Single firm supply: cost curve

• Fixed costs *F:* occur regardless the produced quantity (rent of the building)

• variable costs: $c_v(y)$, change with the quantity (electricity)

$$c(y) = c_v(y) + F$$

La **Average cost function**

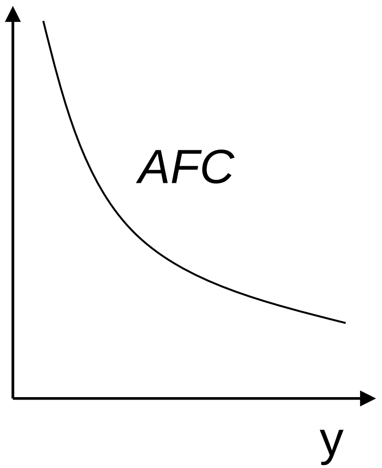
Variable average cost: *AVC(y)*

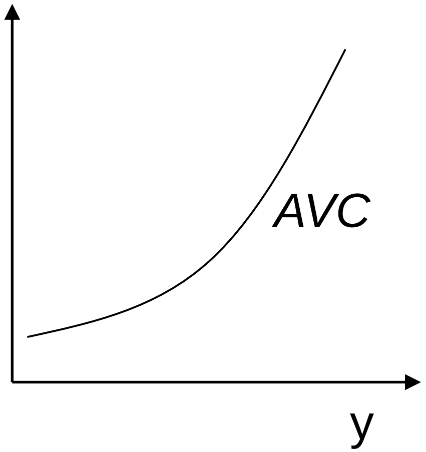
Fixed average cost: AFC(y)

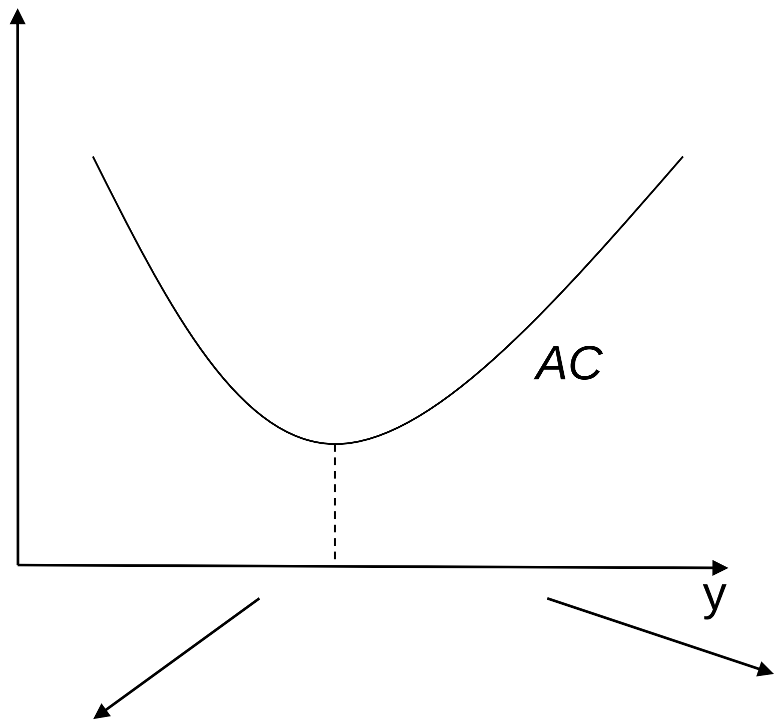
variable AC: measures variable cost per unit

Fixed average cost: fixed cost per unit

$$AC(y)=\frac{c(y)}{y}=\frac{c_v(y)}{y}+\frac{F}{y}=AVC(y)+AFC(y)$$







For low output **fixed average cost dominates**

For high output ***variable average cost dominates*** (per unit cost)

- When *y* increases, the *AFC* effect on the total average cost is smaller and smaller
- Variable average cost effect (per unit) starts to dominate

Marginal cost curve: cost variation with respect to an output variation

$$MC(y) = \frac{\Delta c(y)}{\Delta y} = \frac{c(y+\Delta y) - c(y)}{\Delta y}$$

Marginal cost in terms of variable cost

$$c(y) = c_v(y) + F$$

F does not change with y !!!...

