

# Industrial Organizational Analysis 2025

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## Multiple choice questions

Question	Answer
1	a
2	b
3	d
4	d
5	d
6	c

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## Long question A

- a) Firm 1 has a residual demand of:

$$Q_1 = Sq_1 = S\left(v_1 - \frac{2}{3}v_2 - p_1 + \frac{2}{3}p_2\right) \text{ or } S\left(k_1 - p_1 + \frac{2}{3}p_2\right)$$

Firm 2 has a residual demand of:

$$Q_2 = Sq_2 = S\left(v_2 - \frac{2}{3}v_1 - p_2 + \frac{2}{3}p_1\right) \text{ or } S\left(k_2 - p_2 + \frac{2}{3}p_1\right)$$

The profit function for Firm 1 is, due to zero marginal and fixed costs, then:

$$\pi_1 = S\left(k_1 - p_1 + \frac{2}{3}p_2\right)p_1$$

The profit function for Firm 2 is then:

$$\pi_2 = S\left(k_2 - p_2 + \frac{2}{3}p_1\right)p_2$$

Taking the first order derivative of Firm 1's profit function to find the best response function:

$$\frac{d\pi_1}{dp_1} = 0 \rightarrow p_1 = \frac{1}{3}p_2 + \frac{1}{2}k_1$$

Due to symmetry, the best response function of Firm 2 is then:

$$p_2 = \frac{1}{3}p_1 + \frac{1}{2}k_2$$

- b) Inserting  $v_1 = v_2 = 1, p_2 = 0.20$  in residual demand function for Firm 1:



$$Q_1 = S \left( 1 - \frac{2}{3}(1) - p_1 + \frac{2}{3}(0.20) \right)$$

The profit maximizing price for Firm 1 when  $S = 160$  is then found by inserting the new residual demand in and the customer number in the profit function, and then taking the first order derivative:

$$\pi_1 = 160 \left( 1 - \frac{2}{3}(1) - p_1 + \frac{2}{3}(0.20) \right) p_1$$

$$\frac{d\pi_1}{dp_1} = 0 \rightarrow p_1 = 0.2333$$

When Firm 1 has 320 customers, the profit maximizing price is then:

$$\pi_1 = 320 \left( 1 - \frac{2}{3}(1) - p_1 + \frac{2}{3}(0.20) \right) p_1$$

$$\frac{d\pi_1}{dp_1} = 0 \rightarrow p_1 = 0.2333$$

The profit maximizing price for Firm 1 at both 160 and 320 customers is 0.2333.

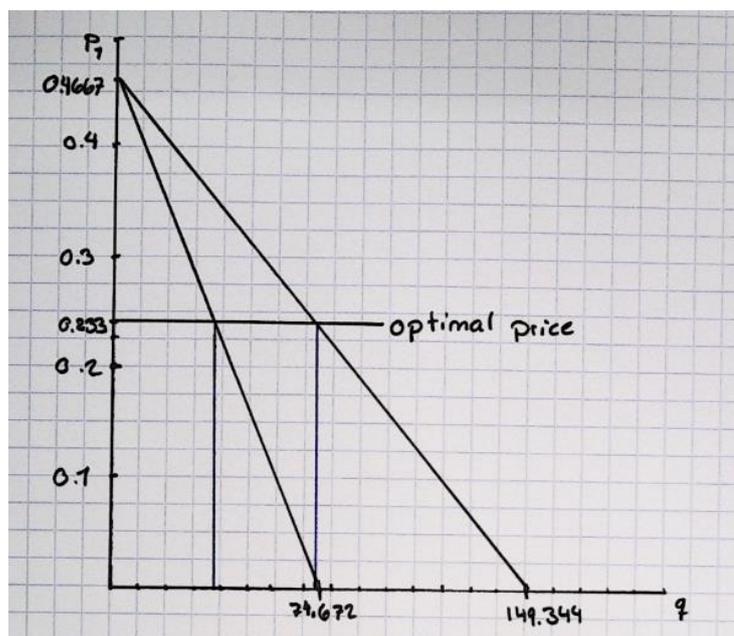
The residual demand for Firm 1 at 160 customers is:

$$Q_1 = 160 \left( 1 - \frac{2}{3}(1) - p_1 + \frac{2}{3}(0.20) \right) = 74.672 - 160p_1$$

The residual demand for Firm 1 at 320 customers is:

$$Q_1 = 320 \left( 1 - \frac{2}{3}(1) - p_1 + \frac{2}{3}(0.20) \right) = 149.344 - 320p_1$$

The residual demand for both 160 and 320 customers are illustrated. It is clear that the profit maximizing price is the same, but the quantity at 320 customers is higher than at 160 customers.





