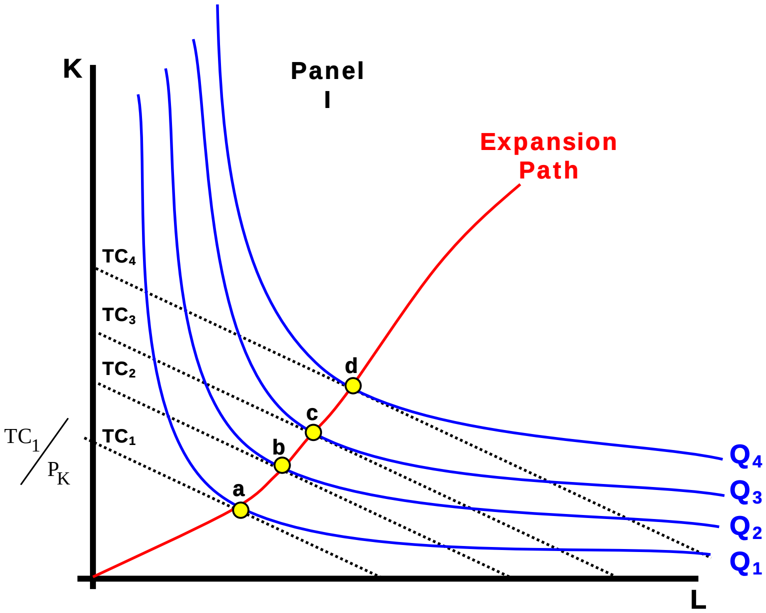
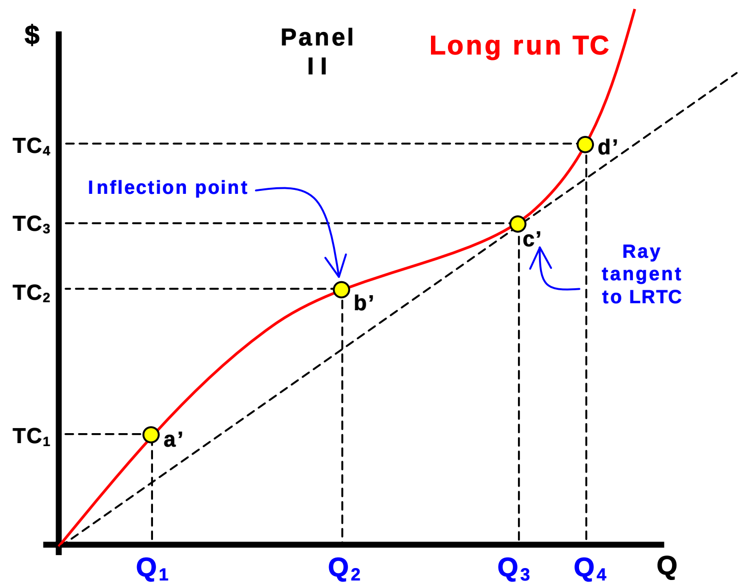
Production and Cost Summary



