)+3432\delta^3-12\,678\delta^2+9747\delta+1215\right]}{24(10\delta-27)^2(l-1)}.$$

iv) If $l > \max\{h_4(\delta), h_5(\delta)\}$, then the discounted profits of a firm are given by the sum of (27) and (28) evaluated at (26), multiplied by $\underline{t}(1-2x)/(l-1)$ and integrated over $x \in [0,1/2]$, which yields the discounted profits of both firms over two periods:

$$\Pi_4^{1+2}(l,\delta) = -\frac{\underline{t}\left[l^2\left(-1360\delta^3+1728\delta^2+2835\delta-3645\right)-l\left(-1280\delta^3+144\delta^2+6480\delta-5832\right)-1360\delta^3+1728\delta^2+2835\delta-3645\right]}{18(20\delta-27)^2(l-1)}.$$

We now compute social welfare. At each location on its turf a firm serves in the first period consumers with $t \geq t^\alpha(\cdot) = \underline{t}[(9-8\delta)(l+1)]/(27-20\delta)$. In the second period a firm serves consumers with $\underline{t}(36-28\delta+9l-8l\delta)/(81-60\delta) \leq t \leq t^\alpha(\cdot)$ on α and consumers with $\underline{t}(9-8\delta+36l-28l\delta)/(81-60\delta) \leq t \leq 1$ on $1-\alpha$, which yields the discounted social welfare over two periods, $SW_4^{1+2}(l,\delta) =$

$$= v(1+\delta) - \frac{2}{1-\underline{t}} \int_{\frac{\underline{t}[(9-8\delta)(l+1)]}{27-20\delta}}^{1} \int_0^{1/2} (tx)\, dxdt - \frac{2}{1-\underline{t}} \int_{\underline{t}}^{\frac{\underline{t}[(9-8\delta)(l+1)]}{27-20\delta}} \int_0^{1/2} [t(1-x)]\, dxdt$$

$$- \frac{2\delta}{1-\underline{t}} \int_{\frac{\underline{t}[36-28\delta+9l-8l\delta]}{81-60\delta}}^{\frac{\underline{t}[(9-8\delta)(l+1)]}{27-20\delta}} \int_0^{1/2} (tx)\, dxdt - \frac{2\delta}{1-\underline{t}} \int_{\frac{\underline{t}[9-8\delta+36l-28l\delta]}{81-60\delta}}^{1} \int_0^{1/2} (tx)\, dxdt$$

$$- \frac{2\delta}{1-\underline{t}} \int_{\underline{t}}^{\frac{\underline{t}[36-28\delta+9l-8l\delta]}{81-60\delta}} \int_0^{1/2} [t(1-x)]\, dxdt - \frac{2\delta}{1-\underline{t}} \int_{\frac{\underline{t}[(9-8\delta)(l+1)]}{27-20\delta}}^{\frac{\underline{t}[9-8\delta+36l-28l\delta]}{81-60\delta}} \int_0^{1/2} [t(1-x)]\, dxdt = v(1+\delta)$$

$$- \frac{\underline{t}\left[-l^2\left(-4144\delta^3+6696\delta^2+4455\delta-8019\right)-l\left(512\delta^3-3168\delta^2+5508\delta-2916\right)-10256\delta^3+17\,784\delta^2+8181\delta-18225\right]}{72(27-20\delta)^2(l-1)}.$$

Subtracting $\Pi_4^{1+2}(l,\delta)$ from $SW_4^{1+2}(l,\delta)$ we get the discounted consumer surplus over two periods, $CS_4^{1+2}(l,\delta) = v(1+\delta) +$

$$+ \frac{\underline{t}\left[l^2\left(-9584\delta^3+13608\delta^2+15795\delta-22599\right)-l\left(-5632\delta^3+3744\delta^2+20412\delta-20412\right)+4816\delta^3-10872\delta^2+3159\delta+3645\right]}{72(20\delta-27)^2(l-1)}.$$

