LECTURE 12.0

VERTICAL INTEGRATION AND THE BOUNDARIES OF THE FIRM

OUTLINE

12.0 Vertical integration and the boundaries of the firm

12.1 The firm as a vertical chain of production

12.2 Benefits of non-market transactions

12.3 Firm specific assets and hold up

12.4 Vertical integration versus long-term contracts

12.5 Contracting with distributors

READING

Chapter 19, "Vertical Integration and Outsourcing" in Brickley, Smith and Zimmerman (2006) *Managerial Economics and Organizational Architecture* (4th ed)

Lecture Note 3: Hold-Up (May Be Your Friend) in Robert Gibbons, MBA Course (15.903: Organizational Economics and Corporate Strategy)

Lecture Note 4: Make, Buy, or Cooperate? in Robert Gibbons, MBA Course (15.903: Organizational Economics and Corporate Strategy)
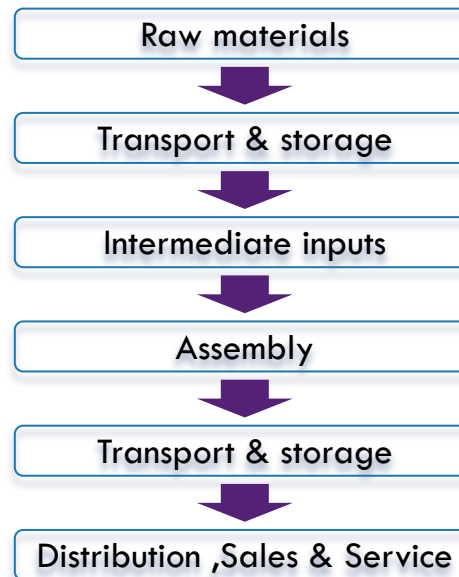
LECTURE 12.1

THE FIRM AS A VERTICAL CHAIN

THE FIRM AS A VERTICAL CHAIN

You can think about a firm as a 'vertical chain'. A vertically integrated firm performs more than one successive stage of production.

Note that the example used in the textbook refers to computers, but approach obviously applies more generally.. For e.g., furniture manufacturers that could own the forests and retail stores…

Raw materials

Transport & storage

Intermediate inputs

Assembly

Transport & storage

Distribution ,Sales & Service

Support Services
- Accounting
- Finance
- Human resources
- Legal
- Marketing

THE FIRM AS A VERTICAL CHAIN

Terminology:

- upstream: occurs earlier in the production chain

- downstream: occurs later in the production chain

- vertical integration: combining successive steps in the production chain within the firm

- downstream integration: the firm performs additional downstream tasks in house

- upstream integration: the firm performs additional upstream tasks in house

THE FIRM AS A VERTICAL CHAIN

A key question for the firm is: What to do in house versus what to outsource?

The vertical boundaries of the firm define the activities that the firm itself performs as opposed to what it purchases from independent firms in the marketplace.

There is a trade-off between technical efficiency (cost minimisation) and agency efficiency (minimisation of coordination costs etc)

- Perhaps technical efficiency is best achieved by buying on the market. Alternatively, can agency costs be minimised when activities are done in house?

Optimal vertical organization requires that the sum of technical inefficiencies and agency inefficiencies are minimized.
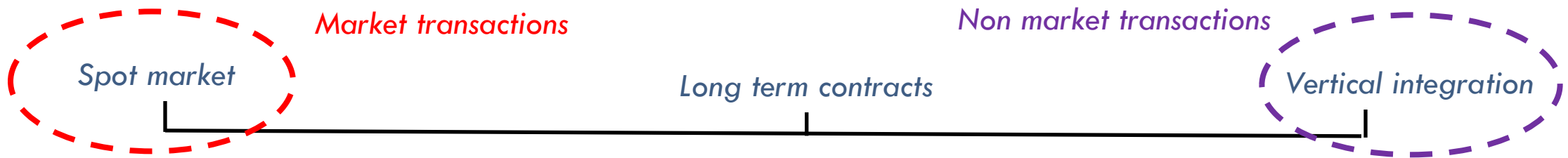
THE FIRM AS A VERTICAL CHAIN

Apple and many others are examples of firms that do much outsourcing. Nike and Reebok do little or no production itself. The typical US manufacturer outsources 70-80 percent of its finished product.