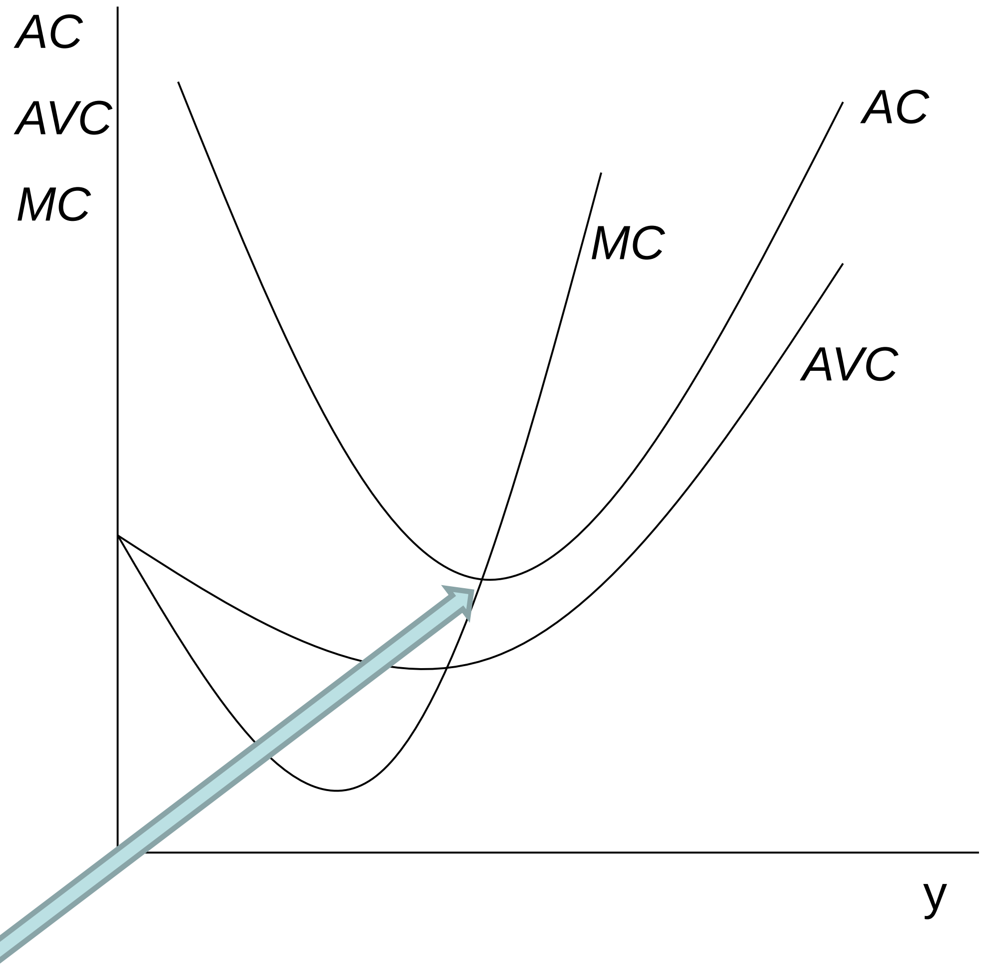
$$MC(y) = \frac{\Delta c_v(y)}{\Delta y} = \frac{c_v(y+\Delta y) - c_v(y)}{\Delta y}$$

$$MC(y) = \frac{dC(y)}{dy}$$

Marginal cost is used to denote the cost variation with respect to <u>the variation of one unit of output</u> $\Delta y = 1$

$$MC(1) = \frac{c_v(1) + F - c_v(0) - F}{1} = \frac{c_v(1)}{1} = AVC(1)$$

The cost of the first additional unit of output is equal to its variable average cost



