Multiple choice

1	B
2	C
3	D
4	D
5	C
6	A
7	B

Long question A

Denote firm A as firm 1, firm B as firm 2 and firm C as firm 3

a)

The costs for a consumer for each firm is given by:

Firm 1: $p_1 + t * x$

Firm 2:$p_2 + t(2 - x)$

Then for the indifferent consumer the following must be true:

$$p_1 + t * x = p_2 + t * (2 - x)$$

Then solve for x:

$$x = \frac{-p_1 + p_2 + 2t}{2t}$$

Then the quantity for each firm is given by:

$$q_1 = N(x) = N\left(\frac{-p_1 + p_2 + 2t}{2t}\right)$$

$$q_2 = N(2 - x) = N\left(2 - \frac{-p_1 + p_2 + 2t}{2t}\right) = N\left(\frac{4t}{2t} - \frac{-p_1 + p_2 + 2t}{2t}\right) = N\left(\frac{-p_2 + p_1 + 2t}{2t}\right)$$

Test a scenario from hoteling where p1 is firs in the negative.

b)

Profit functions are then given by:

$$\pi_1 = \left(N\left(\frac{-p_1 + p_2 + 2t}{2t}\right)\right) * p1$$

Then take the derivative with respect to p_1 and set equal to 0 to find firm 1's BR function:

$$\frac{d\pi_1}{dp_1} = N * t * \frac{(-2p_1 + p_2 + 2t)}{2} = 0$$

$$p_1 = \frac{p_2 + 2t}{2}$$

Profit function for firm 2 is then given by:

$$\pi_2 = N\left(\frac{-p_2 + p_1 + 2t}{2t}\right) * p_2$$

Then take the derivative with respect to p_2 and set equal to 0 to find firm 2's BR function:

$$\frac{d\pi_2}{dp_2} = N * t * \frac{(-2p_2 + p_1 + 2t)}{2} = 0$$

$$p_2 = \frac{p_1 + 2t}{2}$$

c)

I will plug firm 2's BR into firm 1's BR to find the NE:

$$p_1 = \frac{\left(\frac{p_1 + 2t}{2}\right) + 2t}{2}$$

$$p_1 = 2t$$

And the corresponding for firm 2:

$$p_2 = \frac{2t + 2t}{2} = 2t$$

Then, when t=0.25:

$$p_1 = 2 * 0.25 = 0.5$$

And

$$p_2 = 2 * 0.25 = 0.5$$

And profits are given by:

$$\pi_1 = \left(N\left(\frac{-0.5 + 0.5 + 2 * 0.25}{2 * 0.25}\right)\right) * 0.5 = 0.03125N$$

$$\pi_2 = \left(N\left(\frac{-0.5 + 0.5 + 2 * 0.25}{2 * 0.25}\right)\right) * 0.5 = 03125N$$

And when t=0.5:

$$p_1 = 2 * 0.5 = 1$$

And

$$p_2 = 2 * 0.5 = 1$$

And then profits are given by:

$$\pi_1 = \left(N\left(\frac{-1 + 1 + 2 * 0.5}{2 * 0.5}\right)\right) * 1 = 0.25N$$

$$\pi_2 = \left(N\left(\frac{-1 + 1 + 2 * 0.5}{2 * 0.5}\right)\right) * 1 = 0.25N$$

Higher travel costs will relax competition between the two firms, meaning that they will both be able to set higher prices.

d)

I will find the SPNE:

Firm 1 is the leader, and I will therefore plug firm 2's BR into firm 1's profit function:

$$\pi_1 = \left(N \left(\frac{-p_1 + \frac{p_1 + 2t}{2} + 2t}{2t} \right) \right) * p1$$