Why might this be important?

- Decision rights: outsourcing reassigns decisions rights concerning assets and employees across firms.

- Compensation and performance evaluation: Compensation levels are one reason much outsourcing occurs.

THE FIRM AS A VERTICAL CHAIN

The choice of whether to do something in-house versus outsourcing is not a binary choice. There is a spectrum of choices available to firm:

Market transactions   *Non market transactions*

Spot market   *Long term contracts*   *Vertical integration*

Long term contracts themselves can take on a variety of forms:

- Standard supply and distribution contracts.

- Joint ventures.

- Lease contracts.

- Franchise agreements

- Strategic alliances.

LECTURE 12.2

BENEFITS OF NON-MARKET TRANSACTIONS

BENEFITS OF USING SPOT MARKETS OR 'BUYING'

Minimises costs if markets are competitive

- in the long run equilibrium of a competitive market, price is equal to the minimum of long run average cost

- get the advantage of any economies of scale and learning economies that might be available

Do not have to provide incentives or motivate employees

- incentives are provided in competitive markets

- this avoids agency costs and bureaucracy

BENEFITS OF NON MARKET TRANSACTIONS

Potential benefits

- minimise contracting costs

- take advantage of market power

- taxes and regulation

If the benefits of non market transactions exceed those of using the market, the firm may wish to vertically integrate.

- We will focus attention on contracting costs and market power.

BENEFITS OF NON MARKET TRANSACTIONS

Contracting costs: the costs of writing and enforcing contracts

- can be high for market transactions

Costs arise because contracts are incomplete:

- it is not possible to specify all contingencies

- it is difficult to measure performance in order to enforce contracts

- asymmetric information between contracting parties

There are several reasons non market transactions may involve lower contracting costs

- firm-specific assets

- costs of measuring quality

- externalities

- coordination problems

MARKET POWER

Vertical integration may allow the firm to exercise market power

- e.g. the firm may price discriminate

Example: A firm (DrugCo) that produces a patented compound called Painsolve used in the production of two drugs, a pain reliever and a cancer drug.

The cost of producing q grams of the compound is given by:

$$C(q) = 10q$$

The demand curve for each drug is given by:-

Cancer drug (no substitutes):

$$P = 200 - 10Q$$

Pain reliever (many subs.):

$$P = 100 - 5Q$$

MARKET POWER

Assume that there are no additional costs of producing each drug over the cost of producing Painsolve. That is, a drug manufacturer can use Painsolve to produce either the cancer drug or the pain reliever at zero marginal cost.

Also assume retail markets for both drugs are perfectly competitive. This means that the retail price of the pain reliever and cancer drug down to the manufacturers' MC, which in this case is the wholesale price charged by DrugCo for Painsolve.

This means the demand curves that DrugCo faces for Painsolve is the same as the demand curves for the pain reliever & cancer drug.

DrugCo would prefer to maximise profits by setting MR = MC in each market.

This would require them to set a price for the compound when it is sold to pain reliever manufacturers and cancer drug manufacturers. The profit maximising prices are $105 for the cancer drug and $55 for the pain reliever.

Can DrugCo set different prices in each market?

