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Lecture 19

Supply chains

Industrial Economics

Telegram **channel for IE:**

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1 member

Info and alerts on the Industrial Economics course of ICEF-HSE

Multi-stage production

- Production often occurs in ***stages*** that are handled by ***different*** firms
  - the ***output*** of one firm is an ***input*** for another
- We have ***upstream*** firms
  - that produce an ***intermediate*** good
- We have ***downstream*** firms
  - that produce the ***final*** good
- The usual relationship in models is between a ***manufacturer*** and a ***retailer***
  - we focus on situations where the ***manufacturer*** possesses ***more market power***

Vertical relation model

- One ***manufacturer*** (Mf) who produces at constant average ***cost***, $c < 1$
- One ***retailer*** (R) facing ***consumer demand*** $q(p) = 1 - p$

- The ***transfer price*** is $p_w > c$
  - price at which the Mf sells to the R
- R takes p_w as ***given*** and chooses the ***retail price***, p
- Both act as ***monopolists*** in a ***2-stage*** game
  - first, the Mf selects p_w – then, R selects p

Vertical model

- In the second stage

$$\max_p: \Pi_R = (p - p_w)(1 - p)$$

$$p = \frac{1 + p_w}{2} \quad \text{and} \quad \Pi_R = \frac{(1 - p_w)^2}{4}$$

- Then, in the first stage

$$\max_{p_w}: \Pi_{Mf} = (p_w - c)(1 - p) = 0.5(p_w - c)(1 - p_w)$$

$$p_w = \frac{1 + c}{2} \quad \text{and} \quad \Pi_{Mf} = \frac{(1 - c)^2}{8}$$

- ***Price*** is $p = \frac{3+c}{4}$ and ***total profit***, $\Pi_R + \Pi_{Mf} = \frac{3(1-c)^2}{16}$

Integrated benchmark

- If Mf and R make a ***joint decision***

$$\max_p: \Pi_J = (p - c)(1 - p)$$

$$p = \frac{1 + c}{2} \quad \text{and} \quad \Pi_J = \frac{(1 - c)^2}{4}$$

- Independent firms will lead to ***higher final price***

$$\frac{3 + c}{4} > \frac{1 + c}{2}$$

Vertical relation model

Spengler (1950)

- Separated firms make ***lower joint profit*** than the integrated structure

$$\Pi_J > \Pi_{Mf} + \Pi_R$$

- This result holds also for a ***general demand*** function
- It is known as ***double marginalization***

  it is ***bad*** for the ***firms*** and for ***consumers***
- This is an example of ***vertical externality***

Vertical relation model

Intuition

- Mathematically, the 2-stage optimization is ***equivalent*** to a constrained 1-stage optimization
  - Same objective function s.t. the FOC of the second stage
  - That is,

$$\frac{d\Pi_R}{dp} = 0 \quad \nRightarrow \quad \frac{d(\Pi_R + \Pi_{Mf})}{dp} = 0$$

- Economically, when choosing p, R does not take ***into account*** the effect of it's choice on the Mf's profit

Vertical relation model

Vertical restraints

- Assume now that the ***bargaining power*** is on Mf's side
  - The Mf can set $p_w = c$
  - Then, ***extract*** the retailer's profit through a ***franchise fee***, A

$$A = \Pi_J = \frac{(1-c)^2}{4}$$

- This will ***force*** the R to charge the ***price of integration***

$$p = \frac{1+c}{2}$$

  thus, achieving ***First Best*** efficiency similar to integration
- Problems
  1. The retailer bears all the ***risk*** of demand and cost shocks
  2. With ***different types of R***, one 2PT cannot yield the FB

Vertical relation model | Service

Provision of service

- Assume that R can also provide a ***service***, s to consumers

  s affects the ***final demand*** for the product but is ***not contractible***
- The R's ***cost*** for providing s per unit of q is $\Phi(s)$

  $\Phi(s)$ is increasing in s
- ***Demand*** is $D(p,s)$

  decreasing in p – increasing in s

Vertical relation model | Service

Separate decisions

- At the ***second stage***, R maximizes its profit ***given*** p_w

$$\max_{p,s}: \Pi_R = \left(p - p_w - \Phi(s)\right) \cdot D(p,s)$$

- This ***yields*** FOCs

$$\frac{\partial \Pi_R}{\partial p} = \left(p - p_w - \Phi(s)\right)\frac{\partial D(p,s)}{\partial p} + D(p,s) = 0 \quad (1)$$

$$\frac{\partial \Pi_R}{\partial s} = \left(p - p_w - \Phi(s)\right)\frac{\partial D(p,s)}{\partial s} - \frac{\partial \Phi(s)}{\partial s} D(p,s) = 0 \quad (2)$$

