LECTURE 7: COSTS OF PRODUCTION

Today's Topics

1. **What Are Costs? Total Revenue (*TR*), Total Cost (*TC*), Profit (π); the Cost of Capital; Economic v. Accounting Profits.**

2. **Production and Costs: the Production Function, the Total Cost Curve, Fixed and Variable Costs, Average and Marginal Costs, Cost Curves.**

3. **Costs in the Short Run and the Long Run: Average Costs, Economies of Scale.**

4. **Sunk Costs.**

FIRMS, MARKETS, & COSTS

How do market conditions and structure affect the number of firms? the prices charged? the quantities sold?

The firm decides:

- **what to produce**
- **how to produce (technology)**
- **how much to produce**
- **the price it sells at (unless price-taking).**

The firm's costs are key to its production and pricing decisions.

REVENUE, COST, PROFIT

Assume: *the firm's primary goal is to maximise its profits.*

***Total Revenue (TR)*: the amount a firm receives for the sale of its output.**

***Total Cost (TC)*: the amount a firm pays to buy the inputs to production.**

***Profit (π)* = $TR - TC$**

In general, TR and TC (and so profit π) will vary with the level of output y/period.

For a price-taking firm, $TR = P \bullet y$.

Just how TC varies we now explore.

CAPITAL COSTS AS OPPORTUNITY COST

Total Costs *TC* include all *opportunity costs* = explicit costs + implicit costs.

***Explicit* costs are the costs the accountants measure: the outgoings.**

***Implicit* costs are the alternative opportunities forgone: time, interest income on capital, etc.**

The opportunity cost of capital is the value forgone: the best alternative return from that capital, whether it's yours, your family's, or borrowed.

ECONOMIC v. ACCOUNTING PROFITS

Economists look forward (what could we have done instead?); accountants look backwards (verifiable historical costs).

Economists' profit = accountants' profit − implicit costs.

$\therefore$ Accountants' profit measure is greater than economists' profits, in general.

A positive economic profit: above-normal return to capital.

Example: *Economic Value Added* = operating (accounting) profit − cost of capital $\times$ capital

THE PRODUCTION FUNCTION

How are the firm's Total Costs related to its purchasing decisions, as it buys inputs to transform into output?

Number of Workers	Output *y*/hour	Marginal Product of Labour	(4) Cost of Factory	(5) Cost of Workers	Total Cost of Inputs (=(4)+(5))
0	0		$30	$0	$30
		50			
1	50		30	10	40
		40			
2	90		30	20	50
		30			
3	120		30	30	60
		20			
4	140		30	40	70
		10			
5	150		30	50	80

***Production function*: the relationship between quantity of inputs used to make a good or service and the quantity of output of that good or service.**

GRAPHICALLY

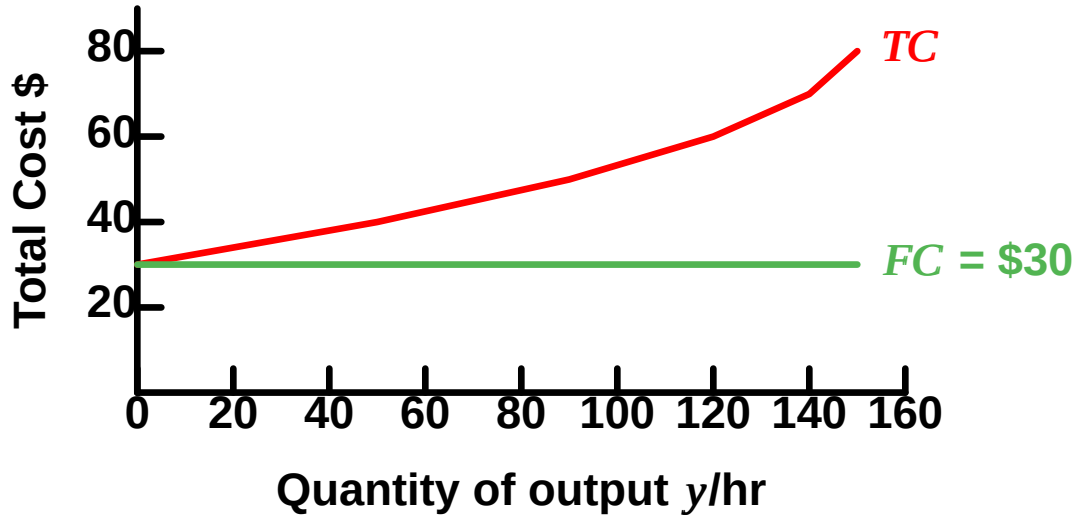
Plotting the quantity of output *y*/hour against the number of workers hired:

