Producers and the Supply of Health (Care)

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Lecture 4: Producers and the supply of health (care)

This lecture should enable you to:

- Describe the concept of 'supply' and the main factors that influence supply
- Understand cost concepts: total, fixed, variable, average and marginal cost
- Illustrate how this relates to concepts of technical and economic 'efficiency'
- Explain the relationship between scale and cost of production
- Apply these concepts to the case of the supply of health (care)

Why the interest in supply?

- Supply concerns the behaviour of firms (or producers) – large corporations and sole providers, private and public sector
- Relates to analysis of 'efficiency'
  - Input (resource) substitution
    - mix of doctors vs nurses, mix of capital vs labour …
  - Economies of scale
    - how many GPs or dentists in a practice, what size of hospital (how many beds etc)?
- Issues with supply drive market 'failures'

What is 'supply'?

- "Supply" = *willingness* and *ability* to sell a good (at given price, over given period)
  - *Willingness* to sell represents desire to produce
  - *Ability* to sell represents resource constraint
- 'Firms' produce those goods which, subject to capacity (resource constraint), maximise profit
  - A firm could be for example a hospital or a GP clinic
  - Relevance of 'profit' in health (care)?
- For now we are considering a situation of a 'free market' without government intervention
  - Later lectures we consider insurance/tax financing

Supply of what?

- What is the output of health care?
  - Health? How defined? How measured?
  - Intermediate outputs – hip's replaced, cataracts done?
  - Other outputs – information, reassurance?
- Complexity of relationship between health and health care means difficult to specify how outputs change as a result of changes in inputs
  - Impact on health of more tests, longer length of stay…
- Whatever the 'output', concept remains relevant!
  - Supply depends on 'production function' and 'cost function'

Production functions

- Consider the **production function** – the relationship between inputs and output
- Firms need to decide how best to combine inputs, given a variety of possible input choices /combinations, in order to maximise outputs
- Involves consideration of 'marginal product' (or marginal returns) of *each* input
  - The change in output as a result of adding additional units of an input (all else constant)
  - Diminishing marginal product. Eg as combine more nurses with existing inputs a point is reached where marginal product of the additional nurse begins to fall, resulting in marginal cost of production rising