MARKET POWER
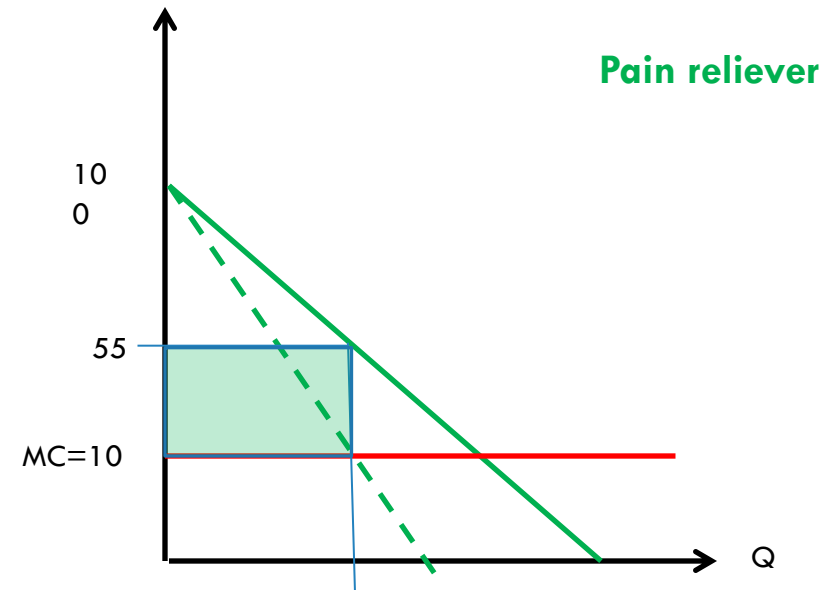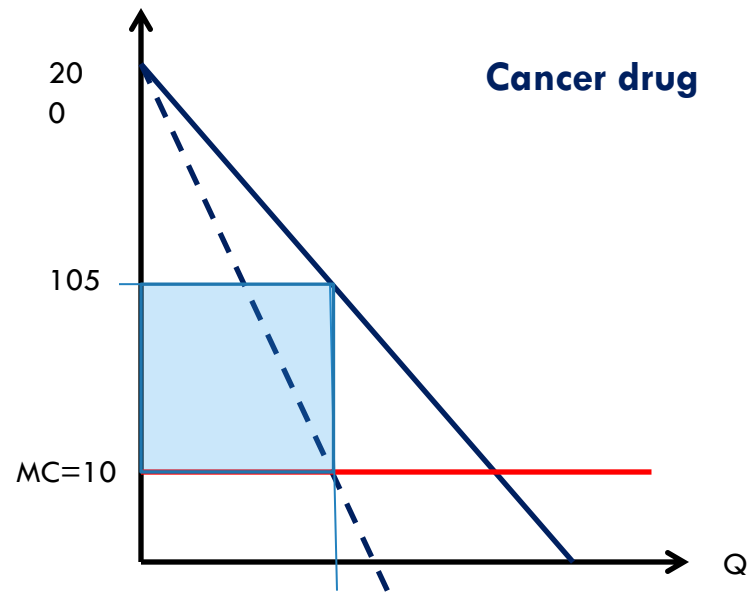
MARKET POWER

To prevent arbitrage, DrugCo could integrate forward (downstream) into the pain reliever market.

- sell the pain reliever at a price of $55 (in the retail market)

- sell the compound at a price of $105 (in the wholesale market)

- arbitrage is not possible (provided the pain reliever cannot be converted to the compound)

OTHER BENEFITS OF NON MARKET TRANSACTIONS

Quality Issues

- Quality might be difficult to observe and verify

- Once contract has been signed, the supplier might cut costs and curtail quality notwithstanding contract stipulations. (Reputation may be a solution.)

Avoiding externalities .

- Downstream firms such as distributors might try to free ride on the efforts of upstream manufacturers e.g. advertising, service, expertise, showroom space

Coordination

- If delicate coordination is required between successive production stages, this is difficult to achieve with market transactions

LECTURE 12.3

FIRM SPECIFIC ASSETS

AND HOLD UP

FIRM SPECIFIC ASSETS AND HOLD UP

Firm-specific assets

- a relationship or asset is specific to the firm if it is substantially more valuable within the firm than in the next best available use

- e.g. Alaskan oil pipeline, a coal mine next to a power plant, software written for a specific firm

Where does specificity derive from?

- Site specificity: an asset is useful to a limited set of users due to location. e.g. a coal mine or a steel mill

- Physical specificity: an asset is suited to a firm due to design. e.g. a mould used to make a car body; software designed for a firm

- Human asset specificity: a transaction requires specialised knowledge. e.g. knowledge needed to write and use software

- Dedicated assets: an asset that is intrinsically tied to a firm. e.g. investments made by a port owner

FIRM SPECIFIC ASSETS AND HOLD UP

Why does specificity create problems?