Then take the derivative with respect to p_1 and set equal to 0 to find firm 1's BR function:

$$\frac{d\pi_1}{dp_1} = N * T * \frac{-p_1 + 3t}{2} = 0$$

$$p_1 = 3t$$

And then the corresponding for firm 2:

$$p_2 = \frac{3t + 2t}{2} = \frac{5t}{2}$$

And when t=0.5:

$$p_1 = 3 * 0.5 = 1.5$$

$$p_2 = \frac{5 * 0.5}{2} = 1.25$$

Profits are then given by:

$$\pi_1 = \left(N \left(\frac{-1.5 + 1.25 + 2 * 0.5}{2 * 0.5} \right) \right) * 1.5 = 0.28125$$

$$\pi_2 = \left(N \left(\frac{-1.25 + 1.5 + 2 * 0.5}{2 * 0.5} \right) \right) * 1.25 = 0.391$$

Thus, firm 1 does not have a first mover advantage, since firm 2's profits are higher as the follower.

e)

The demand for this store will be given by:

$$q_3 = N(q_1 - q_3 + q_2) = N \left(\frac{-p_1 + p_2 + 2t}{2t} \right) - N * q_3 - N \left(\frac{-p_2 + p_1 + 2t}{2t} \right)$$

$$q_3 = \frac{N(-p_1 + p_2 * t)}{1 + N}$$

Another option:

$$q_3 = q_1 - q_2 = \frac{N * t * (-p_1 + p2)}{1 + N}$$

f)

a)

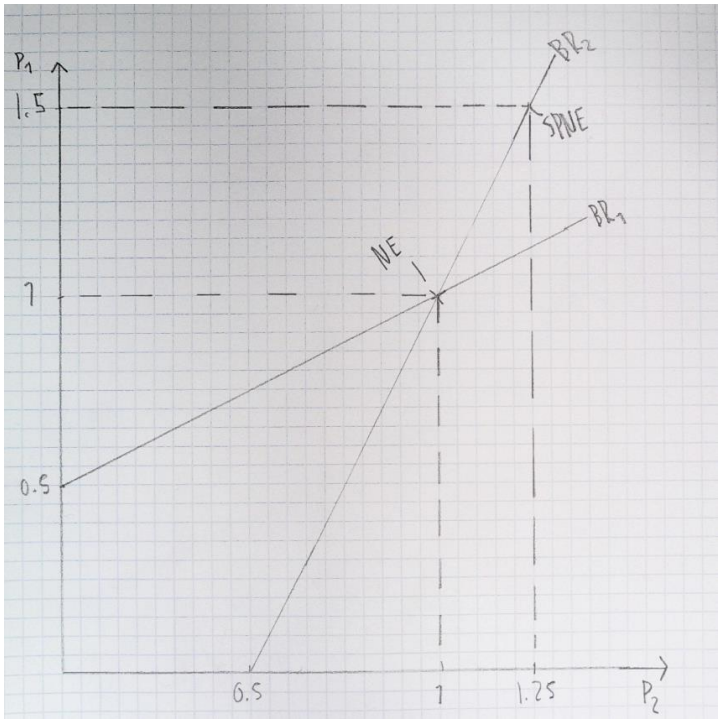
In this scenario, the new firm will steal 25% market share from both firm 1 and firm 2. This will decrease the profits of both firm 1 and firm 2.

b)

In this scenario, firm 1 will gain a total of 75% market share and firm 2 will be left with 25%. Overall, this would increase the profit for firm 1 and decrease the profit of firm 2.

For firm 2 the profit would decrease in both scenarios because of intensified competition by a new entrant. Though, one could argue that in scenario b), firm 1 would set a higher price, so that it does not end up with "cannibalizing" on its already existing product at 0. Therefore firm 2 would prefer scenario b) to scenario a), as it will have higher profits.

g)



Long question B

1)

Vertical product differentiation: When prices are equal, one firm has zero sales and the other has positive sales.