MC crosses AC at its minimum

Marginal Costs and variable Costs

Area below the MC curve, given some values of output *y*, represents the variable cost of producing *y* units

ex. cost of *y=4:*

$$c_v(4)=[c_v(4)-c_v(3)]+[c_v(3)-c_v(2)]+[c_v(2)-c_v(1)]+[c_v(1)-c_v(0)]$$

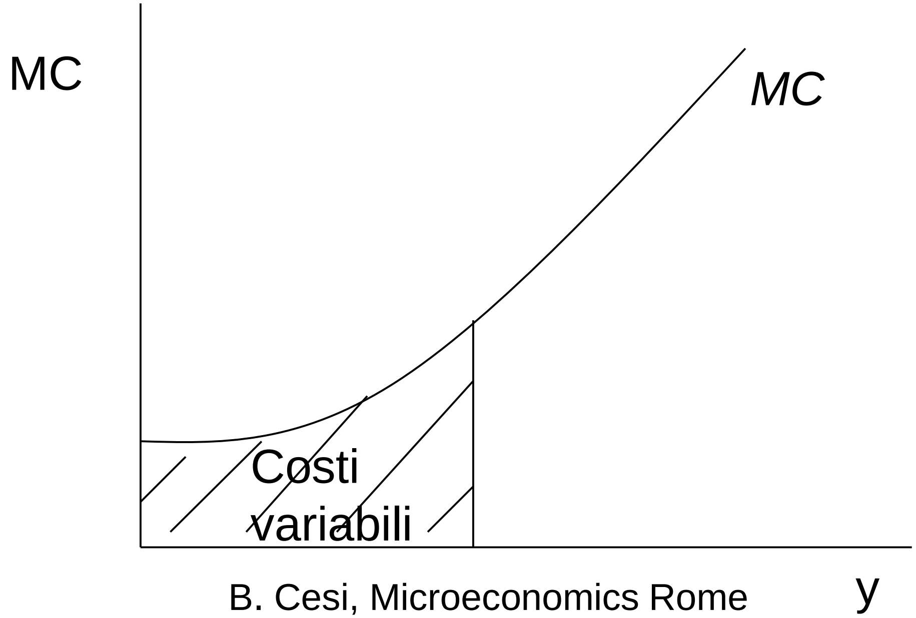
$$c_v(0)=0$$

Each term is the MC for each level of output

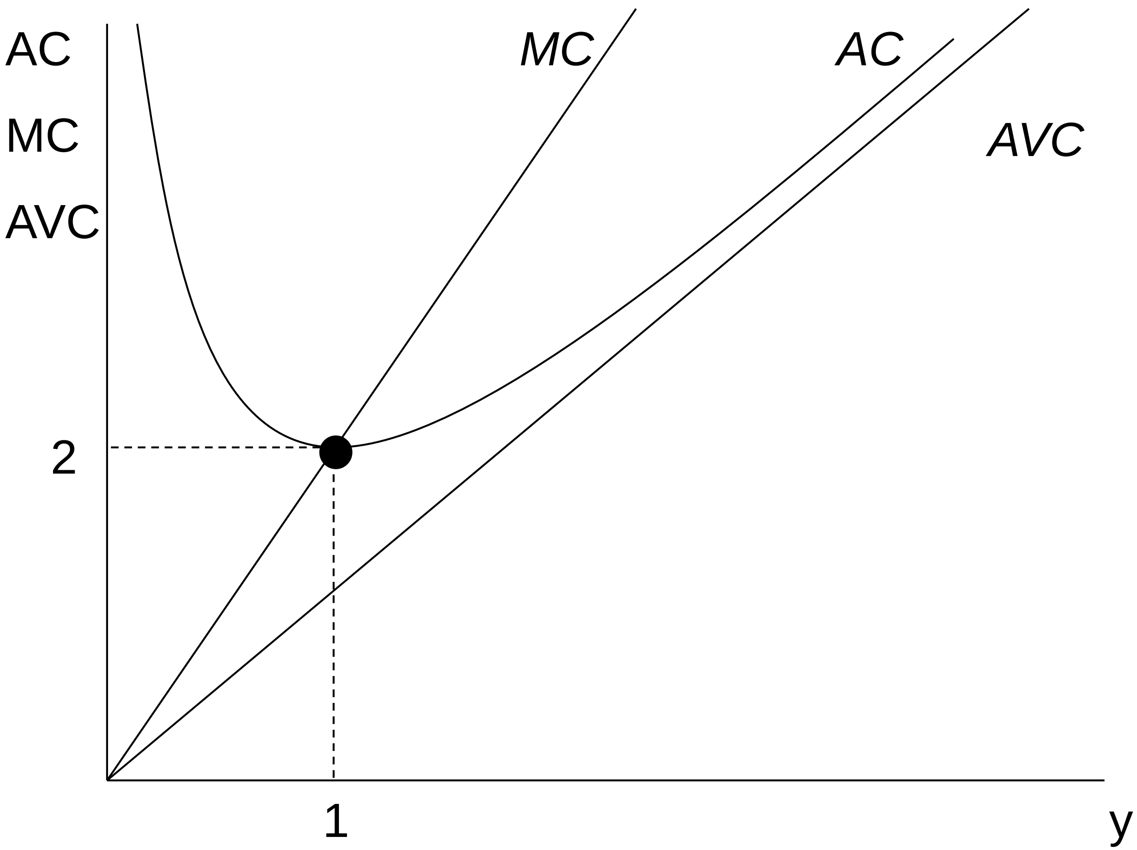
$$c_v(4) = MC(3) + MC(2) + MC(1) + MC(0)$$

Each term is the area of the rectangle with base 1 and height equal to the *MC(y)*

Summing up all the rectangles gives the area below the MC curve



$$c(y) = y^2 + 1$$
$$c_v(y) = y^2$$
$$c_f(y) = 1$$
$$AVC(y) = \frac{y^2}{y} = y$$
$$AFC(y) = \frac{1}{y}$$
$$AC(y) = \frac{y^2 + 1}{y} = y + \frac{1}{y}$$
$$MC(y) = 2y$$


AC
MC
AVC
MC
AC
AVC
2
1
y

Two-plant case

$$c_1(y_1), c_2(y_2)$$

Production based on the two plants to produce *y* at the minimum cost

$$\min_{y_1, y_2} c_1(y_1) + c_2(y_2)$$

$$t.c$$

$$y_1 + y_2 = y$$

$$\min_{y_1} c_1(y_1) + c_2(y - y_1)$$

FOC:

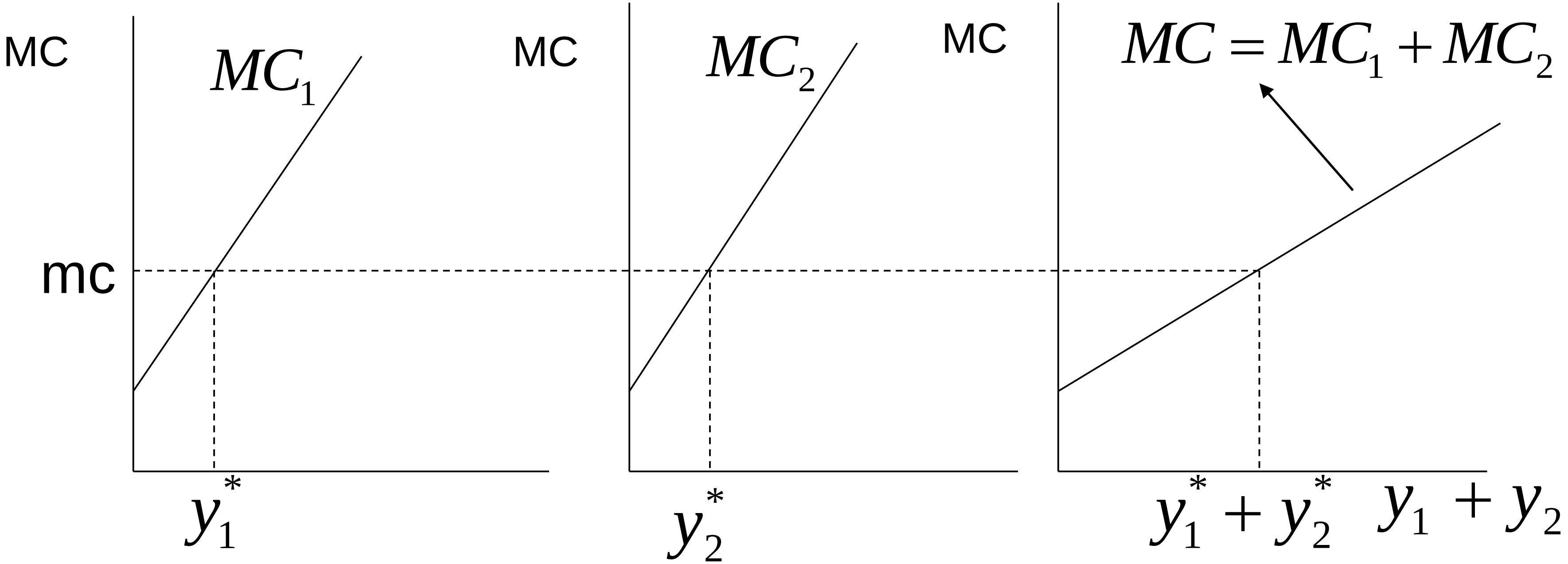
$$\frac{dc_1}{dy_1} + \frac{dc_2}{dy_2}\frac{dy_2}{dy_1} = 0$$

-1

$$\Downarrow$$

$$MC_1 = MC_2$$

<u>To induce the two output levels to produce y at the minimum cost , the marginal cost of producting one more unit must be equal in both plants</u>


MC
MC_1
MC
MC_2
MC
$MC = MC_1 + MC_2$
mc
y_1^*
y_2^*
$y_1^* + y_2^*$
$y_1 + y_2$

Lung Run Costs

Always possible zero production at zero cost

↓

In the long-run it is always possible to go out the business (***EXIT)***

ex. fixed factor= plant size → In the Long-Run time is crucial to modify the size

ex. payment in advance of some wage → In the Long-Run it is necessary an update on the wages

For a plant size *k*, short-run cost function

$$c_s(y,k)$$

For any output there exists an optimal plant

- the size to produce one airplane is different from the one for an entire fleet

Optimal dimension $k(y)$

$$\downarrow$$

Long-Run cost function

$$c(y)=c_s(y,k(y))$$

Firm is able to change the input (size of the plant)

The Lung-Run cost function coincides with the short-run cost function at the optimal size of the plant !

*Optimal output y** produce at optimal size, *k(y*)*

Short-run cost function at the optimal dimension

$$c_s\left(y, k^*\right)$$

The short-run cost necessary to produce *y,* must be **higher or equal** to the long-run cost necessary to produce the same output

$$c(y) \leq c_s(y, k^*)$$

Intuition: in the long-run it is possible to set a *k** minimizing cost, what it is not possible in the sort-run

