BUSS1040 – Economics for Business Decision Making

Lecture 2: Firm Behaviour: Production, Costs
Reading: NW Chapter 7

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THE UNIVERSITY OF SYDNEY

Early Feedback Quiz – Week 3

- Access on BUSS1040 Canvas
- Starts Monday week 3 – keep an eye on email and Canvas
- You have a week to complete
- 10 multiple choice questions, covering material from weeks 1-2
- Shortly after the quiz closes, correct answers will be available on Canvas

- **Schedule enough time to work through the quiz!**
- All questions appear on one page. As long as you have *saved* (but not submitted) your answers, you can return to the quiz and change your answers – once *submitted* your answers are FINAL!
- Make sure you submit your answers before end of the quiz, otherwise NO marks (zero).
- Important: once submitted, I expect you receive a message confirming you submitted. You will not see your mark, neither what you got right/wrong. Your mark will be available in MyGrades after the quiz closes. Questions with answers will be available on Canvas after the quiz closes.
- *ADVICE*: save a screenshot before submitting your answers.

Outline

1. **The Firm**
2. **Production Function**
3. **The Costs of Production**
   - Short-run Costs
   - Long-run Costs

Introduction

- Now we focus on how firms operate.
  - We want to describe firm behaviour with a view on understanding firm and market supply
- First, we examine the ideas of short and long run for a firm's production process;
  - In the short run the firm has at least one fixed input of production, whereas in the long run all inputs can be adjusted if the firm wishes to.
- Second, we analyse the relationship between a firm's inputs and its outputs – that is, its production function.
- Third, we examine how a firm's output is related to its costs in the short run and in the long run.

The Firm

- A firm is an organisation that employs factors of production to produce or provide goods and/or services
- Think of it as the production function

$$q = A\,F(K, L)$$

Where

- *Y is the total output*
- *K is capital; L is labour*
- *A is the level of technology*

For simplification, at this introductory units, the production functions simplified by assuming “A=1”

$$q=F(K,L)$$

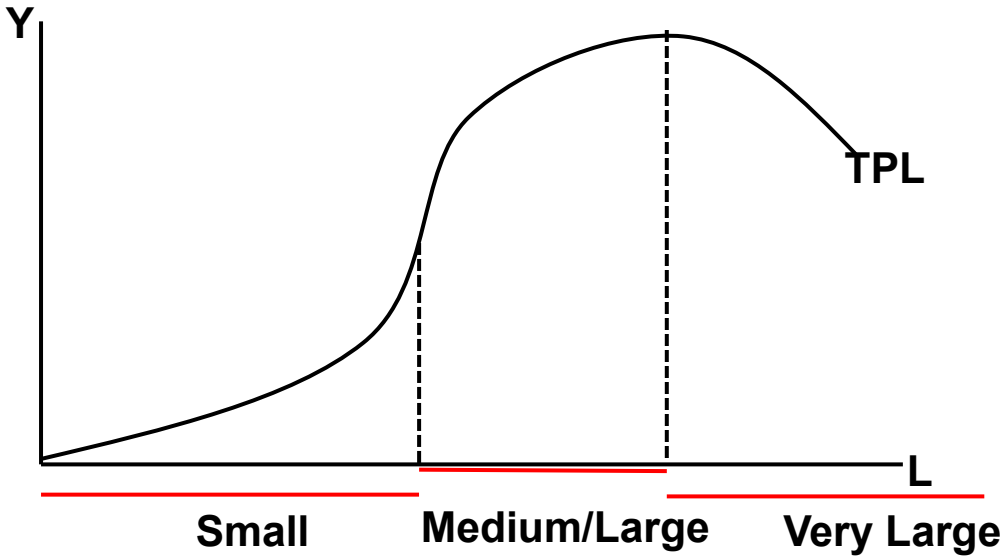
Production Function

- Firm's goal is to maximise profit
  - Recall that this is a constrained maximisation problem

- **Short-run:** is the time frame where *at least one of the factor of production is fixed*. In the above production function, *A* and *K* are likely to be fixed in the short-run, L is variable.
- **Long-run:** the time frame in which *all input factors are variable*
- The short run and the long run is not defined in relation to a set period of time, but rather in relation to how long it takes for all of a firm's inputs to become available – this will differ between industries.