- if one party needs to make a **relationship-specific investment**, they are vulnerable to the **hold up** problem

An example: A and B have a profit opportunity. Timing:

1. A decides whether to invest $6m in the project.
2. If A invested, A and B can earn combined profits of $10m.

Suppose A and B negotiate a contract before A invests

- What might the contract look like?

Suppose A and B negotiate a contract after A invests

- What might the contract look like?

FIRM SPECIFIC ASSETS AND HOLD UP

Consider the following situation:

- A firm makes an investment of $50,000 in a machine tool to make a specific component for XYZ Inc.

- Assume that variable cost of production is $1 and the life of the machine is 50,000 units.

- Requires payment of $2 per item to break even.

What might happen after contract signed and the investment has been made?

- the buyer has an incentive to argue "circumstances have changed" and to bargain the price down to $1 per piece

- this may be possible if the contract is incomplete

Hold-up problem

- One way to think about the problem here is that after the investment has been made it is a sunk cost and one of the parties can exploit this. The implication?

FIRM SPECIFIC ASSETS AND HOLD UP

A worked example: Suppose you consider an investment to produce an auto part for Audi

$$C(q) = I + q \times c$$

- $C(q)$ is the cost of making q units of the auto part

- I is the annual payment on the loan used to finance investment

- c is the average variable cost when producing q units

Suppose you could also sell modified parts to Fiat at a price of p_f > c

$$I > q(p_f - c)$$

- the investment is not fully recoverable

- the relationship-specific investment is $I - q(p_f - c)$

- e.g. c = \$3, q = 1,000,000, I = \$8,500,000, p_f = \$4 → Relationship specific investment = \$7,500,000.

FIRM SPECIFIC ASSETS AND HOLD UP

Now suppose Audi agrees on a price *p** such that:

$$I < q(p^* - c)$$

It is socially efficient to invest

Define:

- rent: the profit under the contract: $q(p^* - c) - I$

- quasi-rent: the extra profit relative to the next best alternative:
$$(q(p^* - c) - I) - (q(p_f - c) - I) = q(p^* - p_f)$$

FIRM SPECIFIC ASSETS AND HOLD UP

A firm holds up its partner if it renegotiates the terms of an incomplete contract

Example: I = 8,500,000, p^* = 12, p_f = 4, c = 3, q = 1,000,000

- rent: $q(p^* - c) - I = \$500,000$

- quasi-rent: $q(p^* - p_f) = \$8,000,000$

By renegotiating the price from \$12 to \$8, Audi increases its profits by \$4,000,000 and captures half of the quasi-rent

- your profits fall from \$500,000 to -\$3,500,000

- The investment was not worthwhile!

The hold up problem can be resolved by vertical integration

- no need to worry about contract renegotiation

- long term contracts are sometimes an alternative

FIRM SPECIFIC ASSETS AND HOLD UP

There are many cases of hold up in the 'real world'.

- Perhaps the most famous is the Fisher Body GM example in which Fisher Body made the chassis for GM cars

- GM approached Fisher and asked Fisher to make the necessary investments – of course such a request left both parties hostage to a potential hold up problem.

- While a contract was signed between Fisher and GM whereby Fisher was protected via clauses specifying price as a markup over variable cost, this created incentives for Fisher Body to pad variables costs.

- Eventually GM purchased Fisher at a high cost.

(As an aside, more recent evidence suggests that the actual experience of the two firms is not as simple as suggested above. Rather the relationship between the firms was somewhat more complex and that it was not a simple case of hold-up as described.)

FIRM SPECIFIC ASSETS AND HOLD UP

The GM-Fisher Body example highlights that hold up is a two-way street, the upstream 'owner of an asset' can take actions that are inefficient but nonetheless benefit itself.

- As we will see in a numerical example later, ownership/ vertical integration doesn't necessarily solve the problem of hold up.

- Gibbons suggests that relational contracts between firms, not just those within firms, might also be important to address some of the issues associated with incomplete (formal) contracts.

Ultimately, vertical integration is one way that the hold up problem can be resolved, but it may create different types of problems.

- The hold up problem may be alleviated with vertical integration – that is the use of non-market transactions.