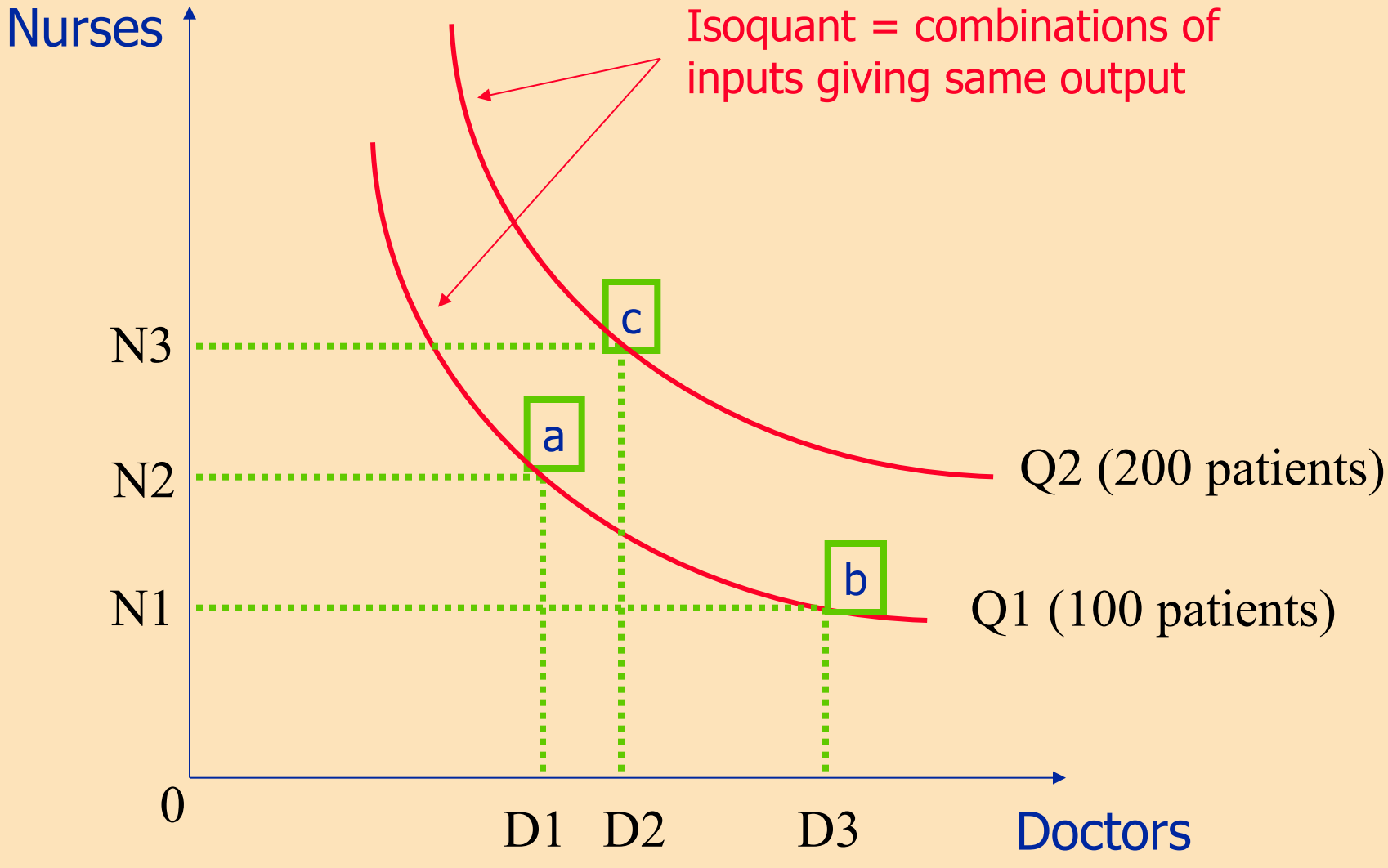
Diminishing marginal productivity

- Consider a clinic with 4 doctors and everything else constant apart from the number of nurses.
- In this case the 'product' or 'output' is the number of patients treated each day
- After adding a certain number of nurses there is **diminishing marginal productivity:** the *additional* output (product) from each *additional* unit of input (nurse) falls

Nurses	Number of patients treated	Marginal product
5	100	-
6	110	10
7	115	5
8	117	2

- The relationship between marginal products for different inputs is shown using an ***isoquant***

Isoquant curve



Isoquants and input substitution

- Isoquants are convex because they reflect *diminishing marginal product/returns*.
  - As move left to right the quantity of doctors used increases (and quantity of nurses decreases), such that each additional doctor confers a smaller increase in total output – the *additional* output (product/return) from each *additional* unit of input (doctor) falls (and corresponding additional output lost from each additional nurse forgone increases)
- Isoquants cannot cross!

Supply and efficiency

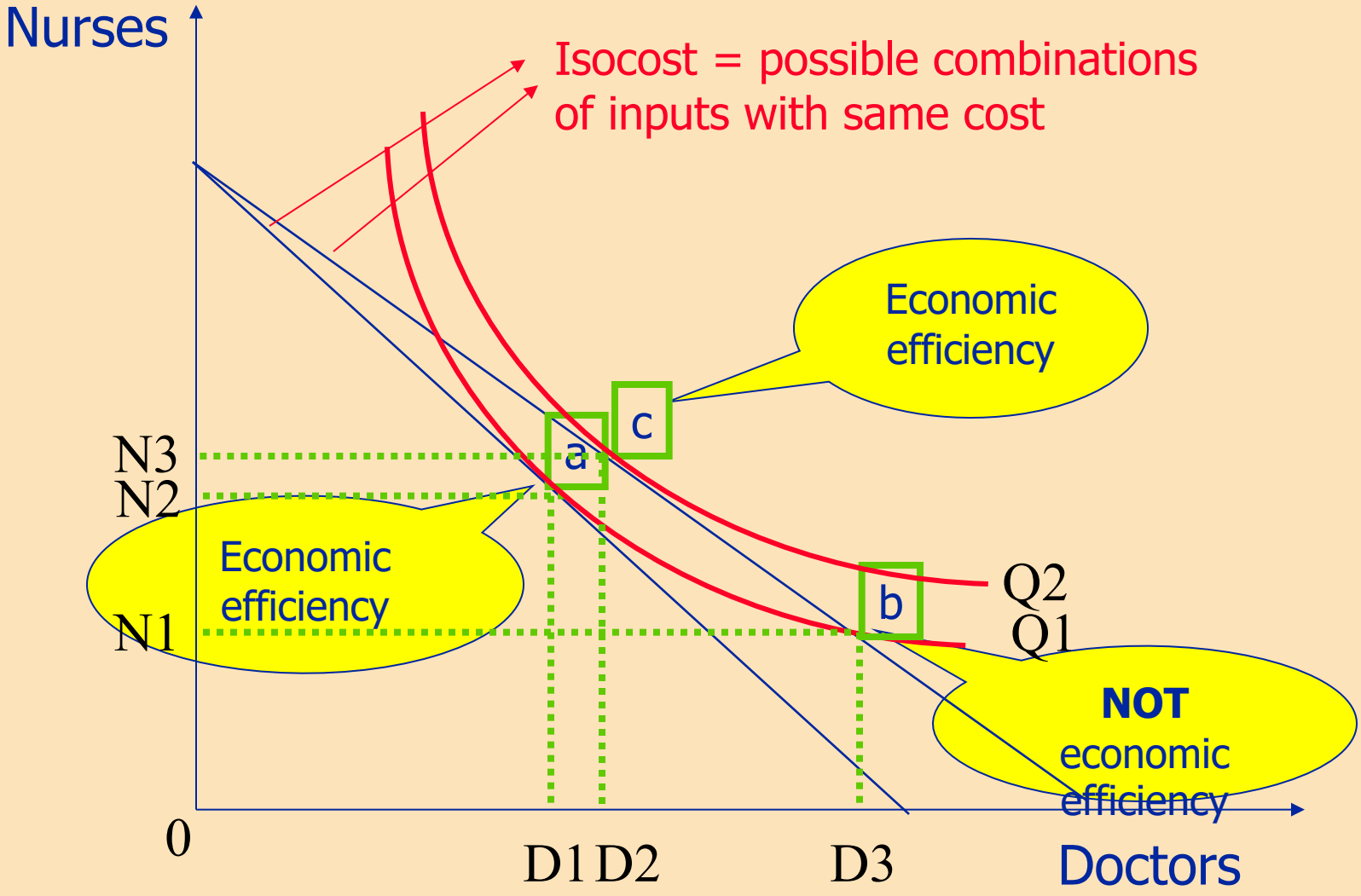
- **Technical Efficiency** = cannot produce more without using more of at least one input
  - All points on an isoquant are *technically efficient* (as technical efficiency does not consider costs)