Short-run Production Function

- Assuming a variable input *L* with *constant K* and *A*
  - Total Production of Labour
  - With small amount of labour, more labour input, output increases very fast (increasing returns). *Why? (hint: constant K and A)*
  - With medium to high amount of labour, more labour input, output increases but slower (diminishing returns). *Why? (hint: constant K and A)*
  - With very large amount of labour, more labour input, output decreases. *Why?*



Short-run Production Function

- ***Average Product of Labour*** = *APL* = $\frac{Y}{L} = \frac{Q}{L}$
  - Total output is denoted as *Y* or *Q*
  - It is the average output each worker can produce

- ***Marginal Product of Labour*** = *MPL* = $\frac{\Delta Q}{\Delta L} = \frac{\partial Q}{\partial L}$
  - It is the additional output when employing one more worker
  - MP is the slope of the production function

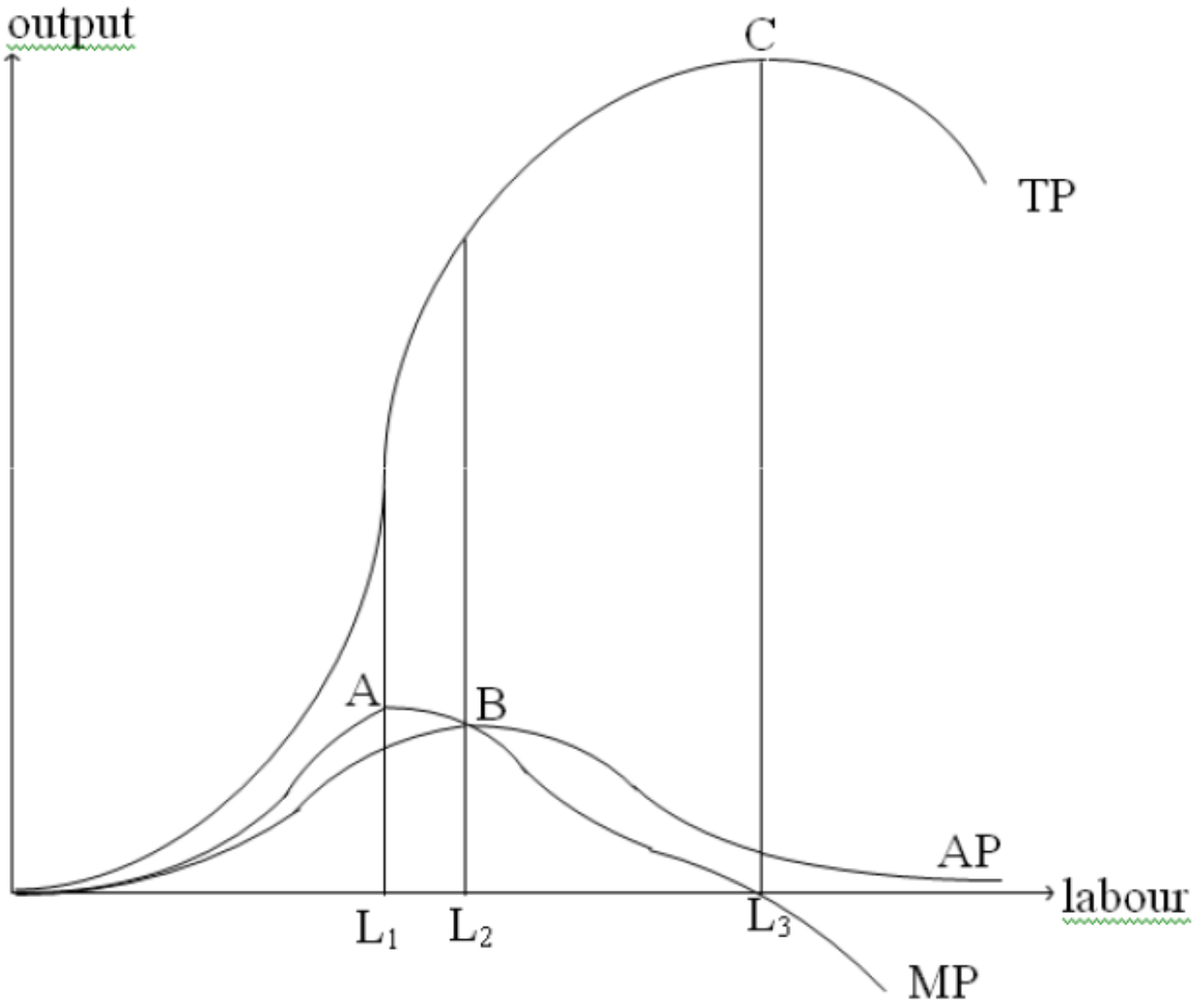
Short-run Production Function

› An example:

L	Y	APL	MPL
1	10	10	10
2	22	11	12
3	36	12	14
4	49	12.25	13
5	55	11	6
6	60	10	5
7	62	8.86	2
8	60	7.5	-2

Short-run Production Function

› Graphically:



Short-run Production Function

- MPL cuts through APL at the maximum APL. *Why? (hint: look at the definition of MPL, APL)*
  - When MPL > APL, average is increasing with L
  - When MPL falls below APL, average starts falling too with L
- **Law of Diminishing Return:**

  "... as successive units of a variable resource (say, labor) are added to a fixed resource (say, land), beyond some point the marginal product (MP) attributable to each additional unit of the variable resource will decline." (Jackson, p.228)

  - Basically, there comes a point if we employ more labour, we probably can produce more output, but output is going to increase at a decreasing rate

Short-run Production Function

- **Law of Diminishing Return (LDR):**
  - So why after point *B*, from ***B*** to *C*, output is going to increase at a deceasing rate?