- c) When  $v_1 = v_2 = v$ ,  $k_1 = k_2 = k$ . And when the qualities are the same, the value of  $k$  will be:

$$k = v - \frac{2}{3}v = \frac{v}{3}$$

Due to symmetry,  $k = \frac{v}{3}$  can be inserted in the best response function:

$$p = \frac{1}{3}p + \frac{1}{2}\left(\frac{v}{3}\right)$$

$$p = \frac{v}{4}$$

The Nash equilibrium prices when  $v_1 = v_2$  is therefore for both firms to price at  $p = \frac{v}{4}$ .

Number of customers do not change the prices, as shown in b). Therefore, the Nash equilibrium prices for both 160 and 320 customers are the same. When  $v_1 = v_2 = 1$  then the Nash equilibrium prices are:

$$p = \frac{1}{4} = 0.25$$

When each firm has 160 customers, the profit is then for both firms:

$$\pi = 160 \left( \frac{1}{3} - 0.25 + \frac{2}{3}(0.25) \right) 0.25 = 10$$

When each firm has 320 customers, the profit is then for both firms:

$$\pi = 320 \left( \frac{1}{3} - 0.25 + \frac{2}{3}(0.25) \right) 0.25 = 20$$

When  $v_1 = v_2 = 1$  then the Nash equilibrium prices is for both firms to set a price of 0.25. With 160 customers this yields a profit of 10 for each firm, and with 320 customers it yields a profit of 20 for each firm.

- d) From c) it is known that when  $v_1 = v_2$  then  $k_1 = k_2 = k = \frac{v}{3}$ . Inserting  $k$  and Firm 2's best response function in Firm 1's profit function, and taking the first order derivative to find the price that Firm 2 sets:

$$\pi_1 = S \left( \frac{v}{3} - p_1 + \frac{2}{3} \left( \frac{1}{3}p_1 + \frac{1}{2}\left(\frac{v}{3}\right) \right) \right) p_1$$

$$\frac{d\pi_1}{dp_1} = 0 \rightarrow p_1 = 0.2857v$$

Inserting  $k$  and  $p_1$  into Firm 2's best response function:

$$p_2 = \frac{1}{3}(0.2857v) + \frac{1}{2}\left(\frac{v}{3}\right)$$

$$p_2 = 0.2619v$$



When  $v_1 = v_2$  and Firm 1 sets price first, the subgame perfect Nash equilibrium prices will be for Firm 1 to price at  $p_1 = 0.2857v$ , and then Firm 2 observes this and responds with setting a price of  $p_2 = 0.2619v$ .

The Nash equilibrium prices when  $v_1 = v_2 = 1$  is then:

$$p_1 = 0.2857(1) = 0.2857$$

$$p_2 = 0.2619(1) = 0.2619$$

When  $S = 160$  the profits are then:

$$\pi_1 = 160 \left( \frac{1}{3} - 0.2857 + \frac{2}{3}(0.2619) \right) 0.2857 = 10.1587$$

$$\pi_2 = 160 \left( \frac{1}{3} - 0.2619 + \frac{2}{3}(0.2857) \right) 0.2619 = 10.9747$$

Firm 1 does not have a first mover advantage, because the profit of Firm 2 is higher. It is worth noting that Firm 1 does have a higher profit than when the price simultaneously, but this is not considered a first mover advantage.

- e) It is assumed that they will set both product prices at the same, so they can act like a monopoly and split the profit between the products. Therefore, the profit function will be:

$$\pi_{12} = 2S \left( \frac{v}{3} - p + \frac{2}{3}p \right) p$$

To find the profit maximizing price, the first order derivative is taken of the profit function:

$$\frac{\pi_{12}}{dp} = 0 \rightarrow p = \frac{v}{2}$$

If the two firms merged to form a new firm, they would set price at  $p = \frac{v}{2}$ .