$$c(y^*) = c_s(y^*, k^*)$$

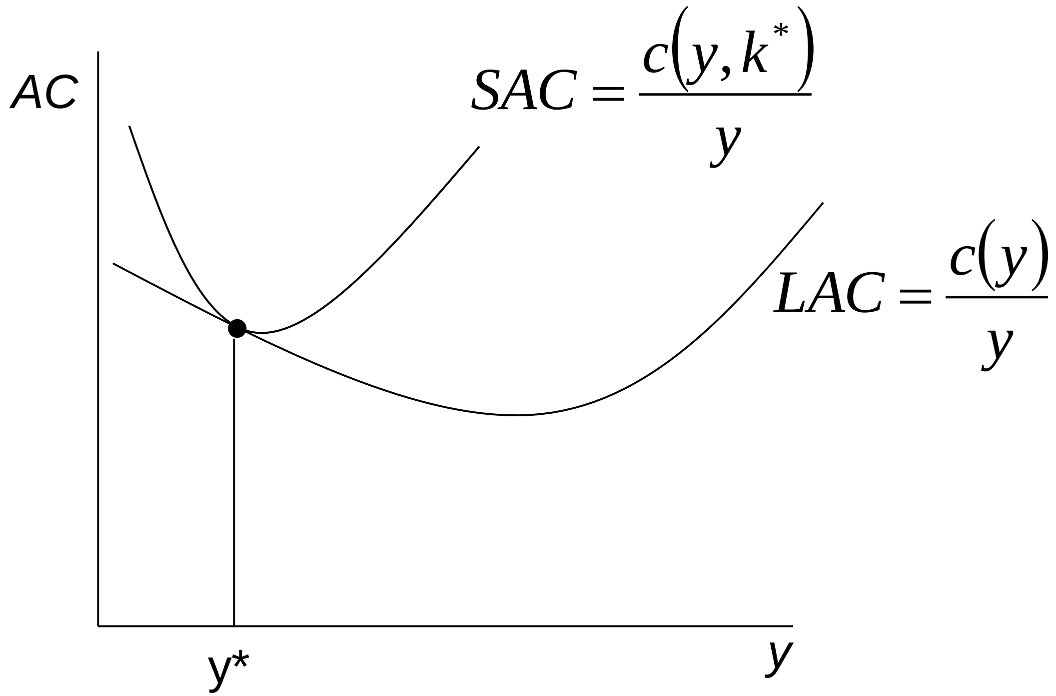
then IF at y^* long and short-run costs coincide…

