Errata file for "Industrial Organization: Practice Exercises with Answer Keys" Springer

Pak-Sing Choi, Eric Dunaway, and Felix Munoz-Garcia

November 18, 2022

1. **Chapter 1**.

   - Exercise 1.17(b). Page 47. The sixth line of the page should read "Taking the first order condition with respect to A, yields "
   - Exercise 1.17(c). Page 48. The fourth and fifth lines of the page should read "a larger α indicates that advertising expenditures are more efficient at boosting demand. "

2. **Chapter 2**.

   - Exercise 2.8(b). Page 74. The sixth displayed equation of the page should read: "Rearranging and solving for q_1, we find firm 1's equilibrium output

   $$q_1^* = \frac{n(1-c) - (n-1)(1-c')}{n+1}.$$

   which is positive since $n > n-1$ and $1-c \geq 1-c'$. We can finally insert this output level into firm i's best response function to find its equilibrium output, that is,

   $$\begin{aligned} q_i^* =& \frac{1-c'}{n} - \frac{1}{n}\left(\frac{n(1-c)}{n+1} - \frac{(n-1)(1-c')}{n+1}\right) \\ =& \frac{1+c-2c'}{n+1}." \end{aligned}$$

   - Exercise 2.8(c). Pages 74-75. Last sentence of the page should read: "Evaluating firm 1's equilibrium output at $c = c'$, we obtain

   $$\begin{aligned} q_1^* &= \frac{n(1-c) - (n-1)(1-c)}{n+1} \\ &= \frac{1-c}{n+1} \end{aligned}$$

   Similarly, evaluating its rivals' equilibrium output at $c = c'$, we find

   $$\begin{aligned} q_i^* &= \frac{1+c-2c}{n+1} \\ &= \frac{1-c}{n+1} \end{aligned}$$

   where $q_1^* = q_i^*$ coincides with the equilibrium output in a standard Cournot model with n symmetric firms. "

- Exercise 2.8(d). Page 75. The answer should read: "First, recall that, as found in part (b), firm 1 is unambiguously active. However, each of its rivals is active if and only if $q_i^* \geq 0$, or

$$\frac{1+c-2c'}{n+1} \geq 0$$

which, solving for firm i's costs, c', simplifies to

$$c' \leq \frac{1+c}{2} \equiv \overline{c}$$

Therefore, when $c' \leq \overline{c}$, all firms are active. Otherwise, only firm 1 is active, as it benefits from a sufficiently strong cost advantage."

- Exercise 2.8(e). Page 75. The answer should read: "When $c = c'$, the inequality in part (d) becomes

$$c \leq \frac{1+c}{2}$$

that simplifies to $c \leq 1$; a condition that holds by definition, so that all firms produce positive units when they are cost symmetric (as in the standard Cournot model with n symmetric firms)."

3. **Chapter 3**.

- Exercise 3.8, page 126, line 18 should read "...the entrant's profits should deduct the fixed costs F."

4. **Chapter 4**.

- Introduction, page 153.
  - Line 5 of the second paragraph should read "costs (Exercise 4.3)."
  - Line 2 of the fourth paragraph should be "Exercise 4.7".

5. **Chapter 5**.

- Introduction, page 198. Line 2 of the first paragraph should read "...a non-polluting oligopoly..."
- Exercise 5.6, the expression in the first bullet point of part (a) should read

$$\max_{q_i \geq 0} \; (1 - q_i - Q_{-i})\, q_i - (c - s)\, q_i$$

6. **Chapter 6**.

- Introduction, page 231-2,
  - Line 7 of the second paragraph should read "... choosing its investments in R&D,...".
  - Line 3 to 4 of the third paragraph should read "... that they sequentially choose...product or not and subsequently competing..."
  - Line 7 of the third paragraph should read "... is based on..."
- Exercise 6.4.
  - Page 241. Last paragraph should read "...lower parameter $\gamma \geq 1$ represents a higher R&D efficiency..."
  - Page 243. The paragraph that starts with "which is decreasing in x_j." should continue with "since $\gamma \geq 1$ holds by assumption. Therefore, R&D investments are strategic substitutes, meaning that a higher investment by firm j induces firm i to reduce its investment. A symmetric expression applies to firm j,..."
  - Page 245, last line, should read "...while the monopolist cannot."
- Exercise 6.5.

- Page 249. Second paragraph, starting with "where $x - x_i < 0$ and..." should read "where $x - x_i < 0$ holds when firm i invests more in R&D than its rivals, $x < x_i$, and $1 - 3n < 0$ holds for all admissible values of n since $n \geq 1$ by assumption; but at a decreasing rate since..."
- Page 249. Third paragraph, starting with "given that $n - 1 > 0$ and..." should read "given that, as described above, $n \geq 1$ and $x < x_i$."
- Page 250. Fourth paragraph, starting with "given that $n^2 \geq 1$. Intuitively...". Its second sentence should read "...while the competition effect cancels out in equilibrium since $x_i = x_j$ for every two firms i and j. Since in equilibrium all firms invest the same amount in R&D, the competition effect is nil, implying that the only benefit from investing in R&D originates, in equilibrium, from the appropriability effect. Because this effect is decreasing in n, while the cost of investing in R&D is unaffected by n, firms reduce their R&D investments."