The profit maximizing price when  $v_1 = v_2 = 1$ ,  $S = 160$  is then:

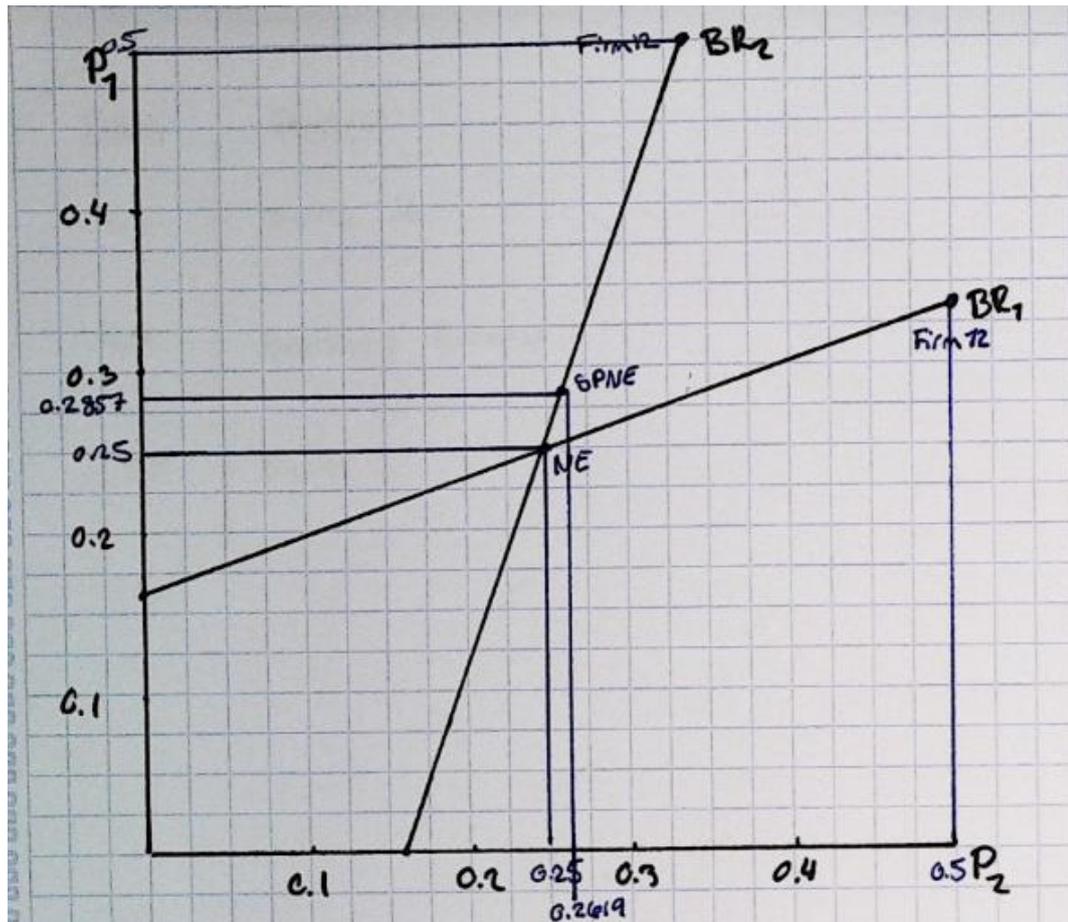
$$p = \frac{v}{2} = \frac{1}{2} = 0.5$$

This yields a profit of:

$$\pi_{12} = 2(160) \left( \frac{1}{3} - 0.5 + \frac{2}{3}(0.5) \right) 0.5 = 26.6667$$

The profit for the merged firm is then 26.6667, which is more than the aggregate in c) and d). This is due to it being a monopoly now, so they can price higher and earn a higher profit. Competition drives prices down, which is the reason behind the higher profit.

- f) It is illustrated that the price setting of 0.5 for both product is not a Nash equilibrium, but they can price higher as they are merged, and therefore they act together.