- **Economic Efficiency** = cannot produce more without increasing cost
  - Takes in to account the relative prices of inputs
  - Shows minimum cost of producing a given output, or the maximum output attainable for a given budget

Isocost curves

- Isocost curves represent the combination of inputs it is possible to use given the resources (budget) available
  - Determined by resource budget and relative price of inputs
  - Imagine doctors were paid five times as much as nurses.
- Point where isocost and isoquant curves touch is ***economically efficient***

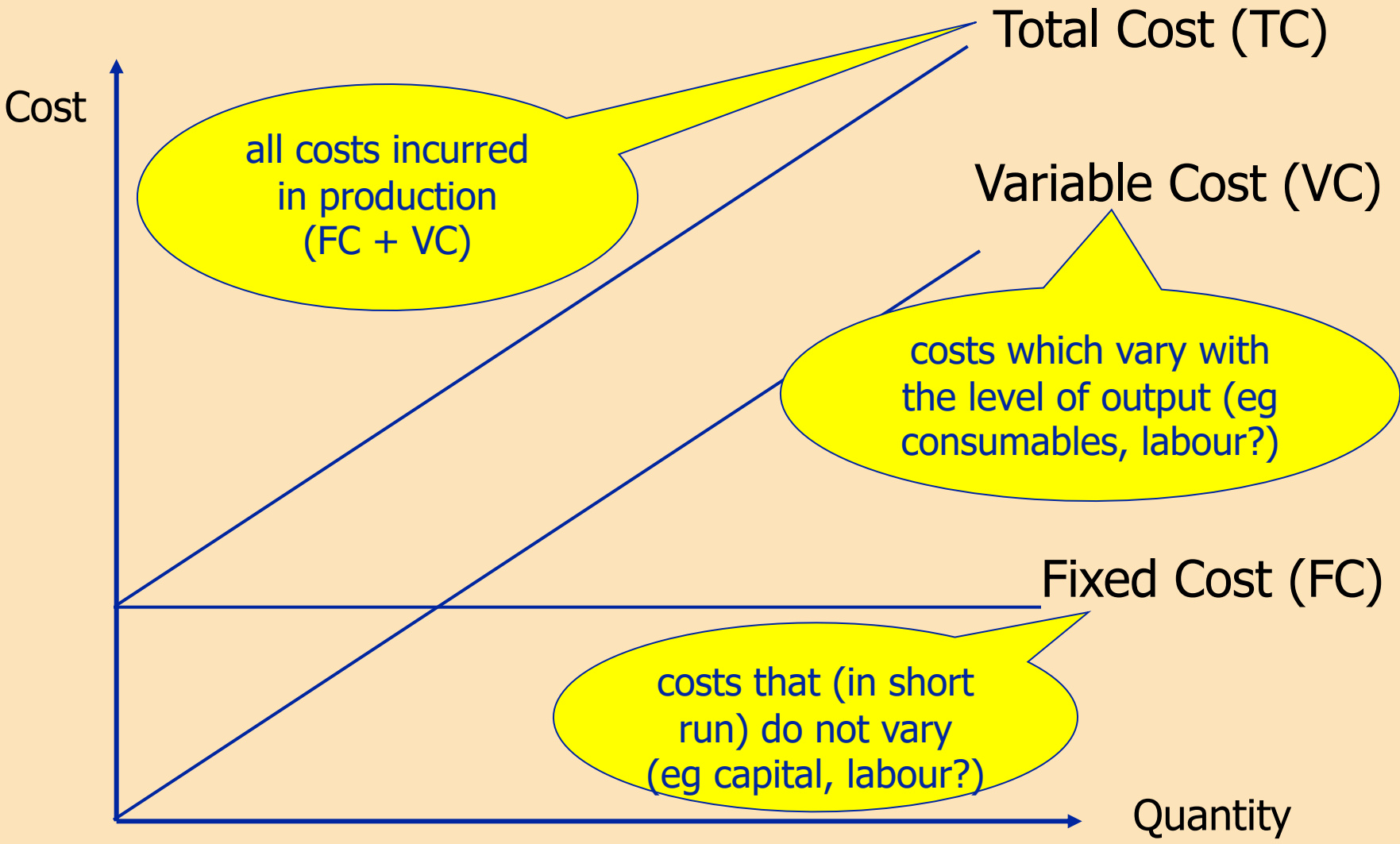
Economic efficiency



Cost functions

- Thus far have mostly considered 'production function': relationship between output and input
- Isoquant and isocost curves allows specification of 'cost functions': relationship between output and cost
  - Fixed Costs (FC)
    - Do not vary in (and therefore define) the **short run** (these costs are incurred even at zero output)
    - Define ease of entry/exit to a market/industry
  - Variable Costs (VC)
    - Vary with output at constant rate
    - Drive marginal cost in short-run
  - Total Cost (TC)
    - Sum of fixed and variable costs (FC+VC)