For HMB's, this could be the amount layers, width of interface or energy efficiency

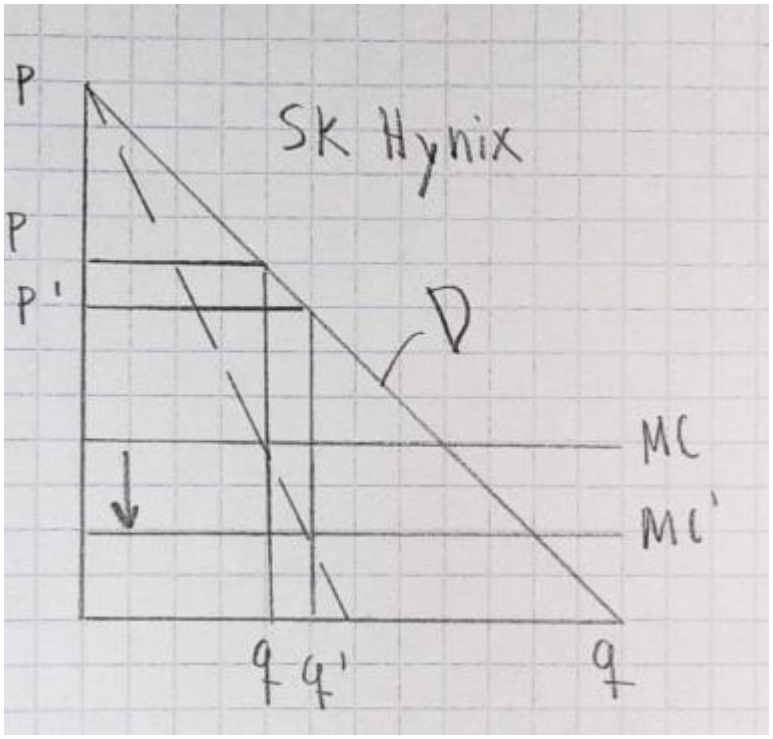
Horizontal product differentiation: When prices are equal, both firms have positive sales.

For HMB's, this could be which device/AI the HMB's are the most compatible with.

Two important characteristics for HMBs could be what the HMB is most compatible with and capacity per stack.

2)

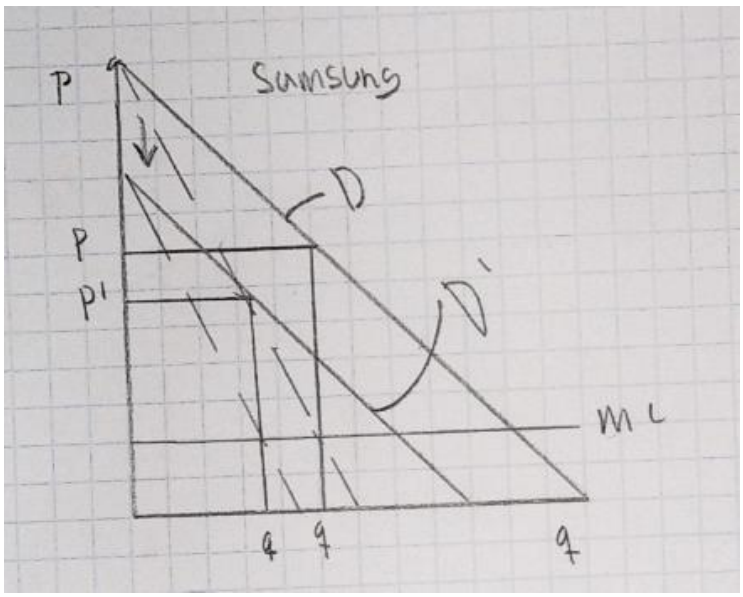
The improved yield will shift the marginal costs for SK Hynix downwards. This would incentivize them to set lower prices and produce higher quantities. Since SK Hynix is a monopolist, its profit would increase.