- Obviates the need to worry about 'new circumstances' and contract renegotiation

- An alternative would be long term contracts, but these come with costs and benefits discussed in more detail in the next section.

LECTURE 12.4

VERTICAL INTEGRATION VERSUS

LONG-TERM CONTRACTS

VERTICAL INTEGRATION VS. LONG TERM CONTRACTS

Consider a firm (AutoCorp) that wishes to purchase car bodies.

- Should they vertically integrate or write a long-term contract?

There are several factors to consider

- contracts may be incomplete

- ownership and investment incentives

- specific assets

- asset ownership

VERTICAL INTEGRATION VS. LONG TERM CONTRACTS

Consideration 1: Incomplete contracts

If a complete contract was possible, then it would not matter if AutoCorp made their own car bodies or wrote a long term purchase contract.

But contracts are often incomplete. Possible problems include:

- difficulty in specifying all possible contingencies

- the cost of negotiating contracts

- the difficulty and cost of contract enforcement

VERTICAL INTEGRATION VS. LONG TERM CONTRACTS

Consideration 2: Ownership and Investment incentives.

Recall the Property Rights theory of the firm: ownership determines the residual use of an asset

- vertical integration ensures that asset ownership stays within the firm

- long term contracts allow ownership to reside outside the firm

- asset ownership influences investment incentives

VERTICAL INTEGRATION VS. LONG TERM CONTRACTS

Consideration 3: Specific Assets

Specific investments place the investor in a tenuous position.

Consider the problem faced by the potential supplier to AutoCorp (a producer of new autos), BodyWorks (which makes the chassis).

- BodyWork may have to construct a plant near AutoCorp's factory.

- Once the plant is built, AutoCorp has an incentive to rewrite the contract

- This reduces the incentive for BodyWorks to make investments

It is also possible that the hold up problem goes the other way

- e.g. AutoCorp makes a specific investment to tailor production to the chassis made by BodyWorks

This example is related to the classic case of GM and Fisher Body

VERTICAL INTEGRATION VS. LONG TERM CONTRACTS

When is it better to use long term contracts?

- When assets are less specific, markets are more likely to produce efficient outcomes

- When there is greater uncertainty, specific assets pose greater problems. Contingencies become more important, and these may be difficult to contract for.

To vertically integrate, AutoCorp could buy BodyWorks, or BodyWorks could buy AutoCorp

- the ownership structure matters!

VERTICAL INTEGRATION VS. LONG TERM CONTRACTS

Consideration 4: Asset Ownership

AGT manufactures modems, and CCC makes circuit boards (an important input)

- AGT is CCC's only customer

- CCC is the sole supplier of circuit boards for AGT

- assume circuit boards are firm specific

The value that each party gets from the transaction depends on their investment or effort

- investment by AGT could increase the value of the modem

- investment by CCC could reduce the cost of the circuit board

VERTICAL INTEGRATION VS. LONG TERM CONTRACTS

The realised surplus from the transaction is:

$$S = V - C - 10x^2 - 10y^2$$

where V is the value to AGT, C is the cost of CCC, x is the investment of AGT, and y is the investment of CCC.

Investment by AGT determines V:

$$V = \begin{cases} 40 & \text{with probability } x \\ 20 & \text{with probability } 1 - x \end{cases}$$

Investment by CCC determines C:

$$C = \begin{cases} 10 & \text{with probability } y \\ 30 & \text{with probability } 1 - y \end{cases}$$

The outcome depends on the effort of the two firms. If CCC puts in lots of effort, the cost is likely to be lower. If AGT puts in lots of effort in the redesign of the circuit, the benefits from the improved circuit is likely to be higher.

Note that we have assumed that both firms (or their owners) experience a cost of effort equal to $10x^2$ or $10y^2$

VERTICAL INTEGRATION VS. LONG TERM CONTRACTS

First, consider socially optimal investment. Expected joint surplus is:

$$S_J = (40 - 10)xy + (40 - 30)x(1 - y) + (20 - 10)(1 - x)y - 10x^2 - 10y^2$$
$$= 30xy + 10x(1 - y) + 10(1 - x)y - 10x^2 - 10y^2$$
$$= 10xy + 10x + 10y - 10x^2 - 10y^2$$

The FOCs for optimal investment are:

$$\frac{dS_J}{dx} = 0 = 10y + 10 - 20x$$

$$\frac{dS_J}{dy} = 0 = 10x + 10 - 20y$$

Solving simultaneously gives $x = y = 1$, $S_J = 10$.