Fixed, variable and total cost

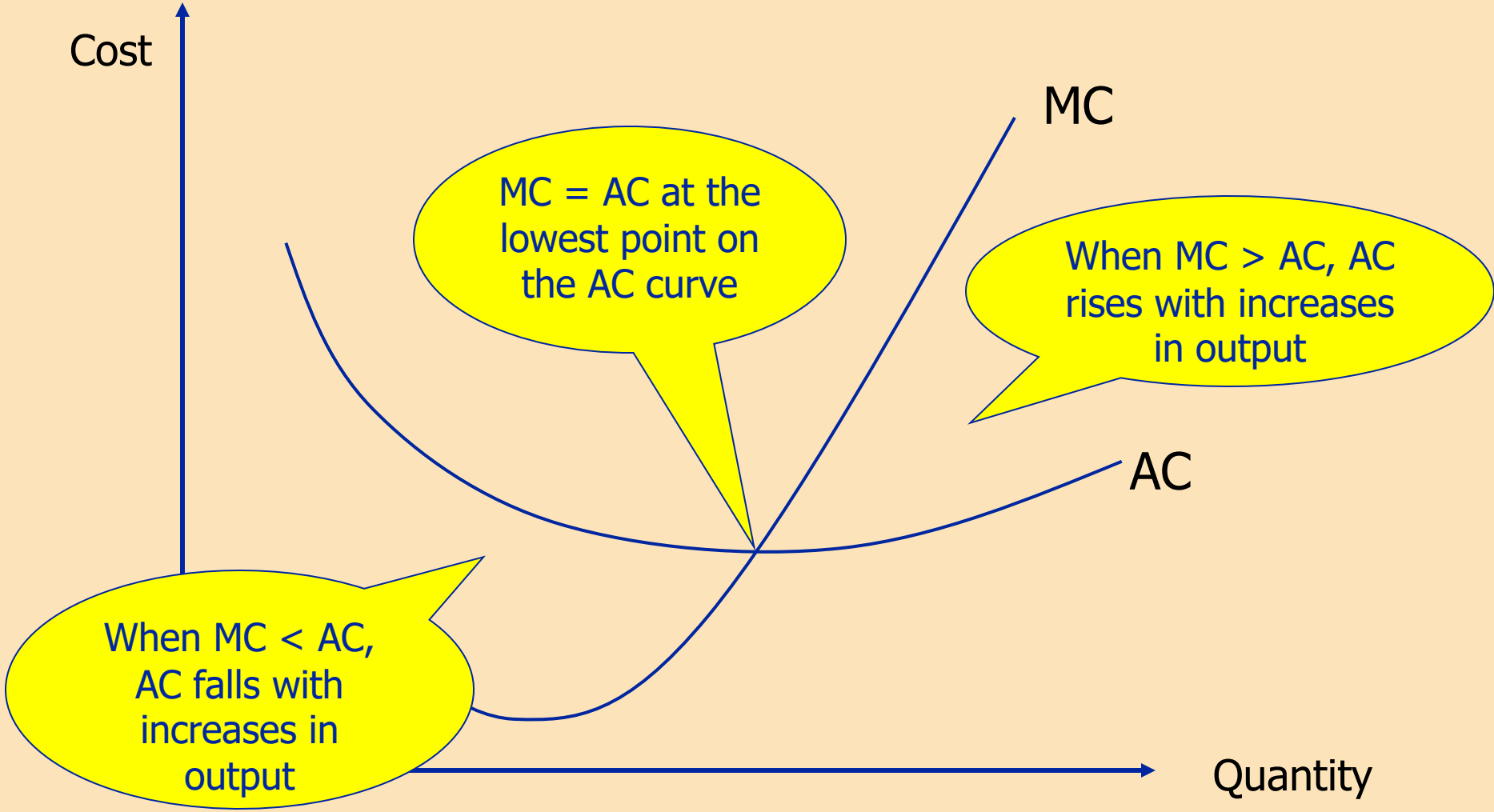


Cost functions

- Average Cost (AC)
  - Total cost ÷ number of units of output
- Marginal Cost (MC)
  - Additional cost of producing one extra unit

Total cost	Output	AC	MC
100	1	100	-
180	2	90	80
240	3	80	60
280	4	70	40
400	5	80	120
540	6	90	140
700	7	100	160