The same holds for the average costs

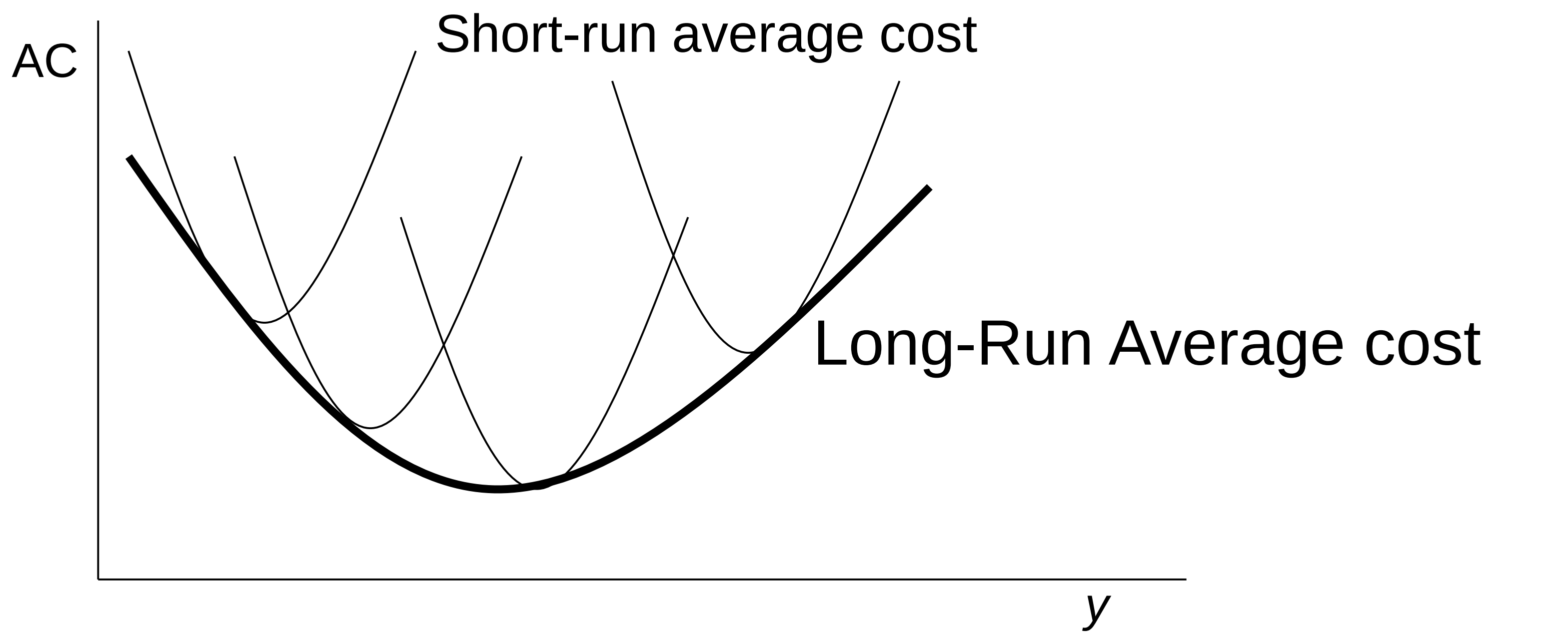
$$AC(y) \leq AC_s(y, k^*)$$

$$AC(y^*) = AC_s(y^*, k^*)$$

