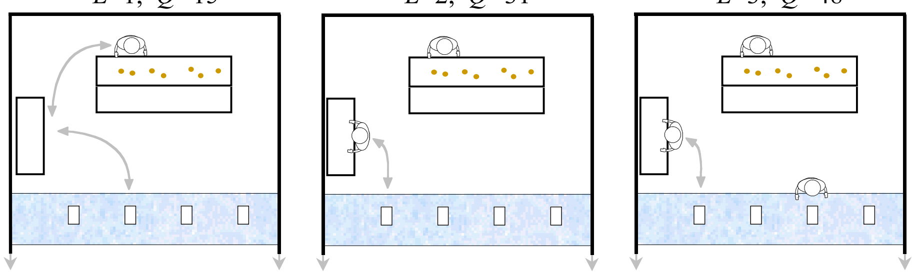
## FORCES DETERMINING THE PATTERN OF MARGINAL PRODUCTS

Division of Labor (*DOL*) - benefits of specialization occur because, as *L* increases, some workers may work with fewer types of materials or capital and perform simpler, more repetitive tasks. When the firm has a relatively small *L*, each worker will very likely be working with many types of materials or capital and be performing less repetitive tasks–so the opportunities for specialization will be obvious and very beneficial. As *L* increases, and more obvious types of specialization have already been used, the benefits of *DOL* will decline for each extra worker employed.

Declining Factor Proportions (*DFP*) - negative effects of *DFP* occur because, as *L* increases, we must determine how to best organize the workers within the same *K*. When the firm has relatively small *L*, portions of *K* may be used very little and the effects of additional workers not very detrimental. As *L* increases, and *K* more intensively used, the negative effects of *DFP* will be more severe for each extra worker employed.

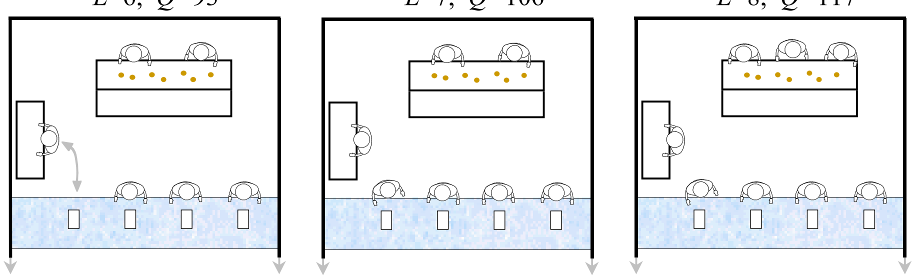
Increasing Returns

*L*=1, *Q*=15    *L*=2, *Q*=31    *L*=3, *Q*=48



Diminishing Returns

*L*=6, *Q*=93    *L*=7, *Q*=106    *L*=8, *Q*=117



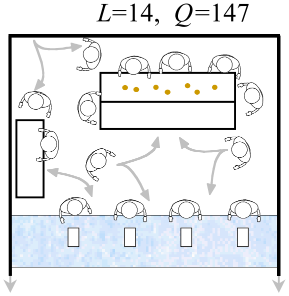
These examples use the kitchen area of our fast food restaurant. For *L*=1, the one worker performs all tasks and is not using all of the *K*. Going to *L*=2 and then *L*=3, the gains from specialization are large and, still, not all of the *K* used. Thus we have increasing returns.

Going from *L*=6 to *L*=7 and *L*=8, the gains from specialization get smaller. For *L*=8 we must be careful with spacing and motion. We have diminishing returns.

For *L*=14, virtually all specialization has been used and another worker will get in the way of the other 14, making *Q* go down. Thus we have negative returns.

Negative Returns

*L*=14, *Q*=147



## The Relationship between Marginals and Averages

Suppose that I have three numbers (5,4,3). Their average is 4.
Now suppose that I bring in a fourth number and compute a new average:

| | | | |
|---|---|---|---|
| 5 | 4 | 3 | ? |

Assume three possibilities for this fourth number: either 2 or 4 or 6.

Case 1: [?] = 2

$$\text{New average} = \left(\frac{5+4+3+2}{4}\right) = 3.5$$

Average has gone down from 4 to 3.5 because the new number is less than the old average.

Case 2: [?] = 6

$$\text{New average} = \left(\frac{5+4+3+6}{4}\right) = 4.5$$

Average has gone up from 4 to 4.5 because the new number is greater than the old average.

Case 3: [?] = 4

$$\text{New average} = \left(\frac{5+4+3+4}{4}\right) = 4$$

Average has stayed the same because the new number is the same as the old average.

Now go back to case 1 and bring in a fifth number, a 2.5:

$$\text{New average} = \left(\frac{5+4+3+2+2.5}{5}\right) = 3.3$$

Average has gone down from 3.5 to 3.3 because the new number is less than the old average. Note that the fact the new number (2.5) is greater than the number before (2) is irrelevant–what matters is that 2.5 is less than the old average.

To apply the above, think of *ATC* as the "old average" and "$ATC_+$" as the "new average" after we produce one more of *Q*:

$$ATC = \left(\frac{TC}{Q}\right) \qquad ATC_+ = \left(\frac{TC+MC}{Q+1}\right)$$

The "average" in our numerical example is like *ATC*, the numbers in the numerator are like *TC* and the "new number" is like *MC*.

Therefore we can conclude that:
If $MC < ATC$, then *ATC* will decrease.
If $MC > ATC$, then *ATC* will increase.
If $MC = ATC$, then *ATC* will not change.

Apply the same logic to *AVC* by defining:

$$AVC = \left(\frac{TVC}{Q}\right) \qquad AVC_+ = \left(\frac{TVC+MC}{Q+1}\right)$$