Average and marginal cost curves



Relationship between AC & MC

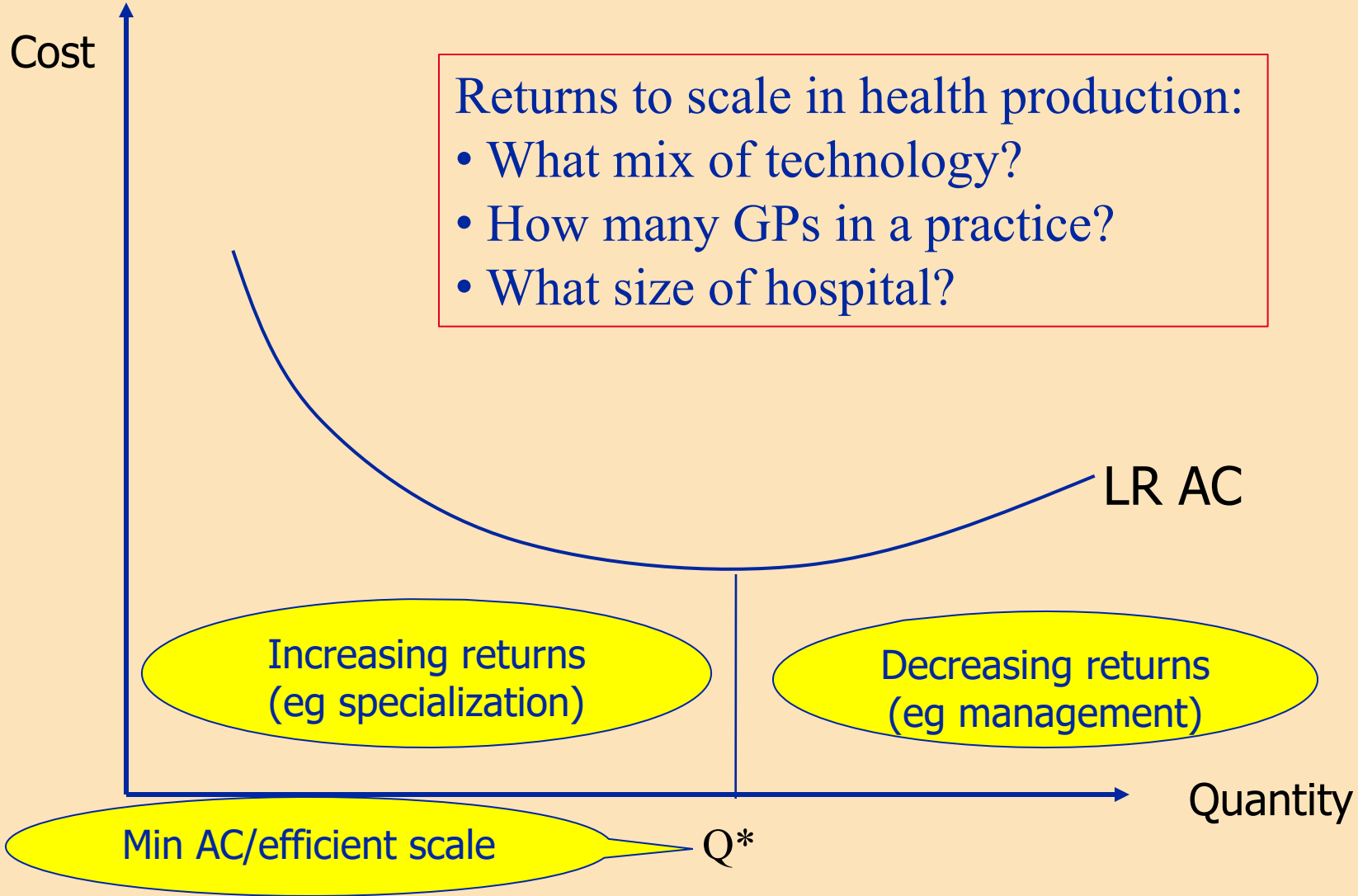
- Where (MC<AC), increasing the level of production reduces the average cost of each unit
- Where (MC>AC), increasing the level of production increases the average cost of each unit

Total cost	Output	AC	MC	
100	1	100	-	
180	2	90	80	(MC<AC)
240	3	80	60	
280	4	70	40	
400	5	80	120	(MC>AC)
540	6	90	140	
700	7	100	160	

Returns to (or economies of) scale

- Thus far looked at returns to a *factor* (i.e. change in output when vary one input). Returns to scale refers to change in output when *all* inputs varied
  - Proportional increase in output that occurs when all inputs increased by the same percentage
  - As at least one input is fixed in short-run, returns to *scale* is a long-run phenomena when all inputs variable
- Economies of (increasing returns to) scale
  - Conditions where AC *decreases* as output increases
- Diseconomies of (decreasing returns to) scale
  - Conditions where AC *increases* as output increases

AC and 'returns to scale'



Available online at www.sciencedirect.com
ScienceDirect
Health Policy 88 (2008) 236–242
HEALTH POLICY
www.elsevier.com/locate/healthpol

Economic barriers to implementation of innovations in health care: Is the long run–short run efficiency discrepancy a paradox?

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Abstract

Favourable cost-effectiveness of innovative technologies is more and more a necessary condition for implementation in clinical practice. But proven cost-effectiveness itself does not guarantee successful implementation. The reason for this is a potential discrepancy between long run efficiency, on which cost-effectiveness is based, and short run efficiency. Long run and short run efficiency is dependent upon economies of scale. This paper addresses the potential discrepancy between long run and short run efficiency of innovative technologies in healthcare, explores diseconomies of scale in Dutch hospitals and suggests what strategies might help to overcome hurdles to implement innovations due to that discrepancy.