The analysis of how social welfare and consumer surplus change when firms become able to recognize consumers yields the following results. If $l \leq 1.5$, both social welfare and consumer surplus do not change with targeted pricing. If $1.5 < l < 2$, they decrease for $\delta > h_1^{-1}(\delta)$ and do not change otherwise. If $2 \leq l < 2.28$ ($2 \leq l < 2.61$), then social welfare (consumer surplus) decreases with behavioral targeting for any ratio of transport costs l and δ. If $2.28 \lessapprox l < 2.29$ ($2.61 \lessapprox l < 2.62$), then social welfare (consumer surplus) (weakly) decrease for $\delta \leq l_{13}^{-1}(\delta)$ ($\delta \leq l_{14}^{-1}(\delta)$), decrease for $\delta \geq h_2^{-1}(\delta)$ and increases otherwise, with

$$l_{13}(\delta) := \frac{-\left(-772\delta^2+254\delta+1026\right)+6(27-10\delta)\sqrt{225\delta^2-1016\delta+1045}}{2(352\delta^2-1016\delta+918)},$$
$$l_{14}(\delta) := \frac{\left(5732\delta^2-21982\delta+18684\right)+2(27-10\delta)\sqrt{3(3347\delta^2-9712\delta+7068)}}{2(1472\delta^2-5776\delta+5076)}.$$

If $2.29 \lessapprox l \lessapprox 2.67$ ($2.62 \lessapprox l \lessapprox 2.67$), then social welfare and consumer surplus increase for $\delta \leq h_3^{-1}(\delta)$ and decrease for $\delta \geq h_2^{-1}(\delta)$. Finally, if $l > 2.67$, then both social welfare and consumer surplus increase for any $\delta > 0$. The technical details of the comparisons of social welfare (consumer surplus) can be found in Baye *et al.* (2018). *Q.E.D.*

How do first-period prices depend on the discount factor?

The relationship between the equilibrium first-period prices and the discount factor is quite straightforward. The following claim summarizes our results.

Claim. *A higher disount factor δ has no impact on the equilibrium first-period price of a firm at any location on its turf if $l \leq h_1(\delta)$. Otherwise, with $l > h_1(\delta)$, these equilibrium prices increase in δ if $l < \widetilde{l}(\delta)$ and (weakly) decrease in δ if $l \geq \widetilde{l}(\delta)$.*

Proof. As firms are symmetric, we consider the equilibrium prices of firm A at any x on its turf in the first period, which are stated in the proof of proposition 2 in the Online Appendix. If $l \leq h_1(\delta)$, then $\partial p_A^{x*}(x)/\partial\delta = 0$ for any δ. If $h_1(\delta) < l \leq h_2(\delta)$, then $\partial p_A^{x*}/\partial\delta = 2(l+1)/(2\delta+3)^2 > 0$ for any δ. If $h_3(\delta) \leq l \leq \min\{h_4(\delta), h_5(\delta)\}$, then

$$\frac{\partial p_A^{x*}}{\partial\delta} > 0 \text{ if } l < \widetilde{l}(\delta) := \frac{120\delta^2 - 648\delta + 675}{40\delta^2 - 216\delta + 216}$$

and $\partial p_A^{x*}/\partial\delta \leq 0$ otherwise. Note that $h_3(\delta) < \widetilde{l}(\delta) < \min\{h_4(\delta), h_5(\delta)\}$ holds for any δ. Finally, if $l \geq \max\{h_4(\delta), h_5(\delta)\}$, then $\partial p_A^{x*}/\partial\delta = -18(l+1)/(20\delta-27)^2 < 0$ for any δ. *Q.E.D.*

Threshold values of the parameter regions

Throughout the paper, we refer to parameter regions defined by threshold values to characterize the results. Precise values are not economically interesting and follow from the parametrization ($\bar{t} = 1$) and assumptions such as the uniform distribution of customers along locations. For completeness, they are reported in this section. We do not repeat the explanation or intuition behind the results in this section.