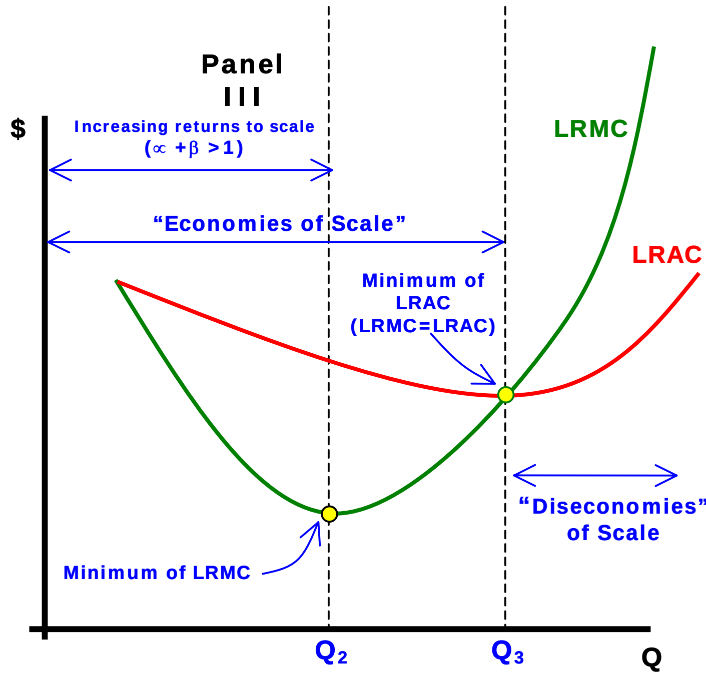


In Panel I the isoquants (Q_1, Q_2, Q_3, Q_4), the isocosts (TC_1, TC_2, TC_3, TC_4) and the expansion path are shown. Remember, the expansion path is where an isocost is tangent to every isoquant, $|MRTS| = |-P_L/P_K|$.

At each of the "least cost" combinations of L and K to produce the output levels (Q_1, Q_2, Q_3, Q_4), There is a TC function. For output (Q_1), the lowest cost per unit will be at point "a." This is the lowest TC to produce that output or the lowest cost/unit (AC).

In Panel II the (lowest) TC associated with an isocost for each level of output is graphed in relation to that output (TC_1 is associated with output Q_1, and so forth.)

Point "a'" (in Panel II) contains the same information as point "a" (in Panel I).

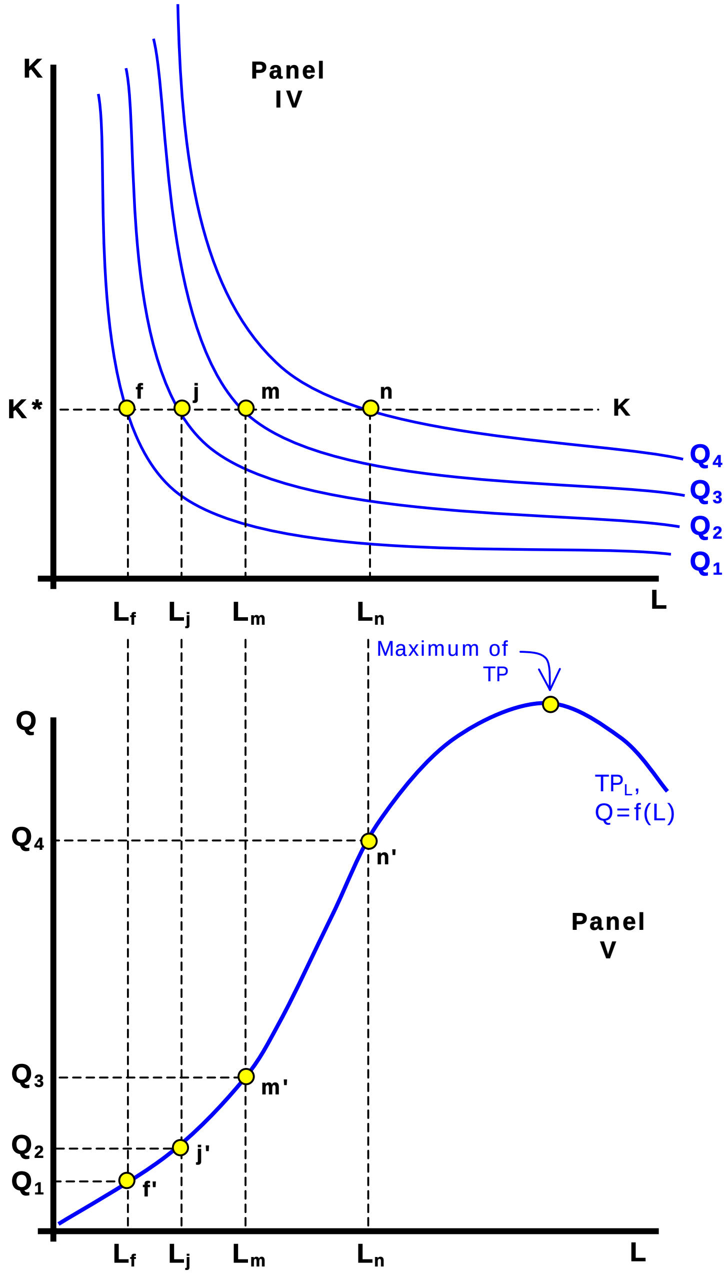


In Panel II, the LRTC is developed from the expansion path in Panel I. Expansion Path identifies an isoquant (output, Q), an isocost (TC) and a combination of inputs (L and K). In Panel B that LRTC is graphed as a function of output (LRTC = f(Q) holding technology (the production function) and the prices of both inputs (P_L and P_K or *w* and *v*) constant. $TC = P_L L + P_K K$.