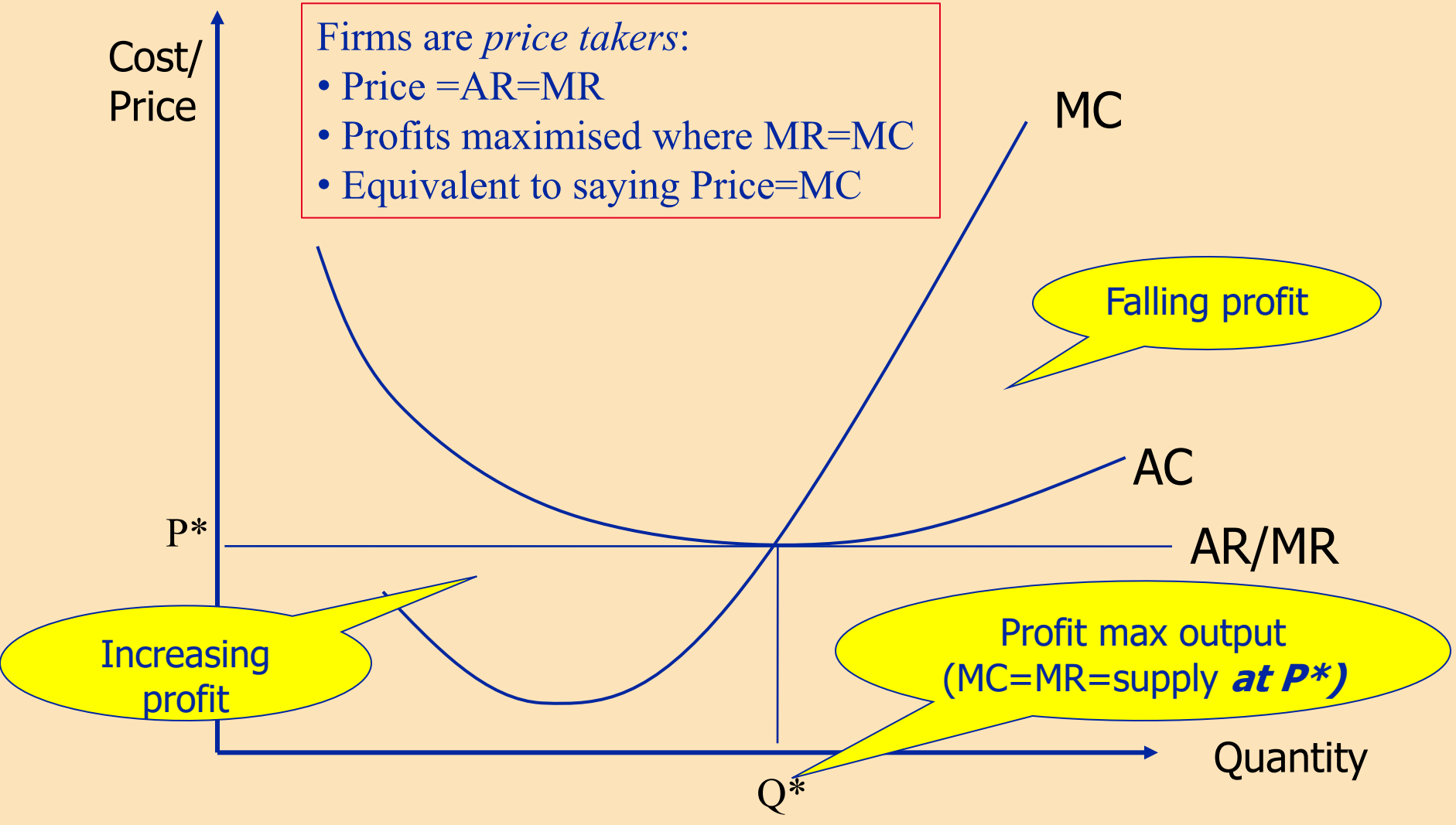
The importance of price

- In competitive markets firms are **'price takers' –** in other words an individual firm can not influence the market price. In these conditions there are lots of firms competing.
- The implication is no matter how many units an individual firm sells it will still only be able to charge the market price (p*), thus:
  - The average revenue (AR) a firm receives for each unit sold = p*
  - The marginal revenue (MR) a firm receives for each extra unit sold = p*

Profit maximisation

- Profit = total revenue (TR) – total cost (TC)
  - where TR = price x quantity
- In competitive markets price=AR=MR
- Maximise profit where distance between TR and TC is at its greatest
  - This occurs where MR=MC (ie price=MC)
  - Where MC>MR then means TC>TR for every extra unit sold leading to reduced profits (and vice versa)

