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**Lecture 14: Isoquants, MRTS**

1. Two input variables
   1. Last class we explored production with one input (specifically, it was labor but you could generalize from that work).
   2. Now we expand into two different inputs: capital and labor.
2. Isoquants
   1. We develop this idea with an *isoquant*—a curve showing all possible combinations of inputs which generate the same output.
   2. Isoquants are basically the same thing as indifference curves.
      1. Instead of each point along the curve having the same utility, each point has the same output.
      2. Instead of different combinations of goods, we use different combinations of inputs.
   3. The shape of the isoquant is also similar to indifference curves and for the same reasons.
      1. Substitution and diminishing marginal returns
   4. The *isoquant map* is a graph combining many isoquants. It is another way of describing a production function: where the isoquants are depends on how inputs transform into output.
3. MRTS
   1. The *marginal rate of technical substitution* is the amount the quantity of one input can change when the other input changes in the opposite direction but output is constant.
   2. MRTS is exactly the same idea as MRS from indifference curves. Note, again we measure as a positive quantity with capital (K) on the y-axis and labor (L) on the x-axis.
   3. MRTS relates to the marginal product of capital and the marginal product of labor.

Change in output from change in labor = (MPL)(ΔL)

Change in output from change in capital = (MPK)(ΔK)

(MPL)(ΔL) + (MPK)(ΔK) = 0

(MPL)(ΔL) = -(MPK)(ΔK)

(MPL)/(MPK) = -(ΔK)/(ΔL) = MRTS

* + 1. So the MRTS is the same as the ratio of the marginal products of inputs.

1. Special isoquants
   1. Perfect substitutes
      1. Isoquants with inputs that are perfect substitutes are straight lines. MRTS is constant throughout.
   2. Perfect complements
      1. Isoquants with inputs that are perfect complements are lines at right angles. MRTS is either zero or infinite.
2. Production in difference countries
   1. Besides the technical differences in definitions, isoquants are different from indifference curves in their axes. There are no standard good to put on an indifference curve. But isoquants have standard inputs: capital and labor.
      1. These are not the *only* inputs you can put on, but they are the standard ones, with capital on the y axis and labor on the x.
   2. These are standard because companies consistently use some mix of capital and labor to produce goods. And countries differ in how they produce goods. We can illustrate this by considering the U.S. and China.

Labor

Capital

Q1

Q2

Q3

UNITED STATES

Labor

Capital

Q1

Q2

Q3

CHINA

* 1. In these diagrams, note how isoquants increase more readily along the capital axis (U.S.) or the labor axis (China). Note we could get a similar result if we used skilled and unskilled labor, since skilled labor tends to require a lot of capital.