In Panel C the LRMC and LRAC are graphed. The minimum of the LRMC occurs at the same level of output as the inflection point in the LRTC. The LRMC falls because of "increasing returns to scale," ($\propto + \beta > 1$): Output increases at a faster rate than the inputs, so the cost of each additional unit of output decreases. As output increases above level Q_2, There are decreasing returns to scale ($\propto + \beta < 1$).

The phrase "economies of scale" is normally used to denote the range of production where the LRAC is decreasing. "Diseconomies of scales" is used to refer to the output range where the LRAC is increasing. Increasing returns to scale is a special case of economies of scale.

Short Run Production and Cost



In Panel IV the isoquants for a production function are shown. Capital is fixed at K*. In the short run the output must fall on ray K*K. To produce Q_1 output, with K fixed at K*, L_f labour must be used.

As more and more labour is added to a fixed input (remember technology is fixed as well) the output will increase at an increasing rate, the “Marginal Product of Labour” (MP_L) decreases. For any fixed input (K) the relationship between labour (L) and output (Q or TP) will be altered.

The short run production function can be shown as as Q = f(L). In Panel V the graph of the short run production function is shown for K* amount of capital. The point “f’” in Panel V is determined by the point “f” in Panel IV.

A change in technology will alter the location of the isoquants and the expansion path (in Panel I) and the average and marginal product curves in Panel III.

A change in the fixed input will alter the level of the line K*K in Panel IV and the location of the short run total product function in Panel V.

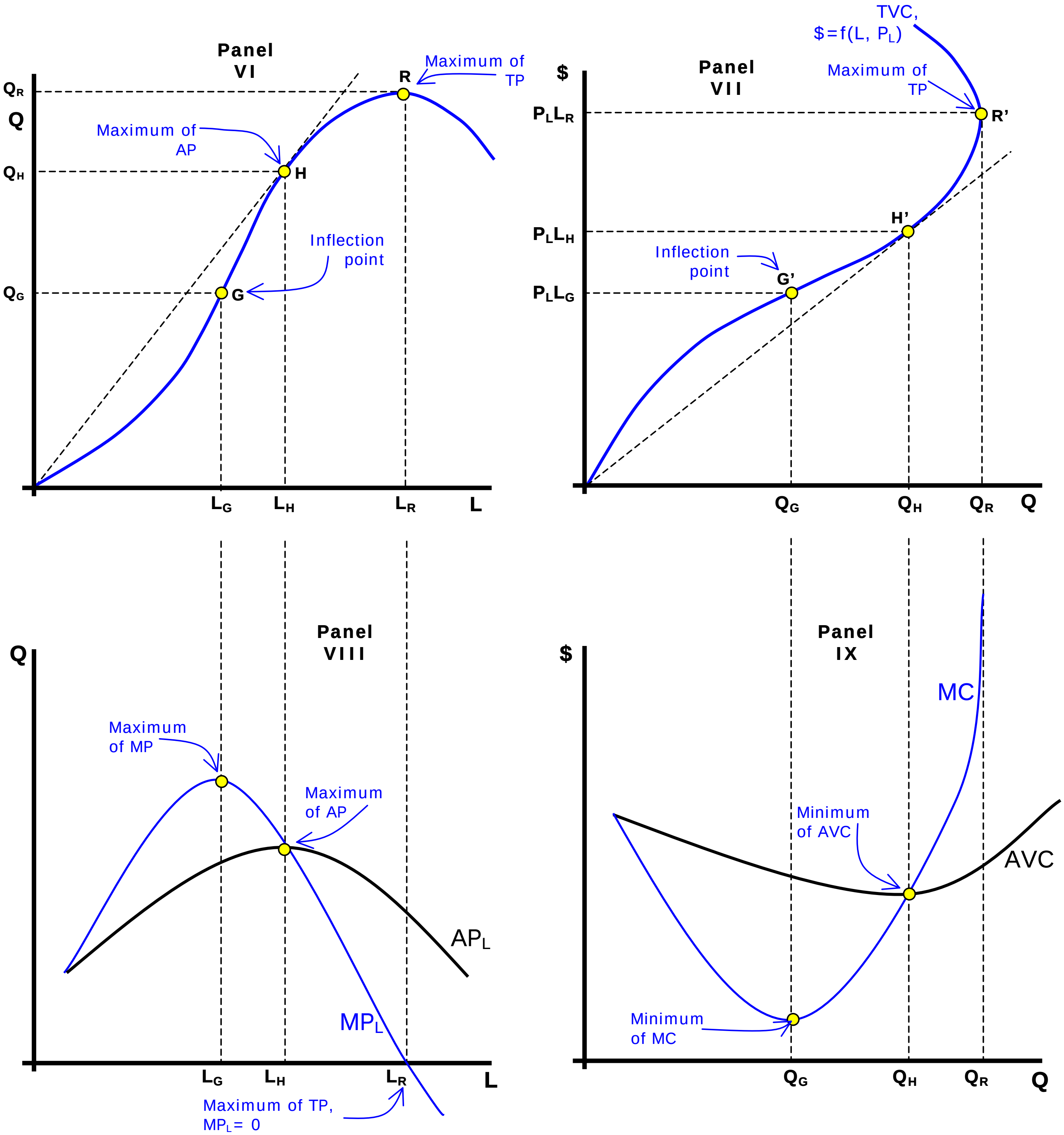
A change in the relative price of inputs (P_L and P_K) will alter the slope of the isocosts and the expansion path in Panel I. The long run total cost (LRTC) would also be altered by a change in the relative prices of input.