[Note that in determining the expected joint surplus, if $V < C$, the firms decide not to produce.

VERTICAL INTEGRATION VS. LONG TERM CONTRACTS

In practice, both *x* and *y* are privately observable, and therefore not contractible. Suppose they are privately chosen, and assume the surplus is split equally. We will look for Nash equilibrium investments. First consider AGT. Their surplus is:

$$S_A = (40-10)xy/2 + (40-30)x(1-y)/2 + (20-10)(1-x)y/2 - 10x^2$$
$$= 15xy + 5x(1-y) + 5(1-x)y - 10x$$

The first order conditions for optimal investment are

$$\frac{dS_A}{dx} = 0 = 15y + 5(1-y) - 5y - 20x$$

This leads to a reaction function for AGT:

$$x = y/4 + 1/4$$

Similarly, for CCC:

$$y = x/4 + 1/4$$

Solving simultaneously gives *x* = *y* = 1/3, S_J = 50/9 = 5.6.

VERTICAL INTEGRATION VS. LONG TERM CONTRACTS

If investment is not contractible, each firm underinvests:

- each firm incurs the full cost of effort, but receives half of the benefits

- free riding leads to suboptimal investment

Could vertical integration solve the problem? Suppose AGT buys CCC

- AGT obtains all residual rights, CCC has no residual rights

- if effort is not contractible, the workers at CCC have no incentive to exert effort → y = 0

AGT has surplus

$$S_A = (40 - 30)x - 10x^2 = 10x - 10x^2$$

Optimal investment is x = 1/2 and surplus is S_A = 5/2.

- vertical integration does not solve the problem!

- if CCC buys AGT, the same problem remains

VERTICAL INTEGRATION VS. LONG TERM CONTRACTS

Key lesson: vertical integration is not always superior to a long term contract

• separate ownership actually gives more value in this example

• investments (or effort) are impacted by organisational structure

When might it be better to give stronger incentives to one party?

LECTURE 12.5

CONTRACTING WITH

DISTRIBUTORS

CONTRACTING WITH DISTRIBUTORS

What is the optimal length of a contract?

- long term contracts provide incentives for relationship-specific investments

- but it is difficult to write and enforce long term contracts when there is substantial uncertainty

- use long term contracts when firm-specific investments are needed and the investment climate is stable

- vertical integration might be preferred if firm-specific investments are needed and the outlook is uncertain

CONTRACTING WITH DISTRIBUTORS

Similar issues apply in the firm's relationships with distributors.

- free rider problems

- double marginalisation

A distributor has an incentive to free ride on the efforts of the manufacturer

- advertising, service, sales effort

Potential solutions

- vertical integration

- partial vertical integration: e.g. the manufacturer takes over advertising

- exclusive territories: grant the distributor market power in a region to improve incentives – but this exacerbates double marginalisation.

DOUBLE MARGINALISATION

Suppose both manufacturer and distributor are monopolists

- each will charge a price above marginal costs

- industry profits are not maximised

- this is an example of an externality between distributor and manufacturer

- there is an incentive for firms to vertically integrate or use vertical restrictions

Example: AutoCorp is a monopolist with demand for cars:
$$P = 55000 - 100Q$$

AutoCorp has costs:
$$C(q) = 5000q$$

Suppose AutoCorp is both manufacturer and distributor.

- The profit maximising output and price are Q = 250, P = 30,000, and π = 6.25m.