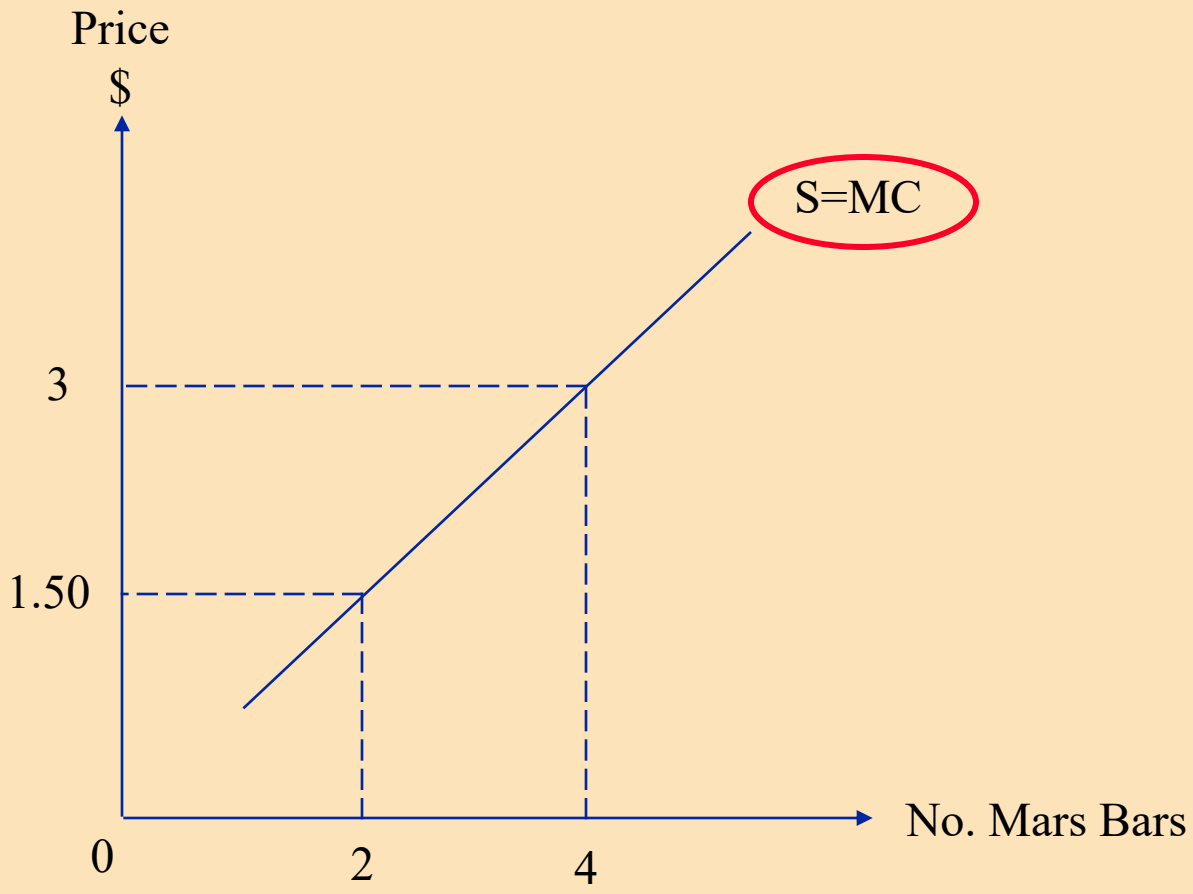
Profit in the competitive market



Supply and marginal cost

- MC curve firm faces is upward sloping because of diminishing marginal productivity (returns)
- Firm chooses output where MC=MR (price) in order to maximise profits
- Supply curve therefore equates to (short run) MC curve: maximum quantity firm will sell at *each possible price* (i.e. MR) in the market
  - Remember firms cannot influence price, so supply curve shows what willing and able to sell at *given* price
  - If they are not willing or able to sell at that price then will leave market as other firms will supply

Supply curve

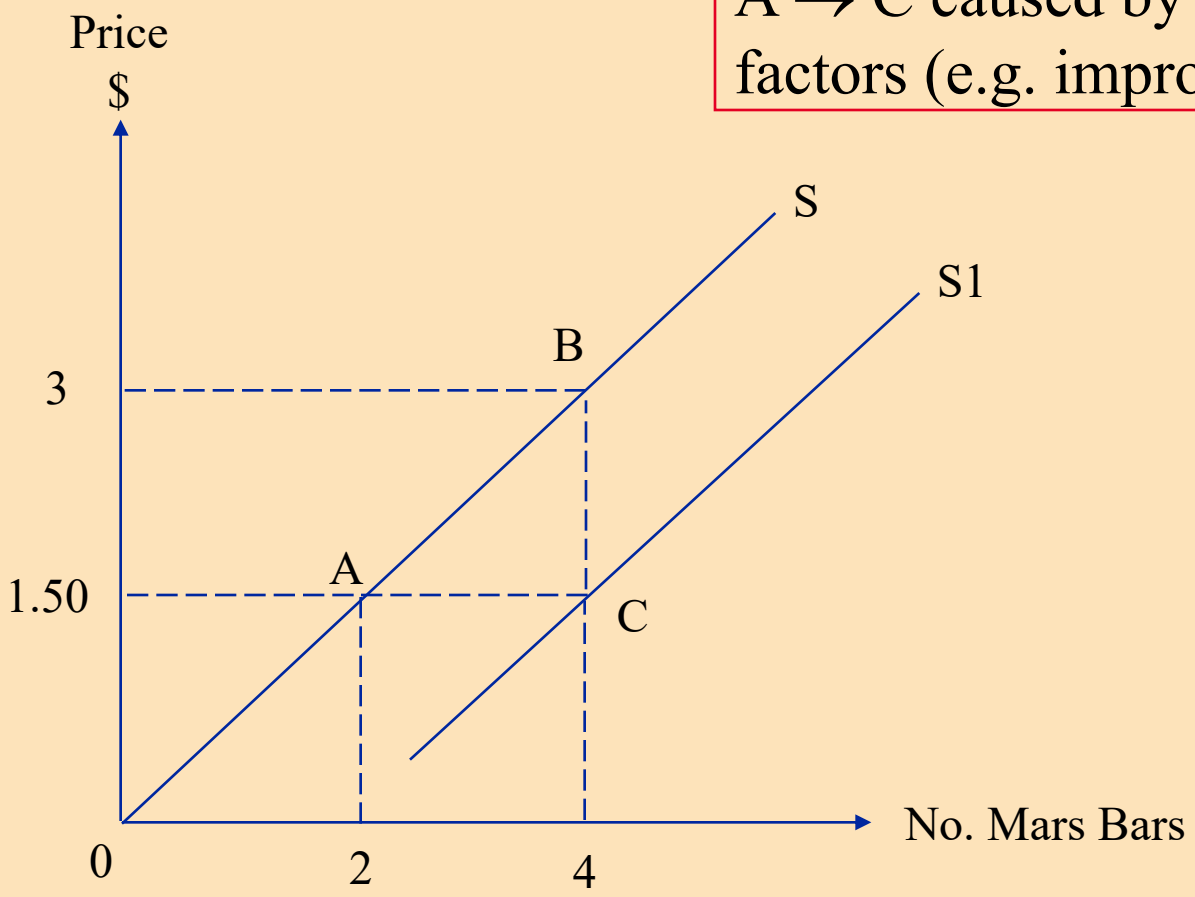


Influences on supply

- Supply is a function of:
  - Price of the good (revenue)
  - Prices of factors of production (isocost)
  - State of technology (isoquant)
  - Other "goals" of firm (than profit maximization)
- This relationship can be estimated empirically to look at what happens to the quantity supplied as these variables change
- Critical issue is between effect of price on supply versus other influencing factors