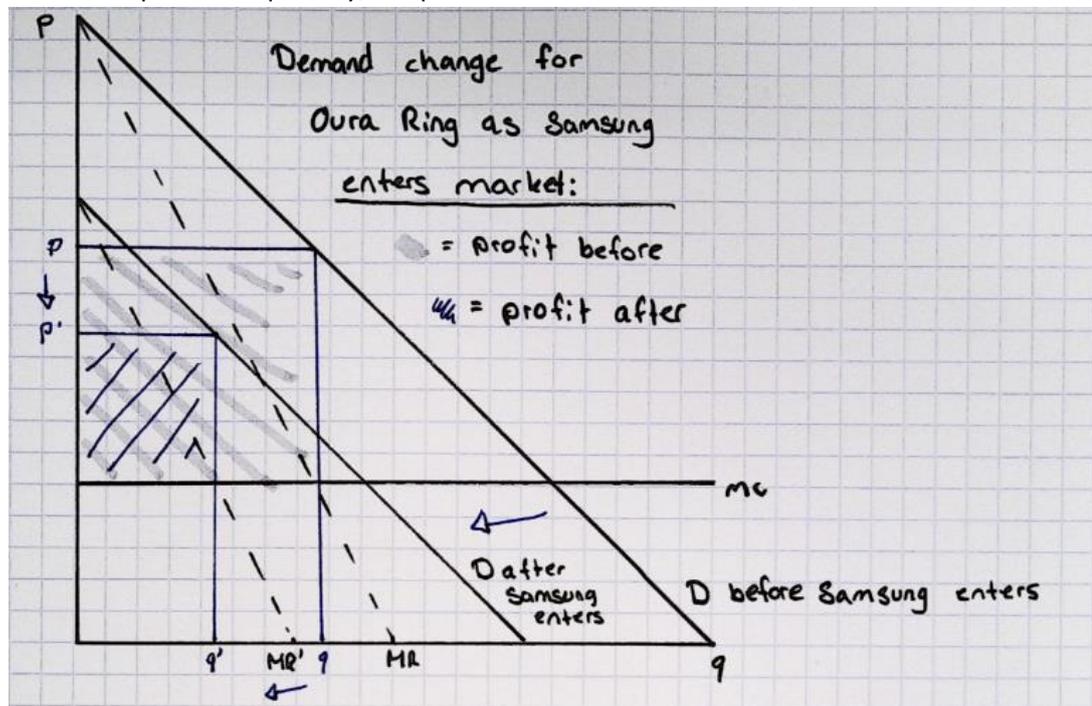
## Long question B

- Vertical differentiation is when, at the same price, only one firm would have positive sales. It is the quality that determines which product is seen as the best. Oura Ring 4 had the highest quality rating of 4.5 stars. In the ring technology things as battery life and the accuracy of the readings is important. When comparing Oura Ring 4 to the Galaxy Ring, it has more battery life and more accurate readings. It can be assumed, that Oura Ring is the best quality firm in the tech-ring market currently.

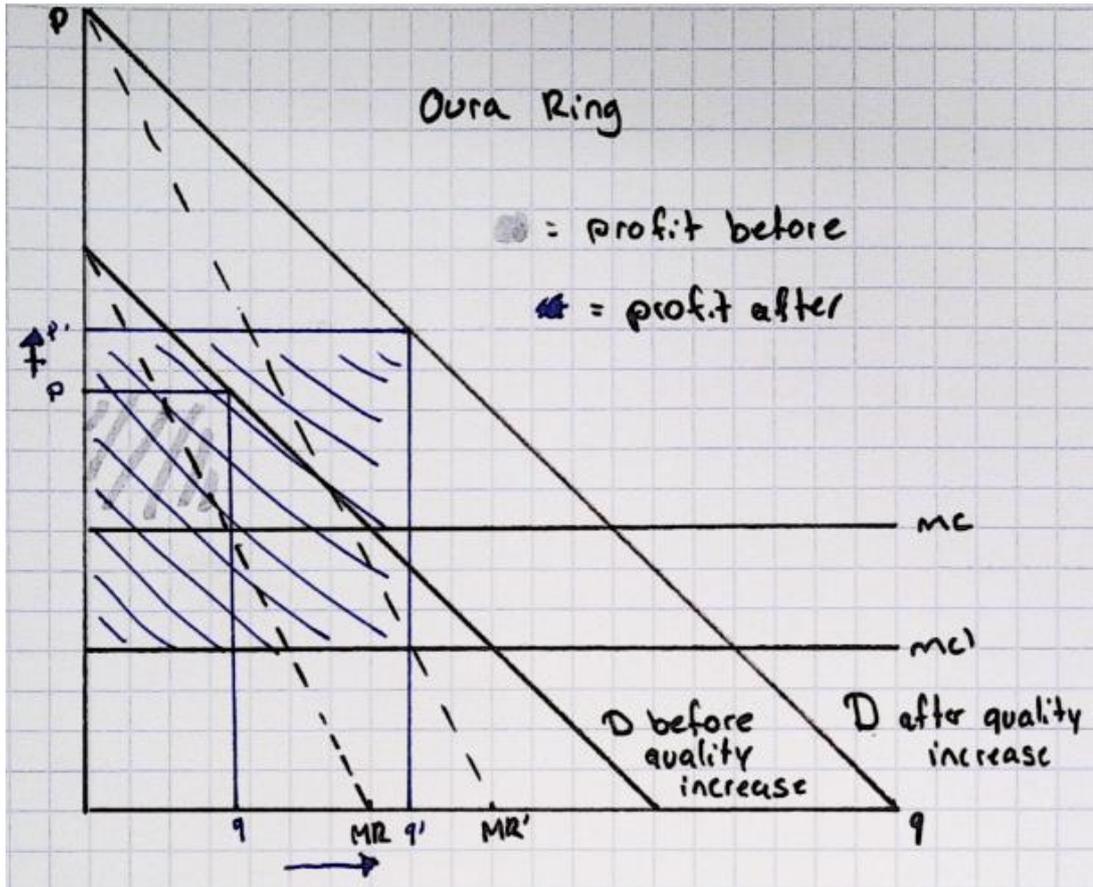
Horizontal different is when, at the same price, multiple firms would have positive sales. This is due to preferences. A product can be viewed as a combination of many characteristics. An IOS user would not want to buy the Galaxy ring, because it is not compatible with their phone. Therefore, compatibility with phones is one characteristic. Another is the color of the ring. Some – especially women – are very determined on only wearing one color of jewelry. If a person only wears gold and wants it to fit with its other jewelry, Oura is the only of the leading smart rings in 2024 that offers this.