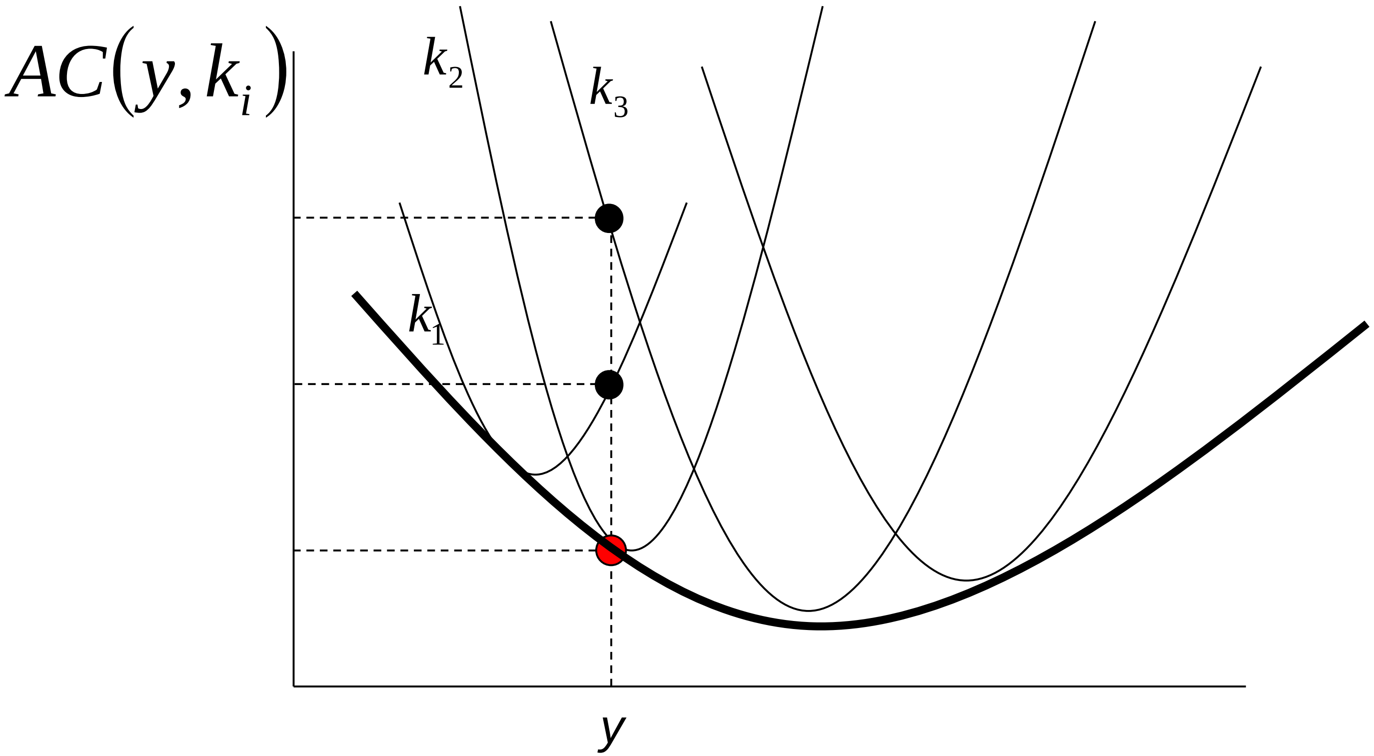
Long-run average cost is below the short-run cost and they coincide at y^*