  - With fixed capital and technology, after point *B* any further addition of labour means that each worker will have less and less of the fixed capital to work with, and so they must become less and less efficient.
  - Crucially, diminishing MP is a short run concept, relying on the idea that at least one input (e.g. capital) is fixed
- **Output is maximum when:**

MPL = 0 or $\frac{\partial Q}{\partial L} = MPL = 0$

Short-run Production Function

- Example: Assuming the production function of Charlie's cocoa distribution business

$$Q = 20L - L^2 \qquad MP_L = \frac{\partial Q}{\partial L} = 20 - 2L$$

$$AP_L = \frac{20L - L^2}{L} = 20 - L$$

- Q is maximised when MPL = 0. That is, at the point where an additional worker cannot contribute positively to output!

$$MP_L = \frac{\partial Q}{\partial L} = 20 - 2L = 0 \qquad L = \frac{20}{2} = 10$$

- So Charlie should employ no more than 10 workers…

Returns to Scale – Production in the Long Run

- Allow all inputs into the production process to be variable.
- Given all factors of production are variable, we are in the long run.
- We are interested in how the quantity of output changes when we change the quantity of all of the factors of production.
- *Returns to scale* refers to how the quantity of output changes when there is a proportional change in the quantity of all inputs.
- That is, returns to scale are a *long run phenomenon. All inputs are variable*
- Diminishing returns is a short run phenomenon as one input (capital) is fixed

Returns to Scale – Production in the Long Run

- If output increases by the same proportional change, there are *constant returns to scale* – if we double the quantity of all the inputs and output also doubles in quantity.
- If output increases by more than proportional increase in all inputs, we have *increasing returns to scale*.
- If output increases by less than the proportional increase in all inputs, there are *decreasing returns to scale*.
- Note, it is possible that a firm has diminishing MP in the short run, and still has increasing returns to scale in the long run.