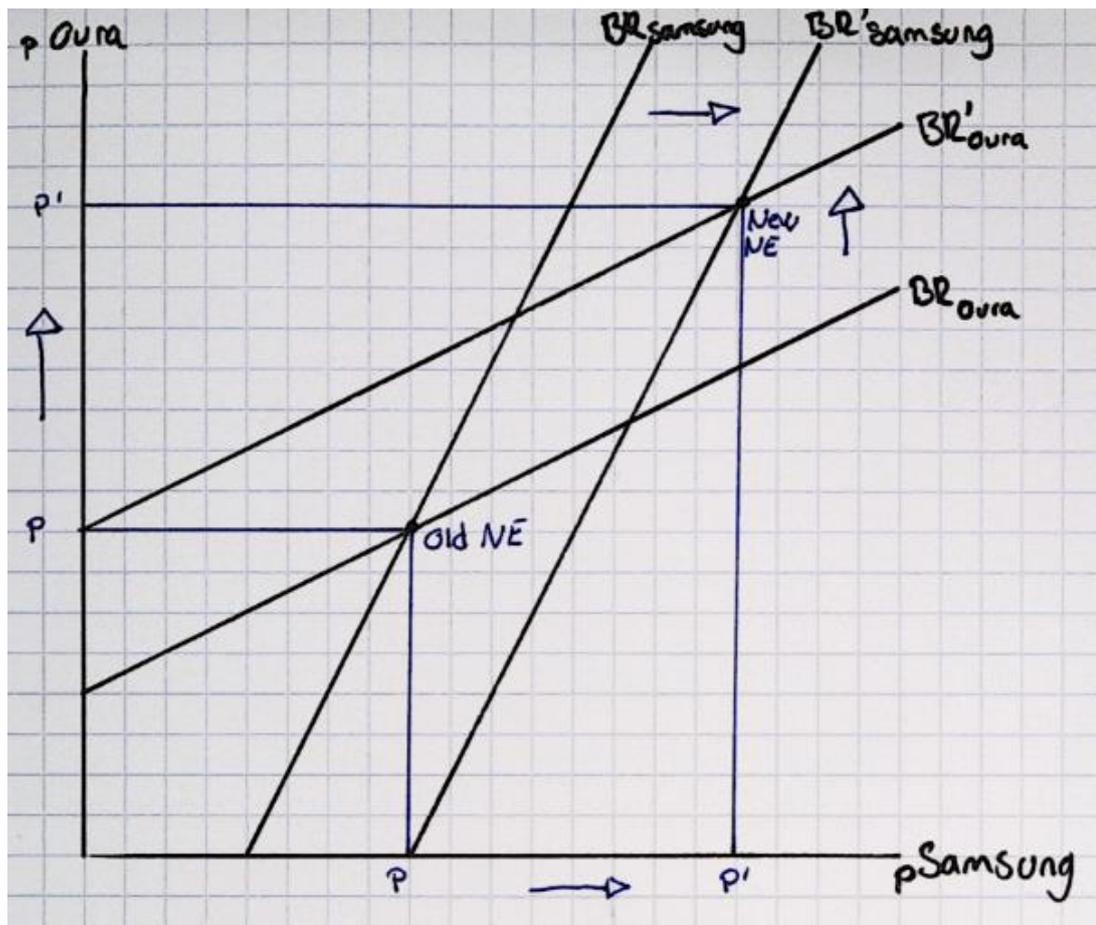
- 2) Before the introduction of the Samsung Galaxy Ring, Oura Ring 3 had monopoly of the market, which means that they could the higher monopoly price. When Samsung enters the market Oura faces more competition, and their residual demand will therefore decrease. This yields that Oura will now price lower than before to be able to compete with Samsung. Furthermore, the quantity will decrease due to more competition, and thus with both decrease in price and quantity, the profit for Oura will decrease.