Price versus other factors

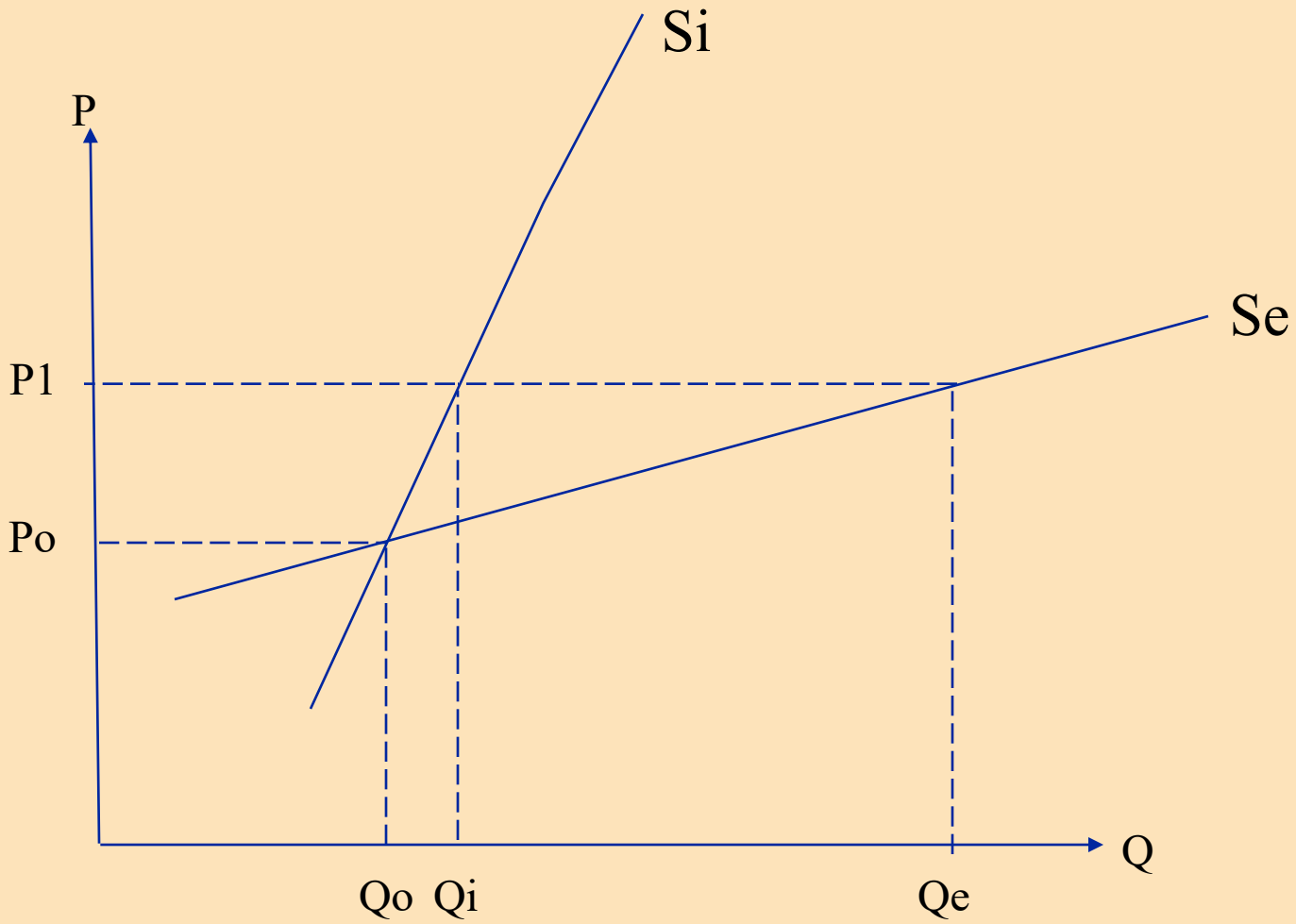
A → B caused by increase in price
A → C caused by change in other factors (e.g. improved technology)



'Elasticity' of supply

- Elasticity (ε) measures *responsiveness* of changes in quantities supplied to other variables – typically price
- **Elasticity of supply (Sε)** = % change in quantity supplied ÷ % change in price
- **Sε** < 1 = inelastic
- **Sε** > 1 = elastic
- **Sε** = 1 = unitary elasticity
- Main determinant = flexibility in production

Elasticity of supply



A final word…

- Supply = willingness and ability to sell a good at each and every price, over a given period of time, subject to all else being constant
- In order to maximise output/minimise cost firm needs to combine inputs according to their marginal productivity and relative prices
  - Need to be *economically* efficient
- Firms seek to maximise profits, where MR=MC
  - As price=MR, firms seek to produce where price=MC
  - Supply curve therefore derived from MC curve
- Over next few lectures we will explore some specific issues concerning supply of health care