***Marginal Product (MP)*: the increase in output arising from an additional unit of one input.**

***Diminishing MP*: the *MP* of a particular input declines as the quantity of input increases. (Too many cooks spoil the broth?) See the graph.**

THE TOTAL COST CURVE

Plot the Total Cost (= the Cost of Factory + the Cost of Workers) against the quantity of output *y* /hr.



The Cost of Factory does not change with the level of output; it is *Fixed*.

The Cost of Workers rises with the level of output; it is *Variable*.

FIXED AND VARIABLE COSTS

***Fixed Costs (FC)*: costs that do not vary with the quantity of output produced.**

***Variable Costs (VC)*: costs that do vary with the quantity of output produced.**

Fuzzy distinction: some costs contain fixed and variable elements.

In the short run many costs (size of production facilities) are Fixed, but in the longer run almost all costs are Variable.

Examples?

AVERAGE AND MARGINAL COSTS

How do costs vary with production?

How much does it cost to make the typical unit of output? The *Average Total Cost ATC* = $\frac{TC}{y}$

How much will it cost to increase output by one unit/period? The *Marginal Cost MC* = $\frac{\Delta TC}{\Delta y}$ **, the increase in *TC* arising from an extra unit of output produced.**

The *Average Fixed Cost (AFC)* = $\frac{FC}{y}$

The *Average Variable Cost (AVC)* = $\frac{VC}{y}$

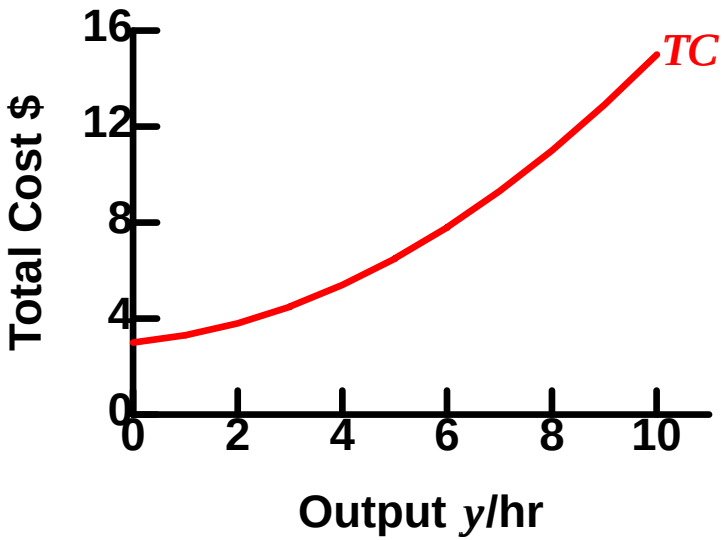
(See Lecture 8 for their uses: shut-down decisions.)

VARIOUS COST MEASURES

Quantity (y/hr)	Total Cost TC	Fixed Cost FC	Variable Cost VC	Average Fixed Cost $AFC = FC/y$	Average Variable Cost $AVC = VC/y$	Average Total Cost $ATC = TC/y$	Marginal Cost $MC = \frac{\Delta TC}{\Delta y}$
0	3.00	3.00	0.00	–	–	–	0.30
1	3.30	3.00	0.30	3.00	0.30	3.30	0.50
2	3.80	3.00	0.80	1.50	0.40	1.90	0.70
3	4.50	3.00	1.50	1.00	0.50	1.50	0.90
4	5.40	3.00	2.40	0.75	0.60	1.35	1.10
5	6.50	3.00	3.50	0.60	0.70	1.30	1.30
6	7.80	3.00	4.80	0.50	0.80	1.30	1.50
7	9.30	3.00	6.30	0.43	0.90	1.33	1.70
8	11.00	3.00	8.00	0.38	1.00	1.38	1.90
9	12.90	3.00	9.90	0.33	1.10	1.43	2.10
10	15.00	3.00	12.00	0.30	1.20	1.50	