- 3) With more accuracy in the sensors, the perceived quality of an Oura Ring will increase, which will increase their residual demand. The cheaper sensors yield a decrease in marginal cost for Oura. With both lower marginal cost and an outward shift in demand, Oura will increase both its price and quantity, which therefore also increases the profit.

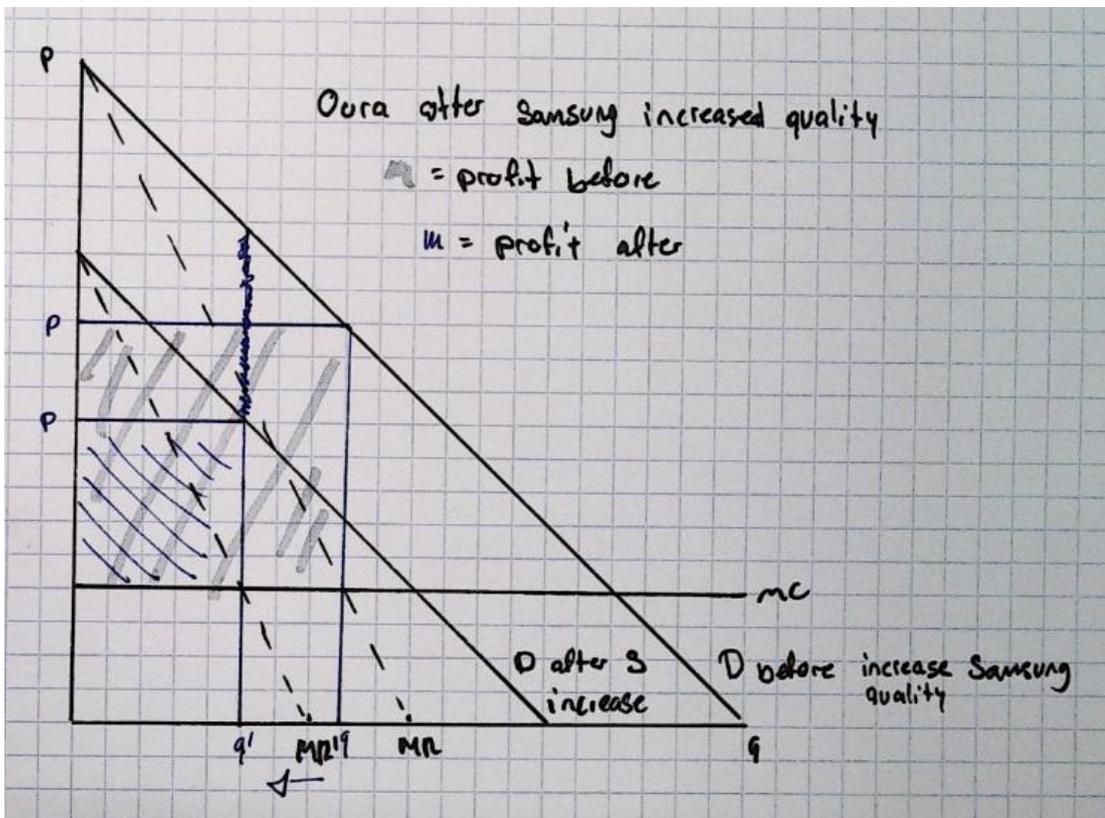
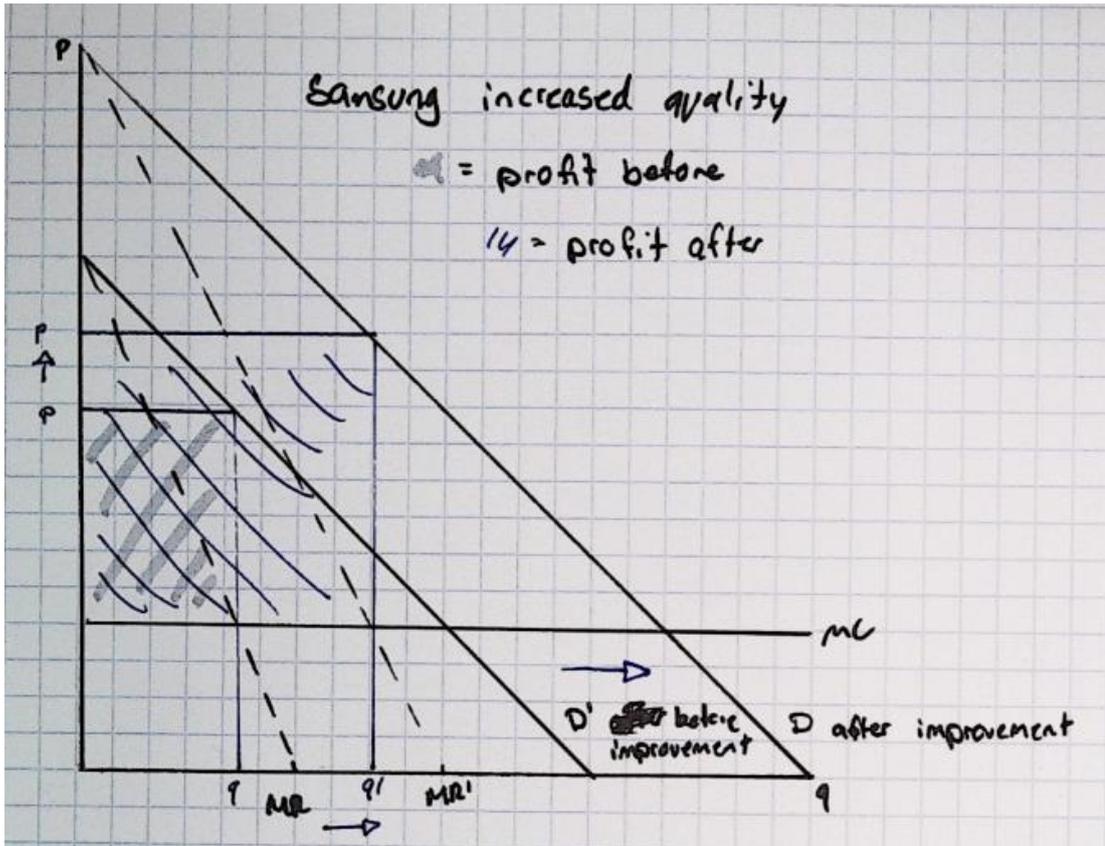