- ***Denote*** the solutions of this system as p_R and s_R

Vertical relation model | Service

The First Best

- Joint profit is

$$\Pi_J = \left(p - c - \Phi(s)\right) \cdot D(p,s)$$

- This can be written as

$$\Pi_J = \left(p - p_w - \Phi(s)\right) \cdot D(p,s) + (p_w - c) \cdot D(p,s)$$

- Maximizing w.r.t. p and s yields FOCs:

$$\frac{\partial \Pi_J}{\partial p} = \left(p - p_w - \Phi(s)\right)\frac{\partial D(p,s)}{\partial p} + (p_w - c)\frac{\partial D(p,s)}{\partial p} + D(p,s) = 0 \quad (3)$$

$$\frac{\partial \Pi_J}{\partial s} = \left(p - p_w - \Phi(s)\right)\frac{\partial D(p,s)}{\partial s} + (p_w - c)\frac{\partial D(p,s)}{\partial s} - \frac{\partial \Phi(s)}{\partial s} D(p,s) = 0 \quad (4)$$

- Denote the solutions of this system as p_J and s_J

Vertical relation model | Service

Comparison – prices

- Compare (1) and (3), the FOCs for p:

Separate case

$$\left(p - p_w - \Phi(s)\right)\frac{\partial D(p,s)}{\partial p} + D(p,s) = 0$$

$$\left(p - p_w - \Phi(s)\right)\frac{\partial D(p,s)}{\partial p} + (p_w - c)\frac{\partial D(p,s)}{\partial p} + D(p,s) = 0$$

Integrated case

- The ***term*** $(p_w - c)\frac{\partial D(p,s)}{\partial p} < 0$ is ***missing*** from the separate decisions case
  - it ***expresses*** the effect of the choice of p by the retailer on the Mf's profit – it is the ***vertical externality***
- In particular, the retailer sets $p_R > p_J$

Vertical relation model | Service

Comparison – service

- Compare (2) and (4), the FOCs for s:

Separate case

$$\left(p - p_w - \Phi(s)\right)\frac{\partial D(p,s)}{\partial s} - \frac{\partial \Phi(s)}{\partial s}D(p,s) = 0$$

$$\left(p - p_w - \Phi(s)\right)\frac{\partial D(p,s)}{\partial s} + (p_w - c)\frac{\partial D(p,s)}{\partial s} - \frac{\partial \Phi(s)}{\partial s}D(p,s) = 0$$

Integrated case

- The ***term*** $(p_w - c)\frac{\partial D(p,s)}{\partial s} > 0$ is ***missing*** from the separate decision case
  - it ***expresses*** the effect of the choice of s by the retailer on the Mf's profit – it is also ***vertical externality***
- The retailer sets $s_R < s_J$
  - service ***lower than optimal***

Vertical relation model | Service

Vertical restraint on R

- The vertical externality occurs because ***both players*** have ***bargaining power***
- Again, we can get the first ***best solution*** if the Mf sets $p_w = c$ and then uses a ***franchise fee***

$$A = \left(p_J - c - \Phi(s_J)\right) \cdot D(p_J, s_J)$$

  - in this case the R will be ***forced*** to choose the ***first best*** final price and his profit will be ***expropriated*** by Mf
- But ***how*** can we solve the vertical externality in s?

Resale Price Maintenance

- Under RPM, ***competition*** between retailers becomes ***less intense***
- If RPM price is set correctly by the Mf, R's ***profits will increase***
- This will ***reduce welfare***
  - output will be ***less*** than the ***socially optimal*** level (no RPM)
- Things may in fact be even worse in the presence of ***different efficiency by retailers***
  - RPM may allow the ***survival of the less efficient*** retailers
  - Prevent the more efficient from ***cutting price***

RPM

Quality certification and RPM

- For some products pre-sale services are ***not tangible***
- A reputable retailer may offer ***quality certification*** by the mere fact that carries the product
  - prestigious stores such as ЦУМ have built ***reputations*** for featuring quality items
- Such a retailer may be ***unwilling to store*** the product if it can also be found at a ***discount store***
- By imposing ***RPM*** the Mf ***prevents*** the discount stores from featuring the product
  - alternatively, the Mf can ***refuse to supply*** discount stores

Thank you!

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