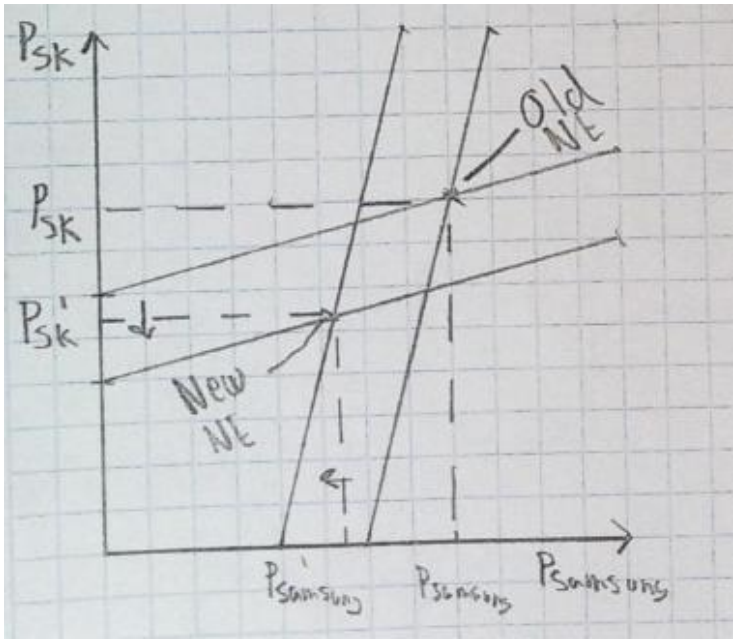


3)

The improved yield for SK Hynix will have the same effect as in 2). The lower price will shift the residual demand for Samsung inward, incentivizing them to set lower prices and produce lower quantities. The BR functions for both SK Hynix and Samsung will shift downwards.

The profit for SK Hynix would likely increase, while the profit for Samsung would likely decrease.