Production and Cost

- The production function relates inputs and outputs
- The firm's cost function relates the total cost of production and output
- There is a one-to-one relationship between the production function and cost function
- *The production function and the cost function 'tell the same story'*
- *They are two sides of the same coin*

Economic profit versus accounting profit

› We assume that firms aim to maximise profits, where

profit = **Economic profit**

› Economic profit may differ from accounting profit

› **Accounting profits** are revenues minus all explicit costs

› **Economic profits** are revenues minus total opportunity cost

Economic profit

Profit: total revenue minus total costs

$$\pi = TR - TC$$

Total revenue : the amount a firm receives for the sale of its output

Total cost : the amount a firm pays to buy the inputs of production + forgone opportunities
= total opportunity cost of producing goods/services

- Opportunity costs include
  - ✓ explicit costs (that are not sunk)
    = direct payments for inputs or factors of production
  - ✓ implicit costs (value of foregone opportunities)
    e.g. forgone wages, interest earnings

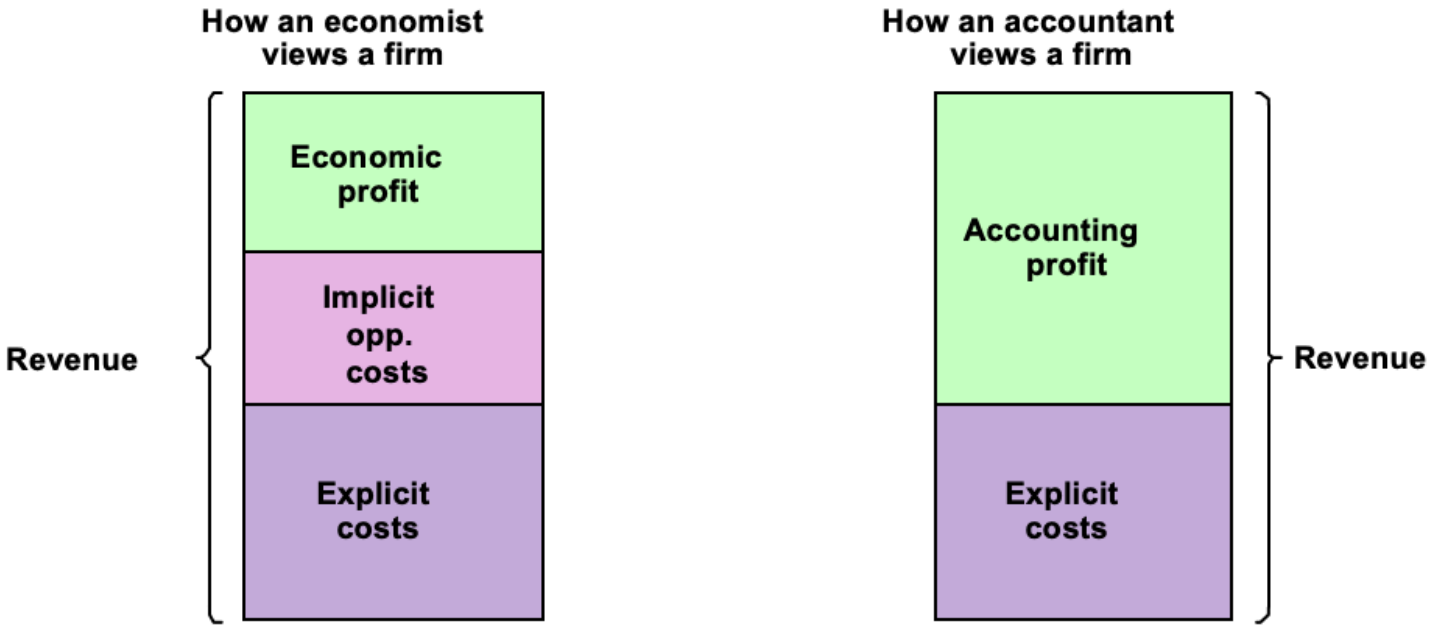
Example: Helen uses $300000 of savings, interest rate at 5 %. Thus Helen gives up $15000 per year in interest

Not an explicit cost – but it is an opportunity cost while she is running the firm, so needs to be included in costs (and measures of economic profit).