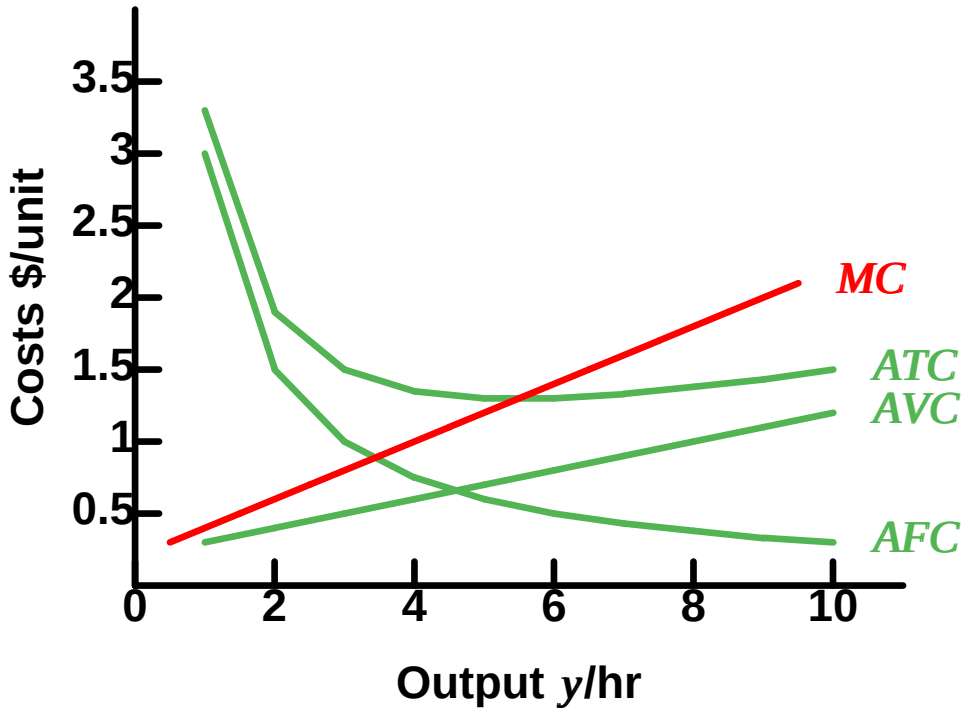
(Thelma's Lemonade Shop, GKSM Table 13.2.)

THELMA'S TOTAL-COST CURVE



The *TC* curve gets steeper as the quantity of output/hr increases because of *diminishing Marginal Product.* (Thelma needs to hire disproportionately more workers.)

PLOTTING THELMA'S COST CURVES



MC AND *AC* CURVES

1. Rising *MC*: reflects diminishing Marginal Product of workers. ("Too many cooks ...")

2. U-shaped *ATC* = *AFC* + *AVC*:
***AFC* is always falling, but *AVC* is rising because of diminishing *MP* of workers.**

3. *MC* and *AC*: when *MC* < *AC* $\rightarrow$ *AC* falling;
when *MC* > *AC* $\rightarrow$ *AC* rising.

(Think of *MC* as the speedo's instant speed measure, and *AC* as the distance/time since the trip began.)

At the output level *y* where *MC* = *AC*, *AC* is a minimum: the *Efficient Scale of production.*