DOUBLE MARGINALISATION

Suppose instead that AutoCorp sells vehicles through SUVMart:

- AutoCorp sets the wholesale price P_w

- SUVMart sets the retail price P

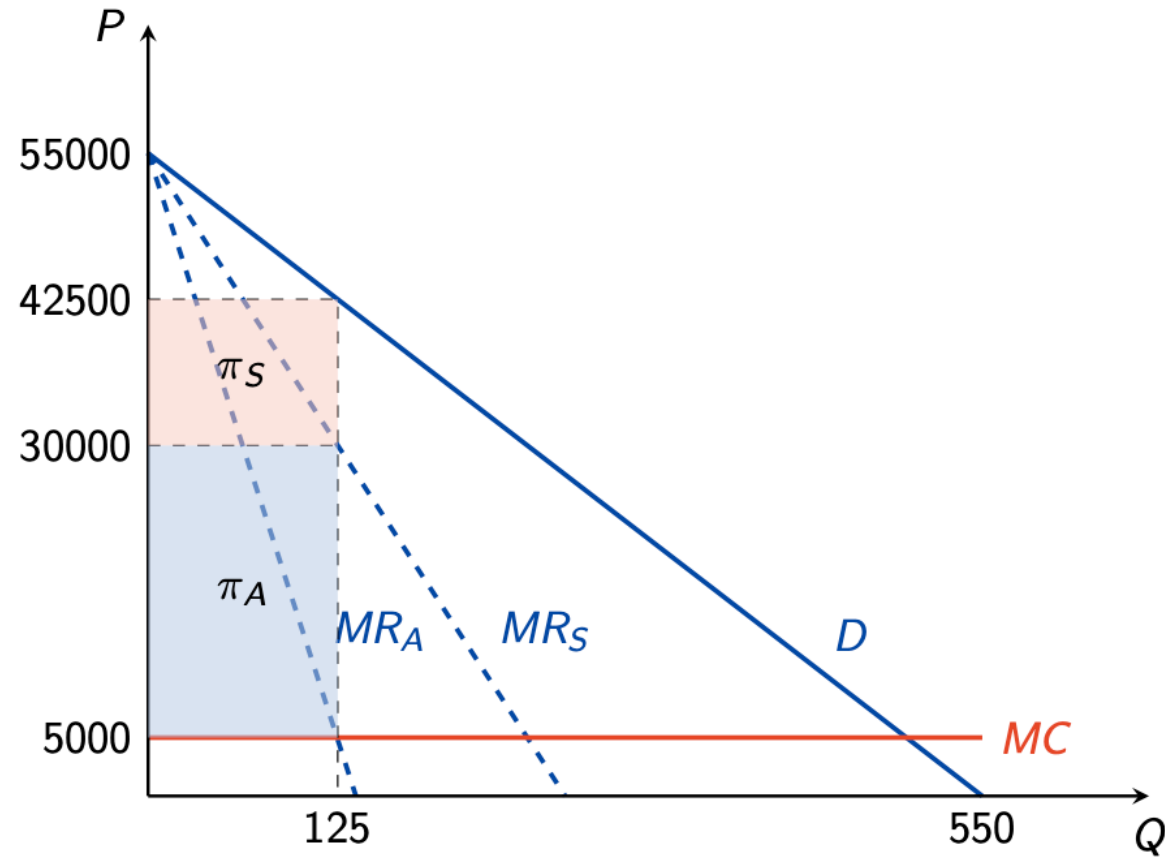SUVMart is a monopolist with marginal cost equal to P_w. They set MR = MC:

$$55000 - 200Q = P_W$$

This is the demand curve for AutoCorp. AutoCorp also sets MR = MC:

$$55000 - 400Q = 5000$$

This leads to prices and output of Q = 125, P_w = 30,000, P = 42,500, and profits for each firm of π_A = 3.125m, π_S = 1.5625m.

DOUBLE MARGINALISATION

DOUBLE MARGINALISATION

When AutoCorp sells directly to public they look at the demand curve for vehicles and choose price/ quantity to maximise profit.

When they sell via SUVMart, if they set the wholesale price equal to MC then SUVMart captures all the profits. To capture some of the profits AutoCorp increase the price at which they sell to SUVMart and in turn reduce the amount that SUVMart sells as the local monopolist.

- Total profits will be lower in the latter case

How to solve this problem?

It would be possible, for example, for AutoCorp to set a two part tariff

- For example, an upfront 'franchise fee' of $3.125m what would AutoCorp do?