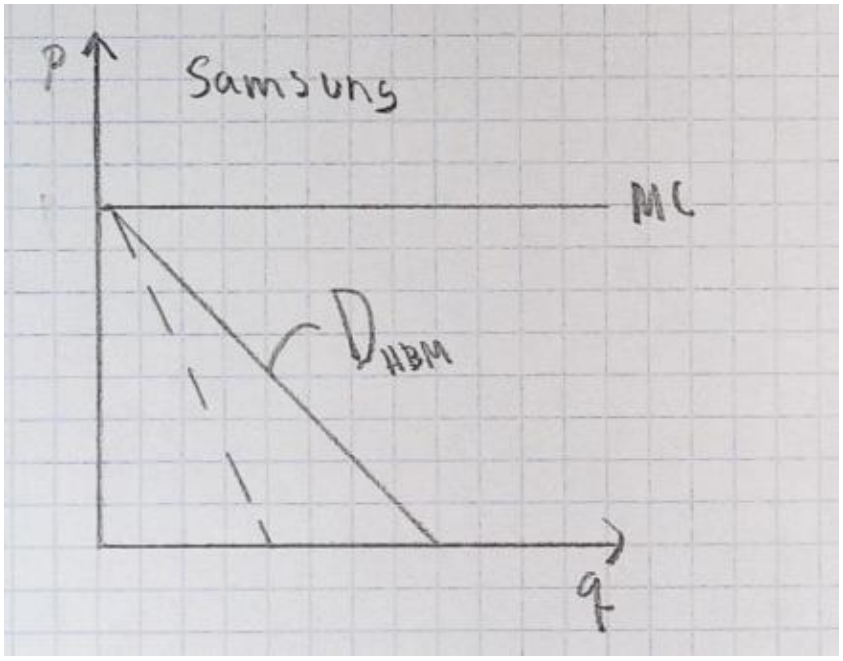


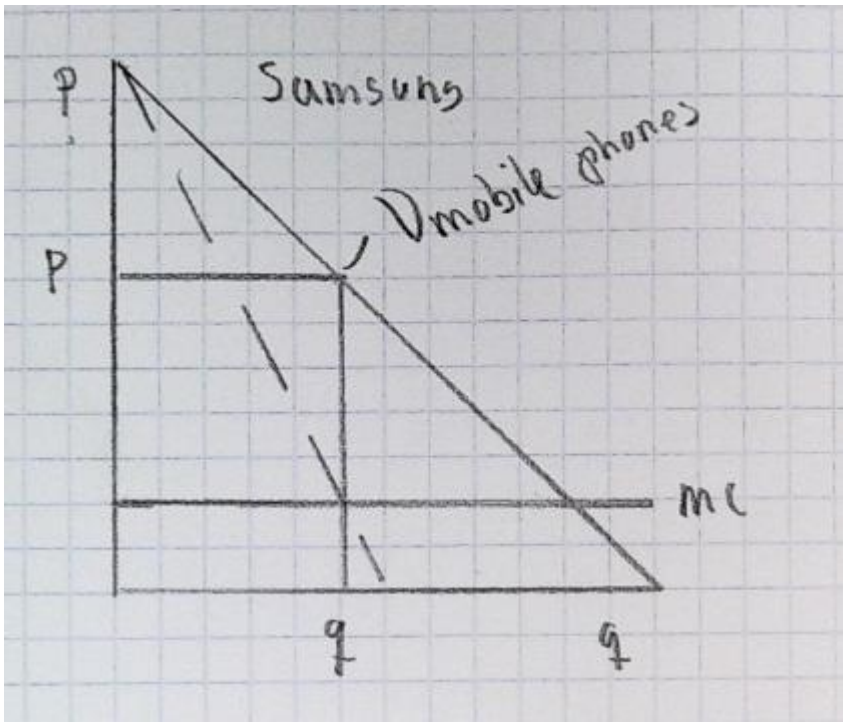


4)

A small market size with high development costs is unattractive, because the lower demand means that there are less profits to be earned. A point is also that Samsung are competitive in other markets with larger market size, and it is therefore better for them to invest in those markets. Below is an illustration of a hyperbole, where the residual demand for Samsung is below the development

costs/marginal costs, showing that it will not be worthwhile for them to invest in this market and would prefer to invest in markets with larger market size.:

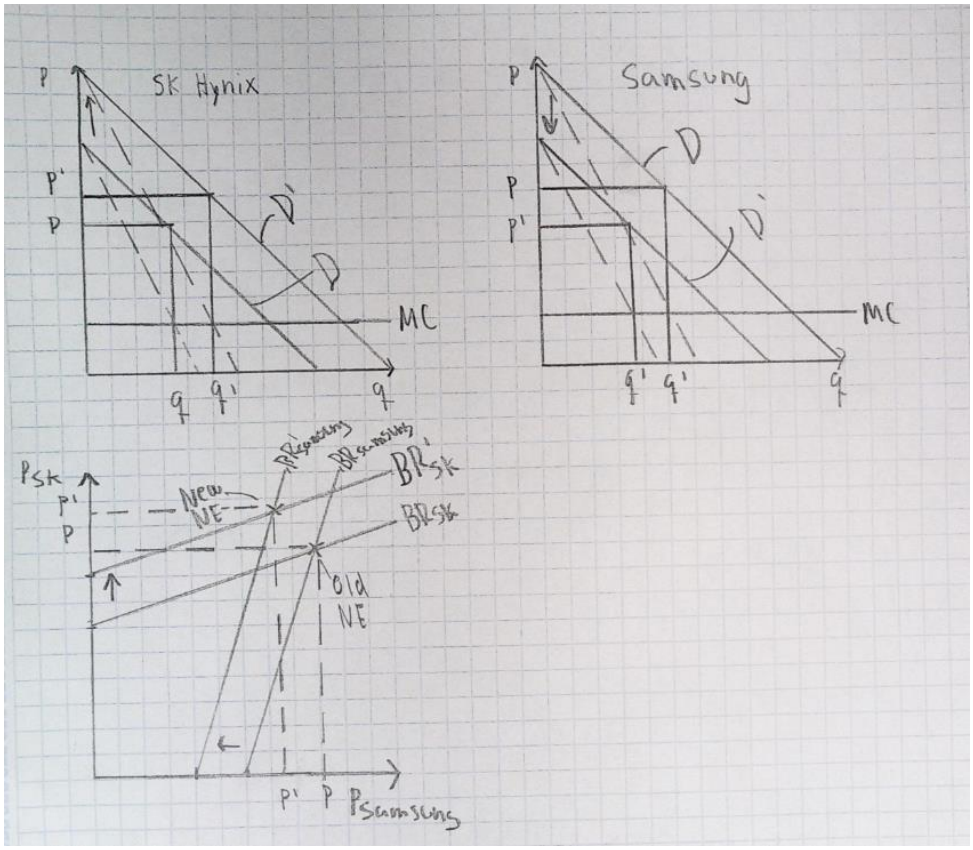




5)

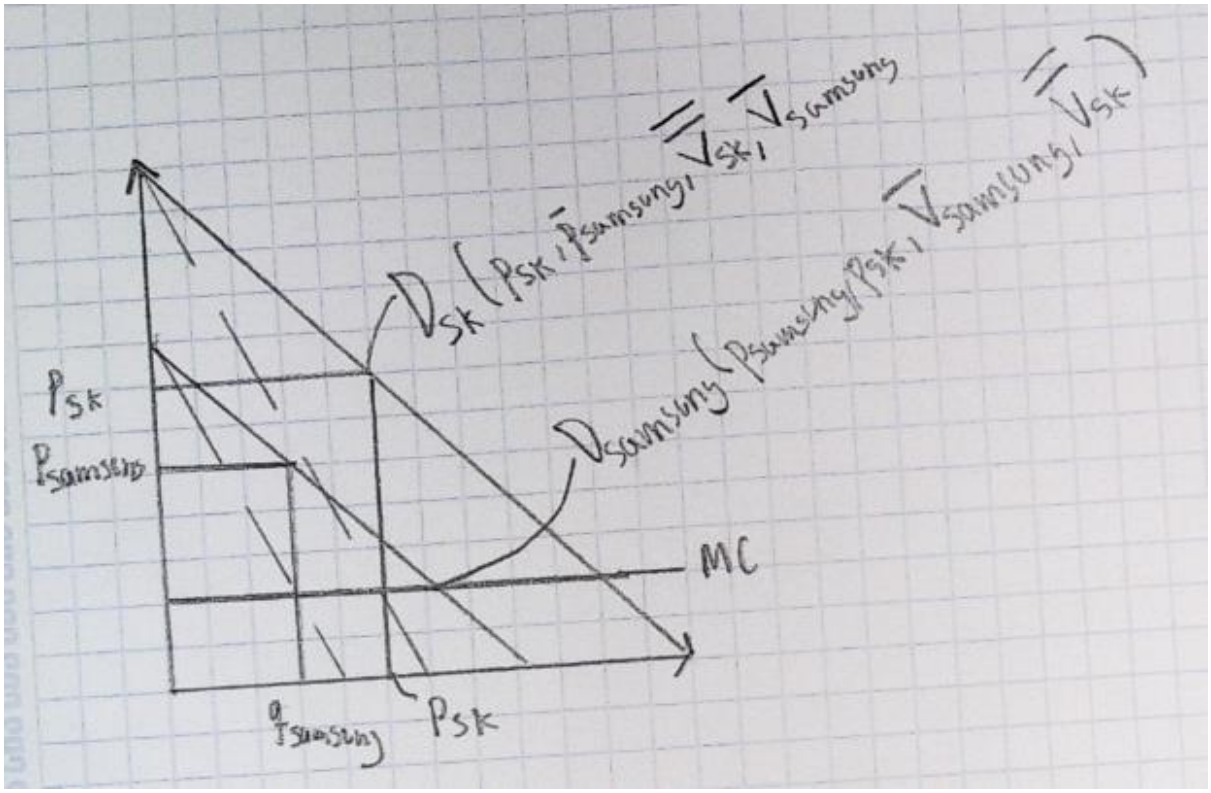
An improvement in SK Hynix's product will improve its perceived quality, which will shift its residual demand outward. Assuming that the costs of improvement will show up on the fixed costs side, there will be no change in marginal costs. This will incentivize SK Hynix to set higher prices and produce higher quantities. If the competitor (Samsung) does not improve its product, its residual demand will shift inwards, incentivizing them to set lower prices and produce lower quantities. The