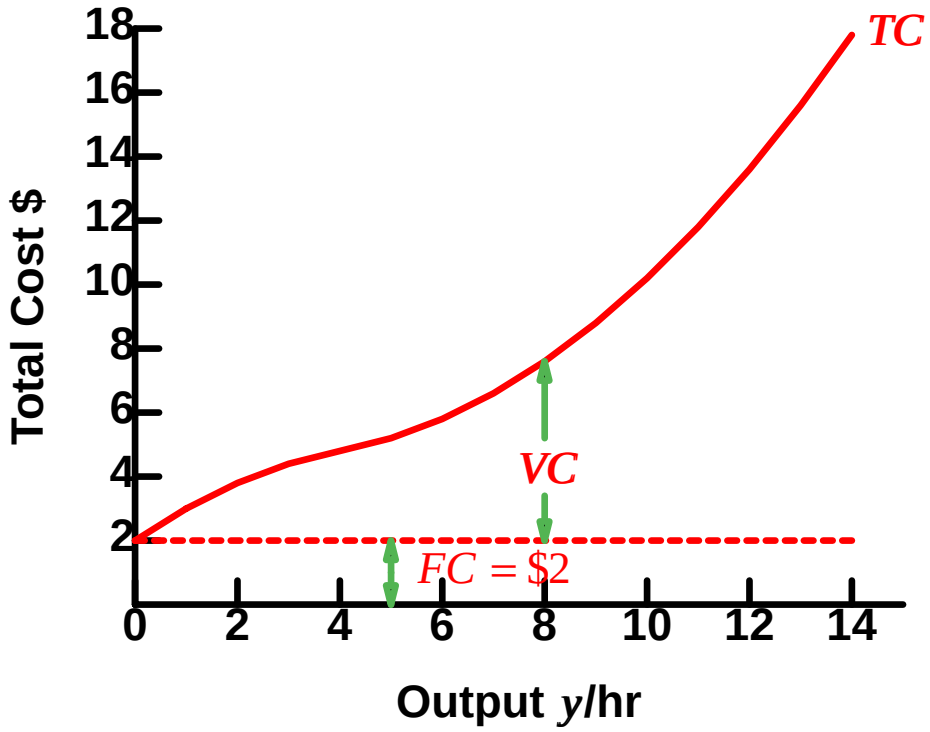
VARIOUS MEASURES OF BOB'S COSTS

y/hr	TC	FC	VC	$AFC = FC/y$	$AVC = VC/y$	$ATC = TC/y$	$MC = \frac{\Delta TC}{\Delta y}$
0	2.00	2.00	0.00	–	–	–	
							1.00
1	3.00	2.00	1.00	2.00	1.00	3.00	
							0.80
2	3.80	2.00	1.80	1.00	0.90	1.90	
							0.60
3	4.40	2.00	2.40	0.67	0.80	1.47	
							0.40
4	4.80	2.00	2.80	0.50	0.70	1.20	
							0.40
5	5.20	2.00	3.20	0.40	0.64	1.04	
							0.60
6	5.80	2.00	3.80	0.33	0.63	0.96	
							0.80
7	6.60	2.00	4.60	0.29	0.66	0.95	
							1.00
8	7.60	2.00	5.60	0.25	0.70	0.95	
							1.20
9	8.80	2.00	6.80	0.22	0.76	0.98	
							1.40
10	10.20	2.00	8.20	0.20	0.82	1.02	
							1.60
11	11.80	2.00	9.80	0.18	0.89	1.07	
							1.80
12	13.60	2.00	11.60	0.17	0.97	1.14	
							2.00
13	15.60	2.00	13.60	0.15	1.05	1.20	
							2.20
14	17.80	2.00	15.80	0.14	1.13	1.27	

(Bob's Bagel Bin GKSM Table 13.3)

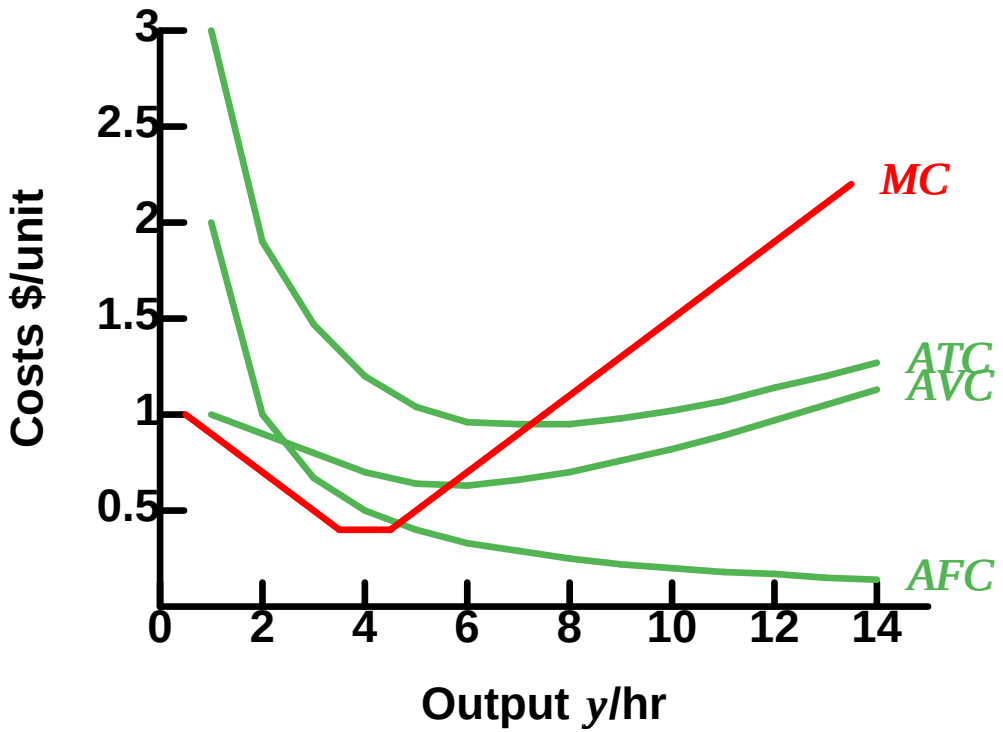
"Many hands make light work": y from 0 to 3
"Too many cooks spoil the broth": y greater than 4