- Exercise 6.6. Page 254. Line 12 should change "their individual " to "its individual."
- Exercise 6.7.
  - Page 256. The last sentence before part (b) should read "which is unambiguously increasing in firm i's R&D investment, x_i. However, $q_i(x_i, x_j)$ is also increasing in its rival's R&D investment, x_j, if and only if $\beta \geq \frac{1}{2}$. Intuitively, when $\beta < \frac{1}{2}$, firm j's R&D investment produces a negative external effect on firm i's profits. (This includes the case where spillovers are absent, $\beta = 0$, as in previous exercises.) In contrast, when $\beta \geq \frac{1}{2}$, spillover effects are so intense that firm j's R&D investment generates a positive external effect on firm i's profits."
  - Page 257. The third displayed equation should read

$$x_i(x_j) = \frac{2(2-\beta)(1-c)}{1+8\beta-2\beta^2} + \frac{2(2-\beta)(2\beta-1)}{1+8\beta-2\beta^2} x_j.$$

  - Page 257. Previous to last paragraph, after the displayed equation of x_i^*, should read "which is unambiguously positive since the numerator is positive and the denominator is also positive for all admissible values of β."
  - Page 258. The last line should read "..., is positive for all $\beta \in [0, 1]$.
  - Page 259. Last paragraph of page 259 should read as follows "Intuitively, when $\beta < \frac{1}{2}$ (which includes the special case of $\beta = 0$, as in exercise 6.6), firm i's R&D investment only generates a negative externality on its rival's costs. As a consequence, when firms form an RJV they internalize this negative externality, choosing a lower investment in R&D. In contrast, when $\beta \geq \frac{1}{2}$, the positive externality from spillovers dominates the negative externality from R&D investment. In this context, the RJV internalizes the positive externality by investing more in R&D than when firms independently choose their own investments."

- Exercise 6.8. Page 260. The title of the exercise should read "Two Firms Sequentially Developing New Products^B"
- Exercise 6.9.
  - Page 265. Line 20 should read "less efficient "
  - Page 266. The fourth expression (first displayed equation in part c) should read as follows

$$\begin{aligned}
W(t) &= \frac{1}{2}\left[Q(t)\right]^2 + N\pi_i(t) - N^2\left[e_i(t)\right]^2 \\
&= \frac{N^2}{2}\left(\frac{1-c-t}{N+1}\right)^2 + N\left(\frac{1-c-t}{N+1}\right)^2 + \frac{Nt^2\left[1+2\beta(N-1)\right]}{2\gamma} \\
&\quad - N^2\left[\left(\frac{1-c-t}{N+1}\right)^2 - \frac{2t(1-c-t)\left[1+\beta(N-1)\right]}{\gamma(N+1)} + \frac{t^2\left[1+\beta(N-1)\right]^2}{\gamma^2}\right] \\
&= \frac{2N^2\left[1+\beta(N-1)\right](1-c-t)t}{\gamma(N+1)} - \frac{N(N-2)(1-c-t)^2}{2(N+1)^2} \\
&\quad + \frac{N\left[\gamma(1+2\beta(N-1)) - 2N(1+\beta(N-1))^2\right]t^2}{2\gamma^2}
\end{aligned}$$

– Page 266. The last displayed equation should read as

$$\frac{2N^2\left[1+\beta\left(N-1\right)\right]\left(1-c-2t\right)}{\gamma\left(N+1\right)}+\frac{N\left(N-2\right)\left(1-c-t\right)}{\left(N+1\right)^2}$$
$$+\frac{N\left[\gamma\left(1+2\beta\left(N-1\right)\right)-2N\left(1+\beta\left(N-1\right)\right)^2\right]t}{\gamma^2}=0$$

– Page 267. The first expression should read as follows: "Solving for t, the optimal emission fee is

$$t\left(N\right)=\frac{\gamma\left[2N\left(N+1\right)\left(1+\beta\left(N-1\right)\right)+\gamma\left(N-2\right)\right]\left(1-c\right)}{4\gamma N\left(N+1\right)\left[1+\beta\left(N-1\right)\right]+\gamma^2\left(N-2\right)-\left(N+1\right)^2\left[\gamma\left(1+2\beta\left(N-1\right)\right)-2N\left(1+\beta\left(N-1\right)\right)^2\right]}$$

Substituting $c=0$ and $\gamma=5$ into the above equation, we find that the optimal emission fee becomes

$$t\left(N\right)=\frac{5\left[2N\left(N+1\right)\left(1+\beta\left(N-1\right)\right)+5\left(N-2\right)\right]}{20N\left(N+1\right)\left[1+\beta\left(N-1\right)\right]+25\left(N-2\right)-\left(N+1\right)^2\left[5\left(1+2\beta\left(N-1\right)\right)-2N\left(1+\beta\left(N-1\right)\right)^2\right]}$$

– Page 267, immediately before part (d), please remove the second line that says 'where $A\equiv 1+\beta\left(N-1\right)$.'