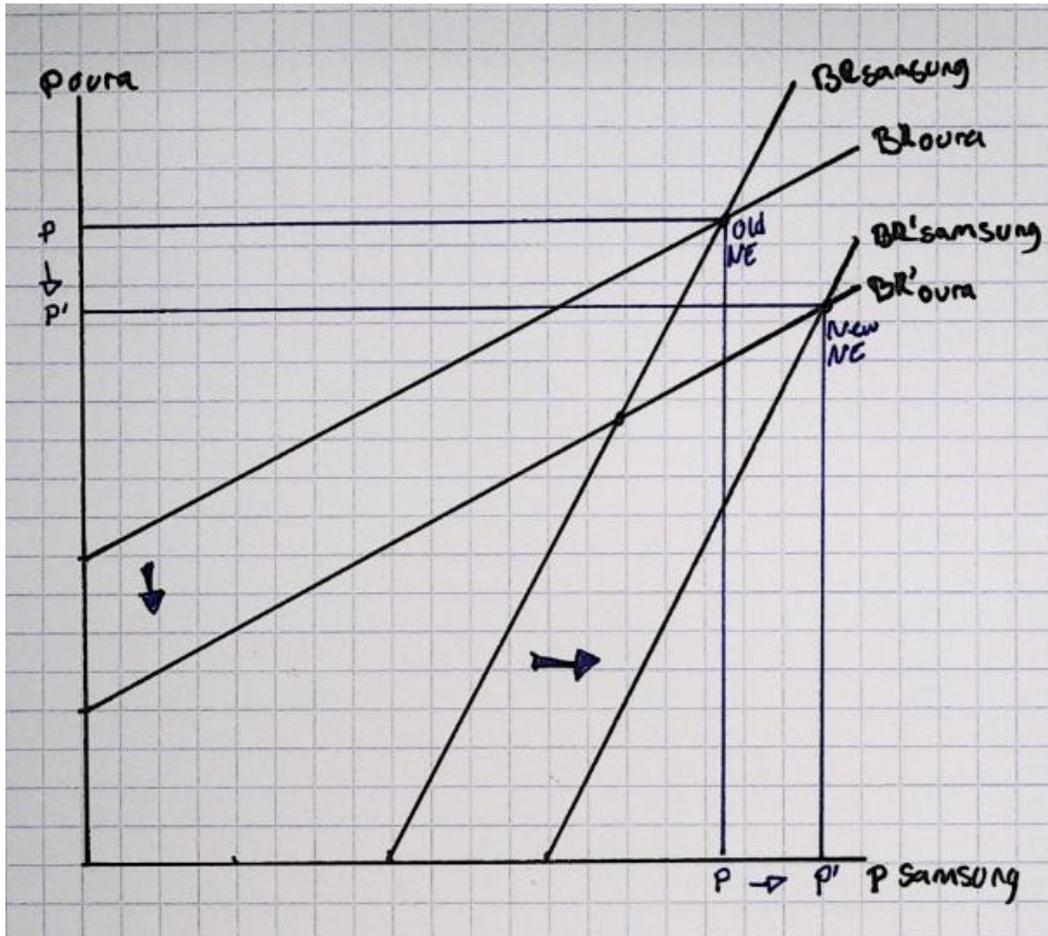
- 4) More accurate and cheaper sensors increase the residual demand for both firms while also decreasing the marginal cost for both firms. In 3) it is illustrated how Oura ring as a monopoly priced higher. The same effects are happening for Samsung, and when they are in a market together, they both have incentives to price higher, which shifts out both of their best response functions. This yields higher Nash equilibrium prices and profits for both firms. It is worth noting that when 1 firm increases the price.