Zero economic profit – revenues just cover opportunity costs

Profit maximisation

- Firm's goal is to maximise profit where profit = economic profit
- Economic profit may differ from accounting profit
- **Accounting profits** are revenues minus all explicit costs
- **Economic profits** are revenues minus total opportunity cost



Economic Profit – Example

Mike recently opened a restaurant. This requires Mike to (temporarily) give up a job working as a lecturer at the university that pays $20 000 a year. The restaurant is located in a house he inherited from his grandmother, of which he is the sole owner. The house would otherwise be rented out at a price of $30,000 a year. This year, the restaurant has revenue of $200 000, personnel costs of $50 000 and costs of food inputs of $20 000. What is Mike economic profit of running his restaurant this year?

(a) $80 000

(b) $90 000

(c) $110 000

(d) $130 000

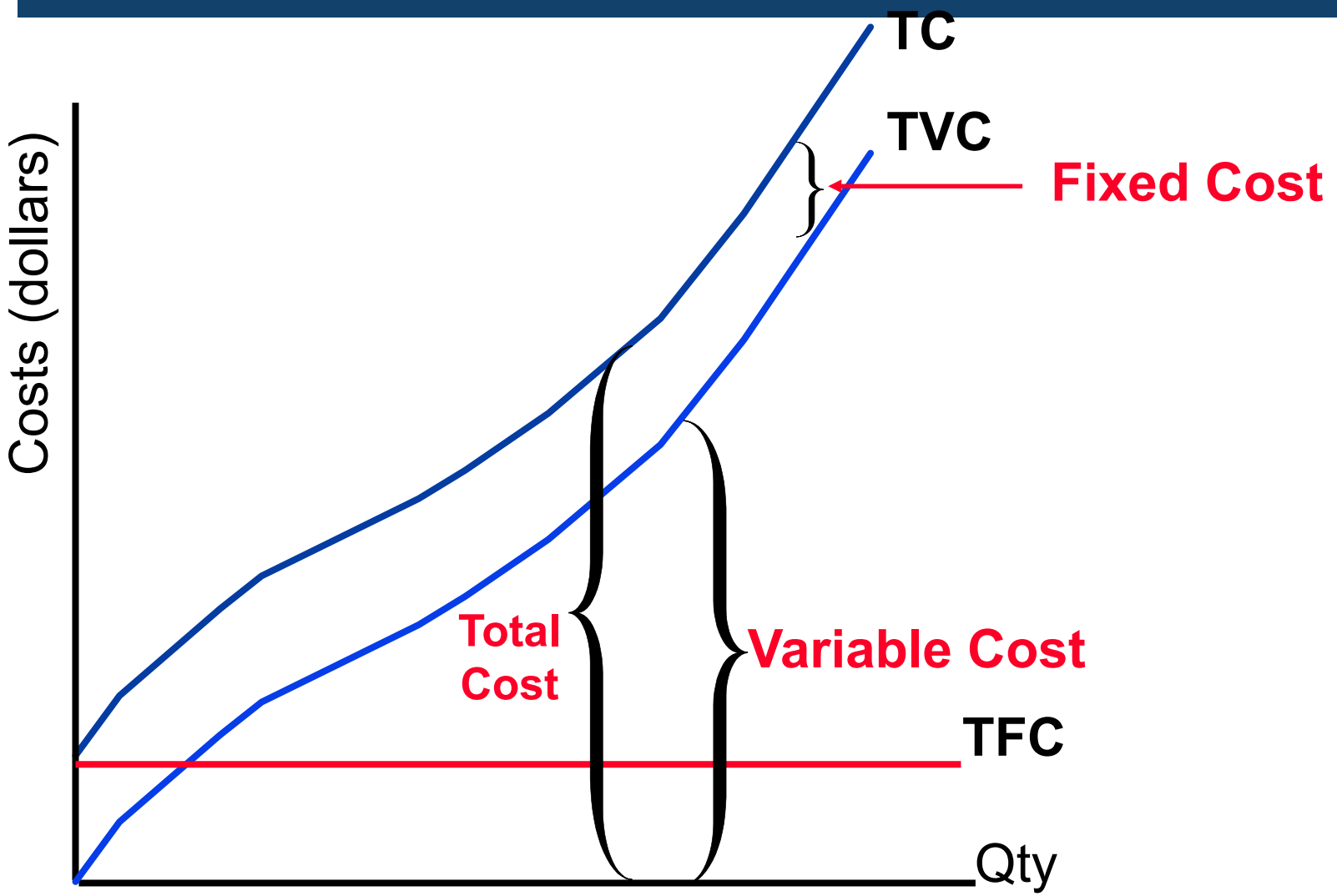
(e) None of the above

- Answer: (a) $80,000
- Explanation: Economic profit = Total revenue – Explicit costs – Implicit costs
- Here, revenue = $200,000
- Explicit costs = $50,000 (personnel costs) + $20,000 (food inputs) = $70,000
- Implicit costs = $20,000 (forgone wages) + $30,000 (forgone rental income) = $50,000
- Therefore, Economic profit = $200,000 - $70,000 - $50,000 = $80,000

Short-run Costs

- A ***cost function*** is an equation that links the quantity of output with its associated production cost.
  - For example, TC = f(q), where TC represents total cost and q represents the quantity of output.
- ***Short-run:*** is the time frame where *at least one of the factor of production is fixed*
- ***Total Costs in the Short-run*** = Total Fixed Costs + Total Variable Costs
- ***Total Fixed Costs (TFC):*** are the costs that in total do not vary with changes in output. e.g. rental payments, portion of machine depreciation…etc.
- ***Total Variable Costs (TVC):*** are the costs that change with level of output. E.g. materials, labour, fuel…etc.

