

ECON 5360/6360
Economics of Market Power & Antitrust Law
Final Exam
Solutions

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You have 1 hour and 20 minutes to complete this exam. There is a total of 100 points available. Please work independently, and make sure to answer the questions that are asked on this exam and not what is written down in your notes.

1. Consider the Hotelling model. Two retailers are located at points 0 and 1 at opposite ends of a line segment, and consumers are located uniformly along the line. They must travel to one of the two firms in order to purchase at most one unit of the good. The cost of distance is given by τ . c_i denotes the cost of sourcing one wholesale unit of the good for each of the two retailers, $i = \{0, 1\}$. Unlike in the version presented in the lecture, for the purpose of this problem consider cases in which consumers value the good produced by each firm differently, so r_i could be different for each of the two firms.

a. Write down the consumer surplus from patronizing each of the two firms, 0 and 1. (5 points)

$$CS(0) = r_0 - \tau x - p_0$$
$$CS(1) = r_1 - \tau(1 - x) - p_1$$

b. Write down an expression for \hat{x} , the consumer who is just indifferent between patronizing each of the two firms. (5 points)

$$r_0 - \tau \hat{x} - p_0 = r_1 - \tau(1 - \hat{x}) - p_1$$
$$-\tau \hat{x} + \tau(1 - \hat{x}) = r_1 - r_0 + p_0 - p_1$$
$$\tau - 2\tau \hat{x} = r_1 - r_0 + p_0 - p_1$$

$$2\tau\hat{x} = r_0 - r_1 + p_1 - p_0 + \tau$$

$$\hat{x} = \frac{1}{2} + \frac{r_0 - r_1 + p_1 - p_0}{2\tau}$$

Note that \hat{x} is firm 0's market share, and it is 1. increasing in consumers' relative preference for 0 over 1, $r_0 - r_1$, and 2. decreasing in the price difference $p_0 - p_1$.

c. Write down firm 0's profit function using your answer to part (b). (5 points)

We treat firm 0's market share \hat{x} as its residual demand curve, since each consumer who patronizes 0 buys only one unit. The expression for \hat{x} is decreasing in p_0 , as we need to set up and then solve a profit maximization problem.

$$\pi_0 = (p_0 - c_0) \left(\frac{1}{2} + \frac{r_0 - r_1 + p_1 - p_0}{2\tau} \right) \quad (1)$$

d. Solve firm 0's profit maximization problem to derive an expression for the optimal price charged by firm 0 as a function of τ , r_0 , r_1 , c_0 , and p_1 . (5 points)

$$[p_0] \quad \frac{1}{2} + \frac{r_0 - r_1 + p_1 - p_0}{2\tau} + -\frac{1}{2\tau}(p_0 - c_0) = 0 \quad (2)$$

$$\frac{1}{2} + \frac{r_0 - r_1 + p_1 - p_0}{2\tau} = \frac{1}{2\tau}(p_0 - c_0)$$

$$\tau + r_0 - r_1 + p_1 - p_0 = p_0 - c_0$$

$$2p_0 = \tau + r_0 - r_1 + p_1 + c_0$$

$$p_0^* = \frac{1}{2}(\tau + r_0 - r_1 + p_1 + c_0)$$

e. Write down a similar expression for firm 1's optimal price. Then use that and your answer to part (d) to compute each firm's optimal price solely in terms of τ , r , and c . (10 points)

$$p_1^* = \frac{1}{2}(\tau + r_1 - r_0 + p_0 + c_1)$$

$$p_0^* = \frac{1}{2} \left(\tau + r_0 - r_1 + \frac{1}{2}(\tau + r_1 - r_0 + p_0 + c_1) + c_0 \right)$$

$$p_0^* = \frac{1}{2} \left(\frac{3}{2}\tau + \frac{1}{2}r_0 - \frac{1}{2}r_1 + \frac{1}{2}p_0 + \frac{1}{2}c_1 + c_0 \right)$$

$$\frac{3}{4}p_0^* = \frac{3}{4}\tau + \frac{1}{4}r_0 - \frac{1}{4}r_1 + \frac{1}{4}c_1 + \frac{1}{2}c_0$$

$$p_0^* = \tau + \frac{1}{3}r_0 - \frac{1}{3}r_1 + \frac{1}{3}c_1 + \frac{2}{3}c_0$$

$$p_1^* = \tau + \frac{1}{3}r_1 - \frac{1}{3}r_0 + \frac{1}{3}c_0 + \frac{2}{3}c_1$$

f. Now assume the following parameter values:

$$\tau = 1$$

$$r_0 = 4$$

$$r_1 = 2$$

$$c_0 = c_1 = 1$$

Use these parameter values to compute the following:

- Prices for each firm (5 points)

$$p_0^* = 1 + \frac{1}{3} \cdot 4 - \frac{1}{3} \cdot 2 + \frac{1}{3} \cdot 1 + \frac{2}{3} \cdot 1 = \frac{8}{3}$$

$$p_1^* = 1 + \frac{1}{3} \cdot 2 - \frac{1}{3} \cdot 4 + \frac{1}{3} + \frac{2}{3} = \frac{4}{3}$$

- Market share for each firm (5 points)

$$\hat{x} = \frac{1}{2} + \frac{4 - 2 + \frac{4}{3} - \frac{8}{3}}{2} = \frac{1}{2} + \frac{1}{3} = \frac{5}{6}$$
$$1 - \hat{x} = \frac{1}{6}$$

- Profits for each firm (5 points)

$$\pi_0 = \left(\frac{8}{3} - 1 \right) \cdot \frac{5}{6} = \frac{25}{18}$$

$$\pi_1 = \left(\frac{4}{3} - 1 \right) \cdot \frac{1}{6} = \frac{1}{18}$$

g. In no more than two sentences, explain why firm 1 charges a lower price than firm 0. (5 points)

Firm 0 has a competitive advantage since consumers prefer its product. If it wants to compete at all, firm 1 will have to charge a lower price.

Call firm 0 “Apple” and firm 1 “Epic Games”

h. If Apple could constrain Epic Games to charge a retail price $p_1 \geq p_0$, what retail price would Epic Games choose to charge? What price would Apple choose to charge? What would Apple’s market share be? And what would Apple’s profit be? You can answer all of these questions without doing any calculus or algebra, and a minimal amount of arithmetic. (15 points)

Epic Games’s only hope is to under-price Apple, hence if Apple can ensure Epic cannot do that, Apple can make itself a monopolist. Epic will charge the lowest price it can, namely Apple’s price. Facing no price competition from Epic, Apple is then free to raise its own price.

Exactly what price Apple will charge is slightly ambiguous: it would want to price discriminate by charging each consumer $p_0(x) = r_0 - \tau x$. If it cannot price discriminate, it might charge the lowest price that will ensure full coverage: $p_0 = 3$, because the consumer that is closest to Epic is willing to pay $r_0 - \tau = 3$. At $p_0 = 3$, there is positive consumer surplus for all the consumers to the left of 1. Therefore, the profit-maximizing uniform price is higher than 3.

But no matter the exact price Apple charges between 3 and 4, there’s no room for Epic to make any profit if it cannot under-price Apple. If Epic charged a price $p_1 = 3$, even the closest consumer would be unwilling to pay since $r_1 = 2 < 3$. At $p_0 = 3$, $\pi_0 = 2$ and $\pi_1 = 0$ since Epic has no market share.

i. Briefly explain why Apple’s profit is so much higher in part (h) than part (f), even though Apple’s market share is not very different between (h) and (f). (5 points)

In part (f) Apple’s profit was $\frac{25}{18}$, so if it can prevent Epic from charging a lower price then its profit increases by (at least) $\frac{13}{18}$ even though its market share only increased by $\frac{1}{6}$. That’s because even though it was the weaker competitor, Epic’s presence in the market exerted competitive pressure on Apple, which limited the price all Apple consumers had to pay, even if there was never any chance they would patronize Epic. By removing that threat (preventing Epic from discounting), Apple’s residual demand elasticity was drastically reduced (no option of switching to Epic), so it increased its price to extract all or nearly all consumer surplus from Apple consumers.

Now assume that Epic Games is vertically integrated: in addition to competing with Apple in the app store market (Apple Store versus Epic Games Store), it also produces a popular mobile gaming app Fortnite which is an upstream supplier to both the Apple Store and the Epic Games Store.

j. What wholesale pricing policy would Epic Games choose for Fortnite? You may answer this question qualitatively. (10 points)

Epic would want to steer consumers from Apple's app store to the Epic Games store, and to do that it would charge Apple a higher wholesale price for Fortnite than it charges itself. This is in effect the conduct that precipitated the *Epic Games v. Apple* showdown: discounting for in-app purchases in Fortnite downloaded from the Epic Games store versus the Apple store.