If the price of inputs increased (or decreased) in the same proportions, the expansion path in Panel I would be unchanged but the total costs would increase (or decrease) causing the LRTC in Panel II to increase (or decrease).

The short run production and short run costs are also related. The short run production function from Panel V is duplicated in Panel VI. With this production information and the price of labour (P_L), the short run total variable cost (TVC) can be calculated and shown in Panel VII.

Short Run Production and Cost Functions

The information from the production function in Panel VI is combined with the price of labour (P_L) to generate the short run total variable cost (TVC) function in Panel VII.

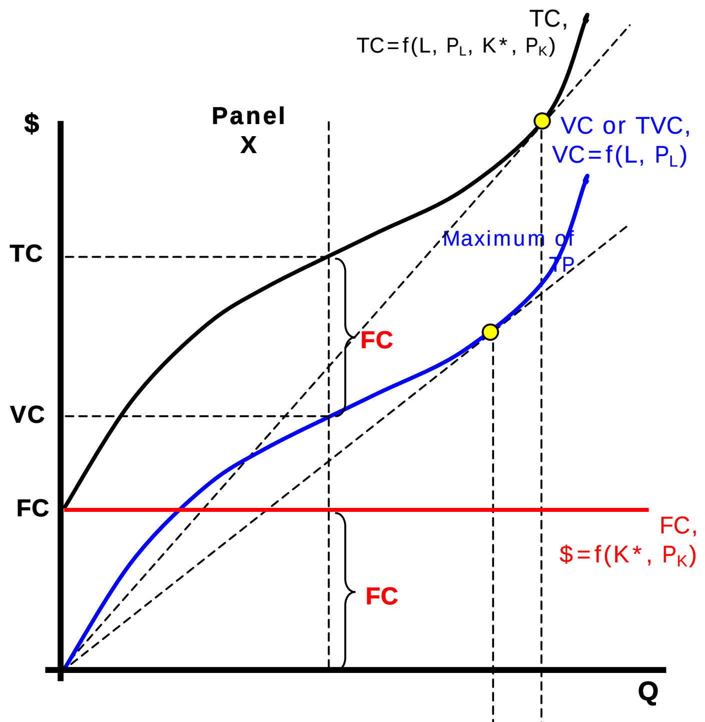


In Panel VI, the short run production function (Q = f(L)) is shown. The TVC in Panel VII is constructed from that production function and the price of labour (P_L).