Short-run Costs



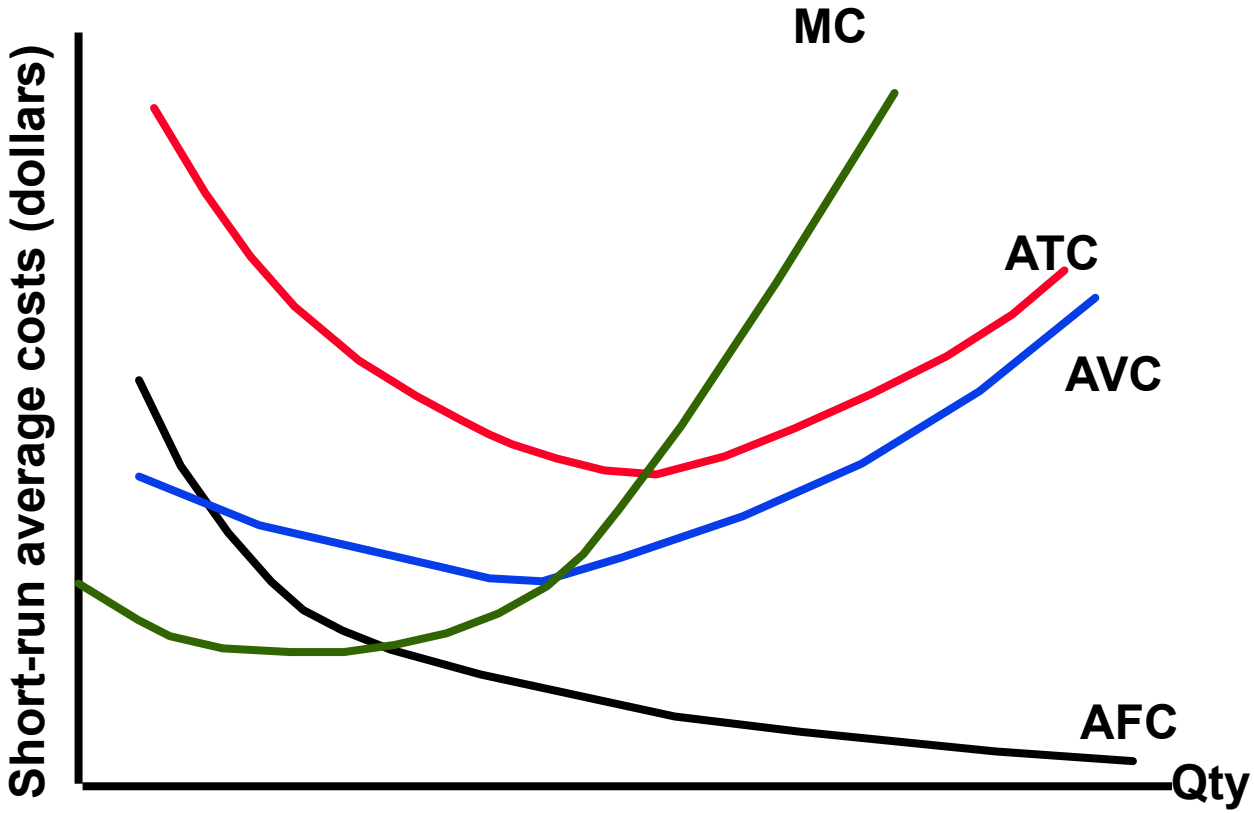
Short-run Costs

- **The TVC and TC curve**
  - At low level of output, TVC and TC increase at a decreasing rate. *Why? (hint: related to the production function at low level of output, what happen when we have more labour and output expands?)*
  - At high level of output, TVC and TC increase at an increasing rate. *Why? (hint: related to the production function at high level of output, what happen when we have more labour?)*

- ***Average fixed cost = AFC =*** $\frac{TFC}{Q}$
- ***Average variable cost = AVC =*** $\frac{TVC}{Q}$
- ***Average total cost = ATC =*** $\frac{TC}{Q} = AFC + AVC$

Short-run Costs

- ***Marginal Cost:*** the additional cost when producing an extra unit of output
- MC = $\frac{\Delta TC}{\Delta Q} = \frac{\partial TC}{\partial Q} = \frac{\partial TVC}{\partial Q}$



Relationship between ATC, AVC and MC

- AFC declines as Q increases. Why? (hint: think about the TFC)
- AVC declines initially, reaches a minimum , and then increases again. It looks like an U shape. Why? (hint: think about the TVC and LDR)
- MC also declines sharply, reaches a minimum and then rises rather sharply. Why? (think about the law of diminishing returns)
- The MC curve cuts both the AVC and ATC curves at their minimum points. Why?
  - When MC > ATC
    - ATC increases
  - When MC < ATC
    - ATC falls
  - When ATC = MC
    - ATC is at its minimum