AC
$SAC = \frac{c(y,k^*)}{y}$
$LAC = \frac{c(y)}{y}$
y*
y

Any output *y* different from *y** is then associated to a different sizes of the plant



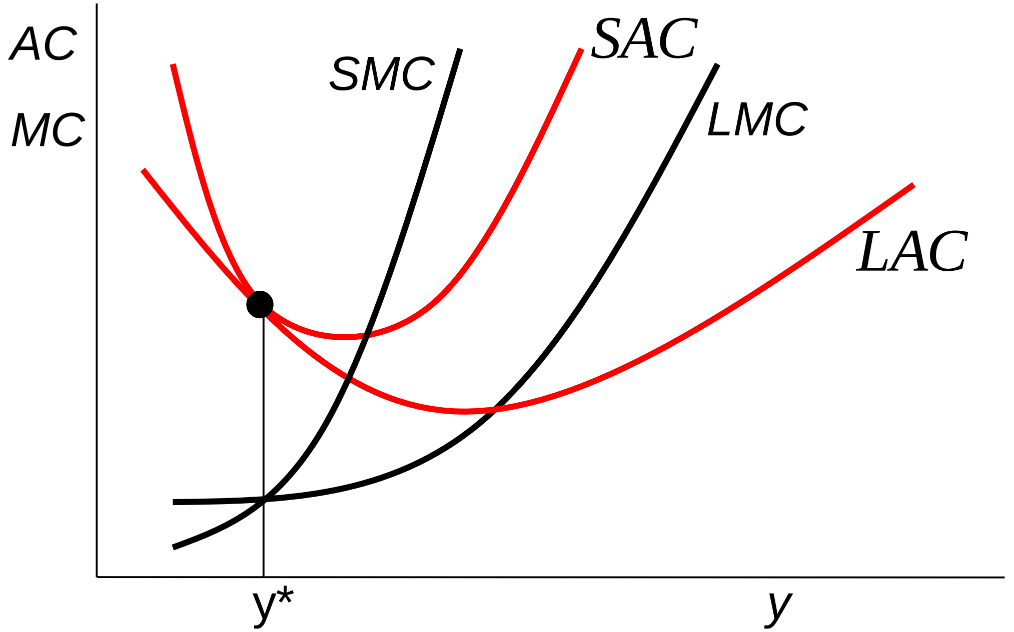
Long-Run Average cost is the <u>lower envelop</u> of the short-run curves



Optimal dimension to produce *y* is k_2

http://www.whitenova.com/thinkEconomics/lrac.html

At each short-run average cost is associated a marginal cost curve



The <u>Long-Run marginal cost</u> for any *y* is equal to the <u>short-run marginal cost</u> computed at the optimal size of the plant that produces *y*