It is worth noting that if one firm is increasing its price, it might be smart for the other firm to not increase its price as much, as it will then get a higher demand due to undercutting the other firm.

- 5) If Samsung improves the quality of the Samsung Galaxy Ring, then their residual demand would shift out, because higher perceived quality yields higher demand. If Oura does not improve its Oura Ring, then their residual demand will shift inward. This gives Samsung an incentive to price higher, and for Oura to price lower, which shifts Samsung's best response function out, and Oura's in. The Nash equilibrium prices will then be for Samsung to price higher than before the improvement, and for Oura Ring to price lower than before Samsung's improvement. Oura's profit would decrease, and Samsung's would increase.





- 6) It is assumed that there are only 2 firms: Ooura with Ooura Ring 4 and Ooura Ring 3 plus Samsung with Samsung Galaxy Ring. The quality perception (from Facts and Assumptions) is that Ooura Ring 4 is rated with 4.5 stars, then comes Samsung Galaxy Ring with 4.0 stars, and then Ooura Ring 3 with 3.5 stars. If Ooura decreases the price of the Ooura Ring 3, then the demand will increase due to the higher price. Some of this demand will be new consumers, but some of them will also be the Samsung Galaxy Ring consumers. Because some will value the difference in price higher than the difference in quality. Therefore, Ooura lowered the price increase profit by both new costumers and some of Samsung's customers. With the lowered price they target both the ones that want the best quality, but also in the lowered cost area, where some does not want the best smart ring, but just one with some features. Therefore, they are expanding their consumer reach.

Samsung will then have an incentive to lower the price of the Samsung Galaxy Ring as a response, so they will not lose a lot of profit. This will in return decrease the demand for the Ooura Ring 4 due to same intuition as with the lowered Ooura Ring 3 price. But as they did not decrease the price of the Ooura Ring 4, Ooura must be certain that the improved quality will be a positive effect and weigh up for the effect of the decrease in demand.

- 7) There is a substitution problem surrounding the smart rings. This is due to smartwatches and smart rings being able to do many of the same things, and due to the high pricing, most consumers will only buy one of the two. Therefore, Samsung has a problem, because if they focus on their ring, then they may lose customers for their watch, so it has a negative effect.



A non-smartwatch new smart ring entrant will only have to focus on the increasing smart ring market and will not have to worry about whether it is decreasing demand for their other products. Therefore, it is a more comfortable situation for the new entrant. Even though it would be the same ring, then some might be hesitant to buy from the new entrant as Samsung has a technology brand-value that (possibly) the new would be missing. If it was e.g. Apple or Garmin, then they might not be hindered by the brand-value. Due to it being a fast-growing market, the possible entrant will therefore have an incentive to enter, partly because they do not already sell and produce smartwatches.

It might be easy to say: "Then Samsung should just not produce both?" This is not optimal for them, as the smart ring might be the "new" smartwatch, and when the demand for smart watches decrease, then they will not be competitive anymore. Therefore, the best strategy is to focus on both, if they want to be competitive in the future market, as the smart ring market is increasing while the smartwatch market is static.

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