More concretely: Unequal wholesale prices for Fortnite (advantaging the Epic Games store) would make Epic a more potent competitor in the app store market. Apple's advantage from $r_0 > r_1$ would be countervailed by $c_0 > c_1$, leveling the playing field. Whether that benefits consumers depends on whether the resulting retail price increase for Apple also increases p_1 more than the relative reduction in c_1 relative to c_0 reduces it. Recall from part (e) that p_1 is more sensitive to c_1 than to c_0 , so that implies that p_1 will, on net, decrease. So overall p_0 will increase relative to part (f) and p_1 will decrease relative to part (f). Epic will definitely gain market share, but whether consumers are benefited or harmed would require more analysis. Note that this example of non-neutrality has the potential to benefit consumers, because it counteracts the asymmetric power of the two retailers ex ante.

k. If Apple terminated Fortnite from its app store upon discovering the policy in part (j), would that benefit or harm consumers? Answer with respect to the following two cases:

- If $p_1 < p_0$, i.e. the scenario in parts (a)-(g) (5 points)

Terminating Fortnite from the app store would probably harm consumers, because it would curtail Epic's ability to steer them to the Epic Games store. Apple's app store is a competitive bottleneck in this model (and in the real world), so in order to reach Apple's consumers, Epic needs access to it, and once it has that access, it can steer by charging lower prices on its own platform. If Apple wants to prevent that, it would have to lower its take rate. By contrast, if Epic is excluded from the app store, Apple doesn't have to worry about its own customers being steered away (unless they happen to really like Fortnite and know where else to find it).

- If $p_1 \geq p_0$, i.e. the scenario in parts (h)-(i). (5 points)

If Apple's retail price parity policy from part (h) is in force, then terminating Epic from the app store probably doesn't harm consumers, because they were already being maximally harmed by the fact that Epic cannot discount. Recall that in this case Apple already has a retail monopoly, so cutting off Fortnite would simply prevent Fortnite from reaching consumers. That would be very bad for Epic, but no worse than the status quo for consumers. It's the price parity policy that's the problem for consumers.

1. On April 24th, 2023, the Ninth Circuit Court of Appeals ruled that Apple did not violate Sections 1 and 2 of the Sherman Act when it terminated Epic Games for charging lower prices for in-app purchases for Fortnite users who did not use Apple Pay for in-app payments. In your view, was that ruling correct? (10 points)

As this entire problem shows, it's a complicated case. Perhaps the best place to start the analysis is whether to define anti-competitive behavior according to Structure, Conduct, or Performance.

- **Structure:** Since in reality Apple did operate a retail price parity policy before Epic tried to steer consumers away from Apple, in the context of this problem we would say Apple was a monopolist both before and after it terminated Epic. The termination could then be understood as maintaining that monopoly (the steering Epic was trying to implement would have eroded Apple's monopoly, and Apple put a stop to it). The court held that Apple is not a monopoly, hence it cannot be liable for monopoly maintenance by definition. So under a Structure test for illegally anti-competitive behavior, the case was wrongly decided.
- **Conduct:** Apple's conduct was consciously exclusionary, hence adjudication under a conduct standard is easy: Apple is liable.
- **Performance:** Under a consumer welfare standard, 'performance' means primarily output and price, and perhaps also variety in this case. We can dismiss output off the top, because throughout the analysis of this problem we assumed full coverage, so there's no output effect, at least given the model we've used. If it's true that Apple was operating an effective retail price parity policy as in part (h), then terminating Epic from Apple's app store may not have changed the prices consumers pay, unless the steering that Apple prevented would have reduced retail prices by enhancing retail competition. This is the case Epic tried to make, but failed to convince the court. Finally, removing Fortnite from the app store necessarily reduces product variety for Apple consumers, so to the degree they are locked into Apple's store, their welfare is reduced.

The case was in fact adjudicated under a Performance standard, specifically the consumer welfare standard. I happen to think that steering is necessary in monopolistic platform markets and hence Apple's anti-steering conduct is anti-competitive, but the court's ruling in this matter is arguably legally correct in that the Supreme Court precedent *Ohio v. American Express* held that anti-steering restraints by dominant platforms likely to be pro-competitive. That case does not reflect sound economic reasoning, but the lower court probably correctly applied its precedent in *Epic Games v. Apple*.