– Page 267. The fourth expression should read as

$$\frac{10N\left[1+\beta\left(N-1\right)\right]-\left(N+1\right)\left[5\left(1+2\beta\left(N-1\right)\right)-2N\left(1+\beta\left(N-1\right)\right)^2\right]}{20N\left(N+1\right)\left[1+\beta\left(N-1\right)\right]+25\left(N-2\right)-\left(N+1\right)^2\left[5\left(1+2\beta\left(N-1\right)\right)-2N\left(1+\beta\left(N-1\right)\right)^2\right]}$$

– Page 267. The fifth expression should read as

$$\begin{aligned}z_i(N) &= \frac{t(N)}{\gamma}\\ &= \frac{2N\left(N+1\right)\left(1+\beta\left(N-1\right)\right)+5\left(N-2\right)}{20N\left(N+1\right)\left[1+\beta\left(N-1\right)\right]+25\left(N-2\right)-\left(N+1\right)^2\left[5\left(1+2\beta\left(N-1\right)\right)-2N\left(1+\beta\left(N-1\right)\right)^2\right]}\end{aligned}$$

– Page 267. The sixth expression should read as

$$\begin{aligned}Z\left(N\right) &= \frac{2N^2\left(N+1\right)+5N\left(N-2\right)}{20N\left(N+1\right)+25\left(N-2\right)-\left(N+1\right)^2\left(5-2N\right)}\\ &= \frac{N(2N^2+7N-10)}{2N^3+19N^2+37N-55}.\end{aligned}$$

– Page 267. The seventh expression (last displayed equation of the page) should read as follows

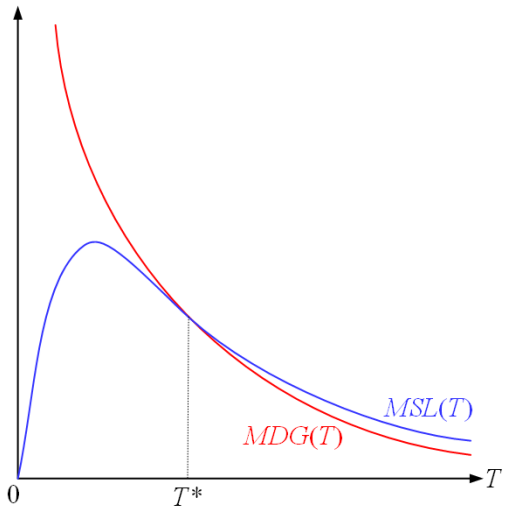
$$\frac{\partial Z\left(N\right)}{\partial N}=\frac{24N^4+188N^3+119N^2-770N+550}{\left(2N^3+19N^2+37N-55\right)^2}$$

– Page 268. The first displayed equation should read

$$\begin{aligned}Z\left(N\right) &= \frac{2N^2\left(N+1\right)^2+10N\left(N-2\right)}{20N\left(N+1\right)^2+50\left(N-2\right)-\left(N+1\right)^2\left[10N-N\left(N+1\right)^2\right]}\\ &= \frac{2N^4+4N^3+12N^2-20N}{N^5+4N^4+16N^3+24N^2+61N-100}.\end{aligned}$$

– Page 268. The first bullet point should be part (f).

- Exercise 6.11. Page 276. Figure 6.6 should be replaced with the following figure.



The last paragraph of this exercise should read "...and the $MSL(T)$ curve, which is concave in T, and their crossing point at the socially optimal patent length, T^*. It is beyond the scope of this exercise, but you may check that, indeed, the $MSL(T)$ curve originates at $MSL(0) = 0$, increases in T, reaches a maximum at $T = \frac{\log 2}{r}$, and then decreases in T."

- Exercise 6.12.
  - Page 276. Add the following sentence immediately after the description in line 10: "For simplicity, consider $\frac{1}{2} \leq c \leq 1$."
  - Page 277.
    - The second expression should read

$$S(T) = \frac{e^{-rT}\left[\frac{(1-\frac{c}{\alpha})^2}{2} - (1-e^{rT})\left(\frac{(1-c)[\alpha(1+c)-2c]}{2\alpha}\right)\right]}{r},$$

and the third expression should read

$$S\left(T\right) = \frac{e^{-rT}}{2\alpha^2 r}\left[c^2\left(\alpha-1\right)^2 + e^{rT}\alpha\left(1-c\right)\left(\alpha+\alpha c-2c\right)\right].$$

    - Line 5. Remove "(an implicit condition suffices)"
    - The fifth expression should read

$$S'\left(T\right) = \frac{e^{-rT}}{2\alpha^2}\left[\alpha\left(1-c\right)\left(\alpha+\alpha c-2c\right) - \left(\alpha-c\right)^2\right],$$

    - Lines 8 to 12. Remove the following phrases "For an interior solution of T, $MSL(T)$ must be increasing in T, ... when $s = 0.05$. "
  - Page 278.
    - Line 1. Change to $c = 0.9$.
    - Line 2. Change to $T = 43.9$.
    - Line 5. Change to 37.8 years.

7. **Chapter 7**.

- Exercise 7.16, page 329, line 2 should read "... δ_{pre}, found in part (a)."