Short-run Costs: Example

$$TC = 50 - 30Q + Q^2$$

$$ATC = \frac{TC}{Q} = \frac{50}{Q} - 30 + Q$$

$$AVC = \frac{TVC}{Q} = \frac{Q^2 - 30}{Q} = Q - 30$$

$$MC = \frac{\partial TC}{\partial Q} = -30 + 2Q$$

$$AFC = \frac{TFC}{Q} = \frac{50}{Q}$$

Long-run Costs

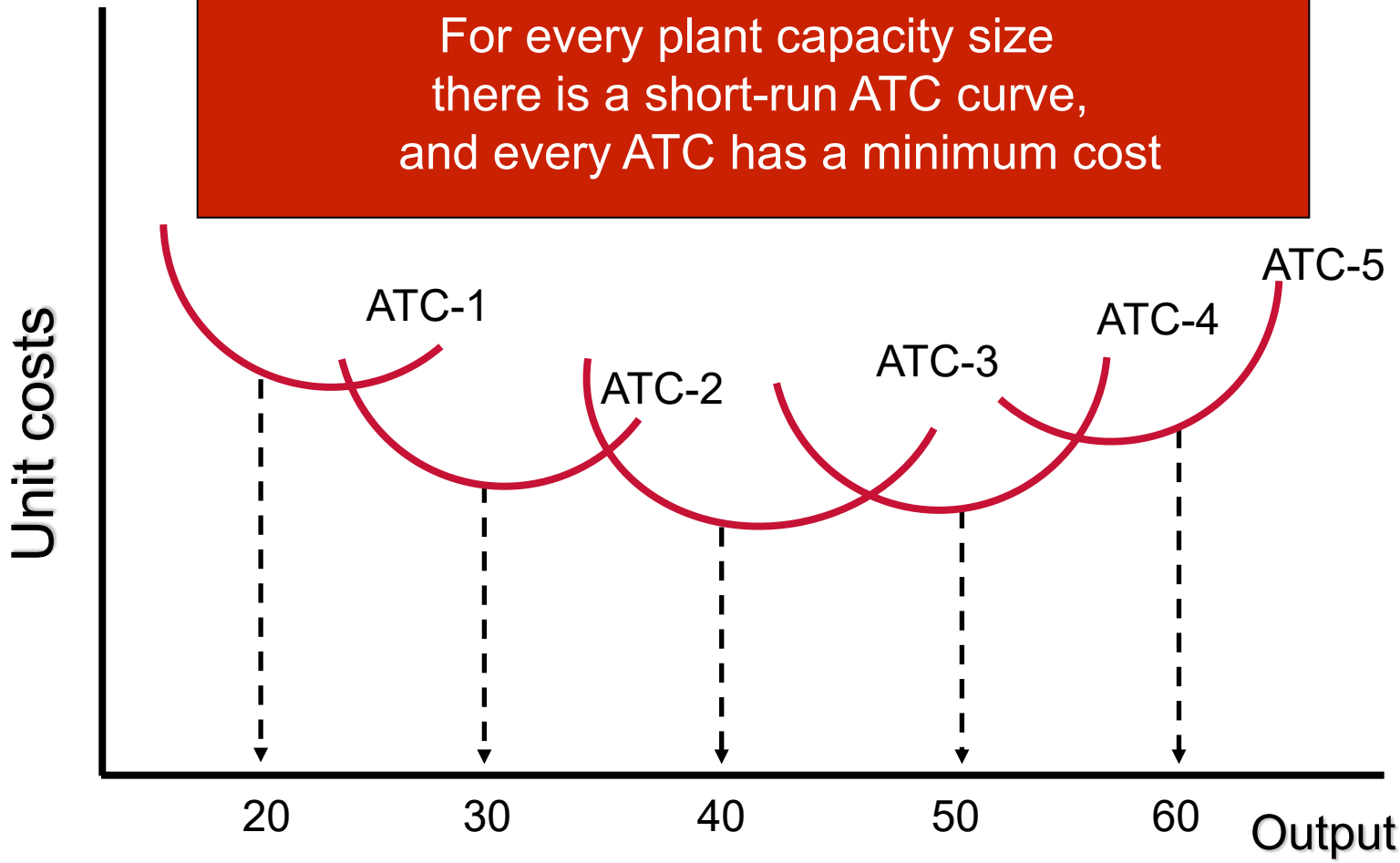
- All factors are variable in the long run
  - All costs are variable. No fixed cost
  - The firm can alter its plant capacity or capital
  - A firm producing a positive output has more flexibility to adjust all of its inputs, so long-run costs should not be more than short-run costs (for a given level of output)
- In the LR, the firm will choose:
  - The most efficient production method
  - The cheapest combination of all inputs – recall that all inputs are variable in the LR

Long-Run Average Cost

- The long-run ATC shows the lowest per-unit cost at which any output can be produced after the firm has had time to make all appropriate adjustments in its plant size
  - Depend on the output, firm adjust its plant size and achieve the lowest per-unit cost
  - The long-run average cost curve will be the lower envelope of all the short-run average cost curves.

Long-run Average Cost Curve

For every plant capacity size
there is a short-run ATC curve,
and every ATC has a minimum cost



Long-run Average Cost Curve

The long-run ATC just 'envelops' all the short-run ATC curves