BOB'S TOTAL-COST CURVE



What is Bob's marginal fixed cost?

GRAPHICALLY



Bob's *MC* eventually rises.
Bob's *ATC* is U-shaped.
Bob's *MC* = *ATC* at *y* with minimum *ATC*

SHORT- AND LONG-RUN AVERAGE TOTAL COST

The long-run *ATC* curve reflects the ability of the firm to invest in new fixed assets (such as factories) given a longer horizon.

∴ In the long run, costs previously fixed become variable.

∴ The long-run *AC* curve is a much flatter U-shaped curve than the short-run *AC* curve, because of greater flexibility.

When is the long run? Depends on the firm: its willingness and ability to adjust its production facilities.

RETURNS TO SCALE

Long-run *ATC* curves have three regions:

1. ***Increasing Returns to Scale IRTS*: long-run *ATC* falls as the quantity of output *y* /hr increases. (or *Economies of Scale*)**
2. ***Constant Returns to Scale CRTS*: long-run *ATC* unchanged as *y* changes.**
3. ***Decreasing Returns to Scale DRTS*: long-run *ATC* rises as *y* increases. (or *Diseconomies of Scale*)**

***Specialisation* at first v. *coordination problems* later as scale of production grows large? Finite inputs?**

The firm faces the long-run *ATC* curve before committing to the size of facility.

SUNK COSTS

***Sunk Costs*: costs already incurred *and* which cannot be recovered.**

***Avoidable Costs*: the opposite, could be avoided.**

Decision makers should ignore sunk costs (but often don't) and consider only avoidable costs.

Q: You see an advert for shirts on special 20 km away, at prices much lower than locally.

Since you "need" new shirts, and the prices advertised are much lower, you drive over.

But when you get there, none of the shirts on special is your size. The shop stocks your sized shirts, but at prices only slightly lower than your local.

SUNK COST EXAMPLE

What should you do?

a. **Should you refuse to buy any shirts because they are not cheap enough to justify the expense of the twenty-km drive?**

b. **Should you buy some shirts anyway?**

c. **Should you buy large numbers of shirts so that the total savings offset the cost of driving over?**

d. **What if your sized shirts are more expensive there than at your local shop? Should you buy them anyway, since you might as well get something for your trip?**

SUNK COST EXAMPLE

Answers:

a. **No. Ignores sunk costs already incurred and unrecoverable.**

b. **Yes. You should buy some shirts anyway—you've already incurred the cost of driving over (and back): it's sunk.**

c. **Depends if you like them and if you think they won't go out of style or size.**

d. **No. You'd be throwing good money after bad.**

Irrelevance of Sunk Costs: bygones are bygones. No use crying over spilt milk.

SUNK COSTS AND FIXED COSTS

Sunk costs ≠ fixed costs necessarily.

Fixed costs: the minimum necessary for producing any output at all.

If some fixed costs are recoverable (say, by reselling equipment at purchase price, or because equipment was leased), then these costs are avoidable, and hence not sunk.

Sunk costs important for analysing:

- **rivalry among firms,**
- **firms' entry and exit decisions from markets, and**
- **firms' decisions to adopt new technology.**

SUMMARY

1. **Economists' profit does not include the opportunity cost of capital: part of Total Costs.**
2. **Marginal Product of any input often falls with output.**
3. **Fixed v. Variable costs; Average v. Marginal costs; Sunk Costs.**
4. **Efficient scale of production at minimum AC.**
5. **Returns to Scale: CRTS, DRTS, IRTS.**