BR function for SK Hynix will shift outwards, while the BR function for Samsung will shift inward. Overall, this will lead to likely lead higher profits for SK Hynix (depending on the increase in fixed costs) and lower profits for Samsung.



6)

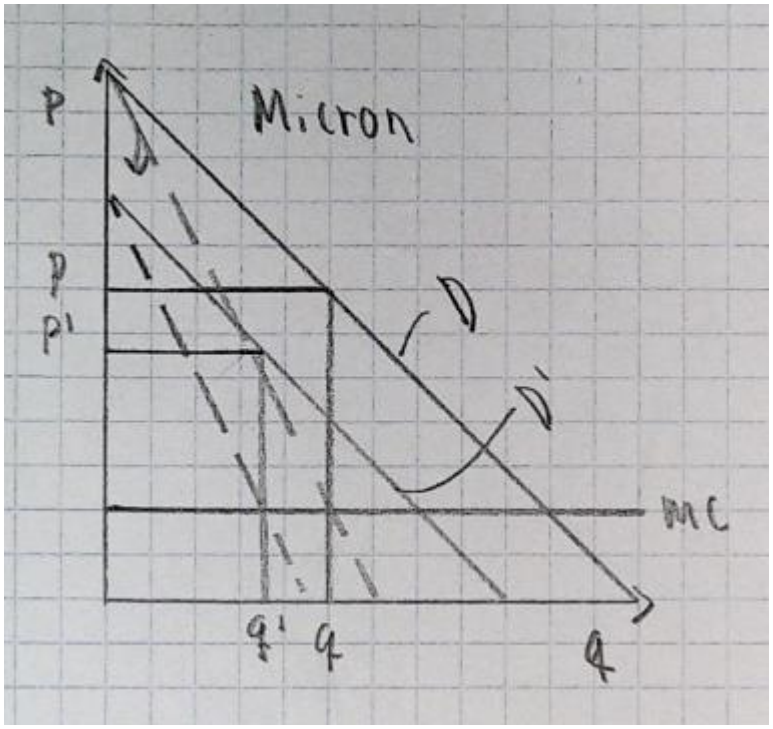
From the articles we are given to understand that SK Hynix was the first mover regarding HBM, largely because they invested heavily in R&D to improve their product. From 5) this has shifted the residual demand for SK Hynix outward, while shifting the residual demand for the competitor (Samsung) inward. Therefore, Samsung will need to invest heavily in order to reach the same perceived quality as SK Hynix. The difference in their perceived quality is illustrated below:



Furthermore, there is also a point to be made about switching costs. Even if Samsung invests enough in R&D to achieve the same perceived quality as SK Hynix, consumers may not switch to Samsung, since they are more loyal to SK Hynix

7)

As per the articles, this is an endogenous sunk cost market, because firm spend heavily on R&D and Marketing (7-14%). Therefore, when the market size increases, the larger firms, like SK Hynix and Samsung will have a higher incentive to invest in R&D and marketing. This will raise the stakes in the market and smaller firms like Micron does not have the capabilities to invest, and their residual demand will therefore shift inwards, which will incentivize Micron to set lower prices and produce lower quantities. This will decrease Micron's overall profit.


P
Micron
P
P'
D
D'
MC
q'
q
Q