In Panel VIII the average and marginal products of labour (AP_L and MP_L) are constructed. The maximum of TP_L and where the MP_L is zero occurs at the same input level (L_R).

In Panel IX the average variable and marginal cost functions (AVC and MC) are constructed from the TVC in Panel VII.

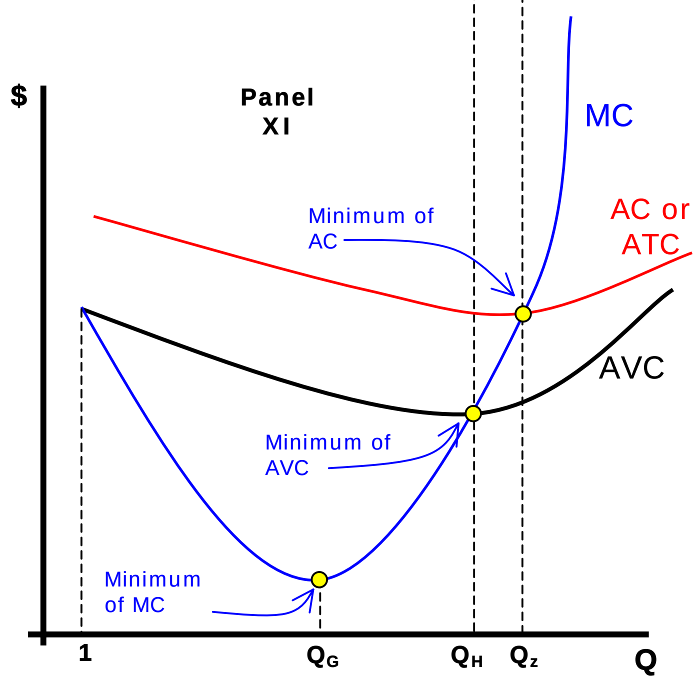
In Panel X the variable cost function (VC or TVC) from Panel VII is shown. The "backward bending" portion of the VC in Panel VII is not included. This backward bending portion is associated with additions of the variable input that causes the TP to fall. This negatively sloped portion of the TP function is shown in Panel VI.



The fixed cost (FC) is the price of capital (P_K or v) times the amount of the fixed input K*. Since the amount of the fixed input does not vary with output, so it graphs as a horizontal, straight line.

The TC function is constructed by adding the FC and VC. The TC maintains the same shape as the VC but it is above the VC by the amount of the FC.

In Panel XI, the MC, AVC and AC (or ATC) functions are constructed from the TC, and VC functions in Panel X.



In Panel XI, the MC is determined by the slope of either the TC or VC in Panel X. Since MC is defined as the "change in TC (or VC) causes by a change in Q" it can be perceived as the slope of the tangent to the TC (or VC) at every level of output. The first derivative or either TC or VC will give the MC, $\frac{dTC}{dQ} = \frac{dVC}{dQ} = MC$

The minimum of the MC will occur at the output level where the inflection point occurs in the TC or VC (Same level for both since the FC does not change or has a slope of 0). In Panel XI this is at output leve Q_G. The inflection point in the VC is at point G' at output level Q_G in Panel VII.

When the MC is less than the AVC, the AVC will be decreasing; when the MC is greater than the AVC the AVC will be increasing. This means that where AVC is equal to MC it has a slope of 0 and is at a minimum. The same is true for the relationship between AC and MC; MC = AC at the minimum of the AC function.

Since fixed cost are independent of the output (Q), the FC is a horizontal straight line or the vertical distance between TC and VC. The average fixed cost is simply the fixed cost divided by the output : $\frac{FC}{Q} = AFC$. As output (Q) increases (and FC is constant) the AFC will decrease. The AFC is not drawn in Panel XI but the average fixed costs can be seen as the vertical distance between the AVC and AC. Note that at greater amounts of Q, the vertical distance between AVC and AC is smaller.