Result	Range of l	Statement
Lemma 1	$l \leq 2$	Firms serve all nearby consumers in period 2 independent of period-1 market shares.
	$2 < l < 4$	Period-2 market shares depend on period-1 market shares.
	$l \geq 4$	Irrespective of period-1 market shares, firms always give up some consumers to the rival in period 2.
Proposition 1	$l \leq 2.38$	Behavioral data (weakly) increases period-2 profits.*
	$2.38 < l < 8$	The effect of behavioral data on period-2 profits depends on α.**
	$l \geq 8$	Behavioral data (weakly) reduces period-2 profits.***
Proposition 2, period 1	$l \leq 1.5$	Firms serve all nearby consumers independently of δ.
	$1.5 < l \leq 2$	Firms give up some nearby consumers when δ is large.
	$l > 2$	Firms give up some nearby consumers independently of δ.
Proposition 2, period 2	$l \leq 2$	Firms serve all nearby consumers independent of α.
	$2 < l \leq 4$	Period-2 market shares and profit depend on α and l.
	$l > 4$	See previous case, but the bounds are different.
Corollary 1	$l \leq h_1(\delta)$	Firms serve all nearby consumers.
	$h_1(\delta) < l \lessapprox 2.64$	Higher δ implies more precise behavioral targeting.
	$2.64 < l < 2.67$	Higher δ implies less (more) precise behavioral targeting if δ is low (high).
	$l \gtrapprox 2.67$	Higher δ implies less precise behavioral targeting.****

Table 2: Numerical results for lemma 1, propositions 1 and 2, corollary 1

$*$ Profits are an inverted U-shaped function of α. Moreover, for any $\alpha \in (0, 1)$ profits are higher than at $\alpha = 0$ ($\alpha = 1$). The highest profit level is attained at $\alpha = 1/2$.

** Profits are given by different non-monotonic functions of l, sharing the following common features: First, there exists $\widehat{\alpha}(l)$, such that profits are lower than at $\alpha = 0(\alpha = 1)$ if $\alpha < \widehat{\alpha}(l)$ and are higher otherwise. Moreover, $\partial\widehat{\alpha}(l)/\partial l > 0$. Second, the highest profit level is attained at $\alpha = 1/2$ if $l < 2.8$ and at $\alpha = (9l - 16) / [8 (l - 1)]$ otherwise.

*** Profits are a U-shaped function of α. Moreover, for any $\alpha \in (0, 1)$ profits are lower than at $\alpha = 0$ ($\alpha = 1$). The lowest profit level is attained at $\alpha = (2l - 3) / [5 (l - 1)]$.

**** In line with Esteves (2010).

Result	Range of l	Statement
Proposition 3	$l \leq 1.5$	No effect of behavioral targeting.
	$1.5 < l < 2$	Behavioral data increases total profit if δ sufficiently high, no effect otherwise.
	$2 < l \lessapprox 3.07$	Behavioral data increases total profit irrespective of δ.
	$3.07 < l \lessapprox 4$	Behavioral data (weakly) increases total profit for sufficiently large δ and decreases it otherwise.
	$l > 4$	Behavioral data decreases total profit.
Proposition 4, social welfare	$l \leq 1.5$	No effect of behavioral data.
	$1.5 < l < 2$	Negative effect for large δ, no effect otherwise.
	$2 \leq l < 2.28$	Negative effect irrespective of δ.
	$2.28 \lessapprox l \lessapprox 2.67$	Negative effect for large δ, positive otherwise.
	$l > 2.67$	Positive effect irrespective of δ.
Proposition 4, consumer surplus	$l \leq 1.5$	No effect of behavioral data.
	$1.5 < l < 2$	Negative effect for large δ, no effect otherwise.
	$2 \leq l < 2.61$	Negative effect irrespective of δ.
	$2.61 \lessapprox l \lessapprox 2.67$	Negative effect for large δ, positive otherwise.
	$l > 2.67$	Positive effect irrespective of δ.

Table 3: Numerical results for propositions 3 and 4