ECON 281 NOTES

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ABSTRACT

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INTRODUCTION

Notes for ECON 281, intermediate microeconomics.

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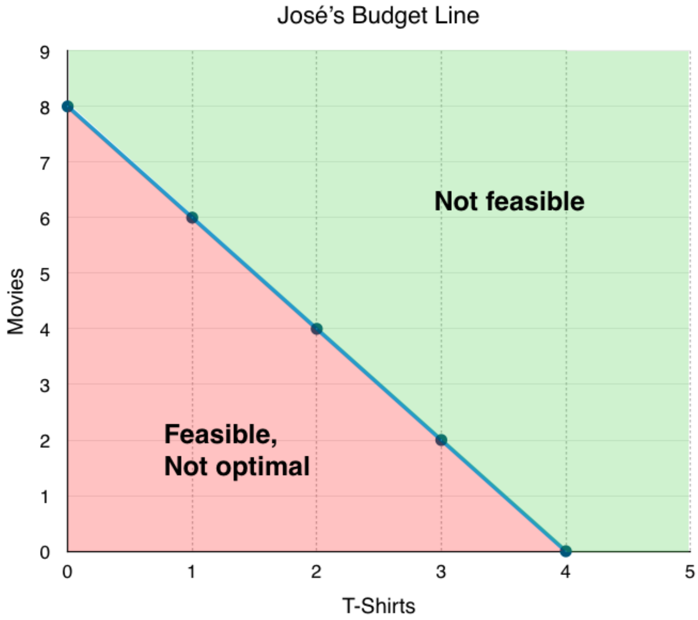

Figure 1: Budget line.

3 CHAPTER

TODO

4 CONSUMER CHOICE

4.1 The Budget Constraint

Budget Constraint. defines the set of baskets that a consumer can purchase with a limited amount of income. Expressed as

$$P_x x + P_y y \leqslant I$$

Budget Line. indicates all the combinations of one good x and another y that a particular consumer can purchase if he spends all his income on the two goods. Expressed as

$$P_x x + P_y y = I$$

Figure 1 shows the graph of a budget line in units of a particular good, and how the most optimal choice is where all income is spent (result is on the line). If all money is spent on movies, 8 units can be afforded. This is found by $\frac{I}{P_y} = 8$.

The slope of the budget line shows how many units of one good have to be given up to get another good.

$$\frac{\Delta y}{\Delta x} = \frac{-P_x}{P_y}$$

An increase in income does not affect the slope because all goods can be purchased in excess of the amount that was afforded by the previous income.

A change in price does affect the slope.

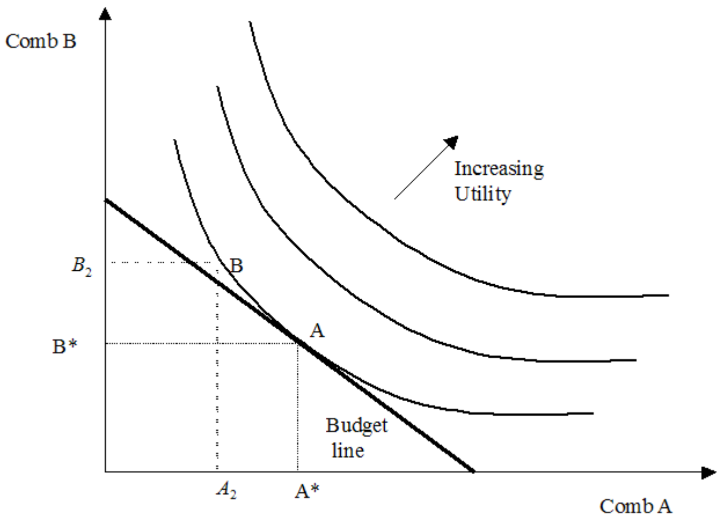

Figure 2: Indifference Map

4.2 Optimal Choice

Optimal Choice. Consumer choice of a basket of goods that (1) maximizes satisfaction (utility) while (2) allowing him to live within his budget constraint.

Interior Optimum. An optimal basket at which a consumer will be purchasing positive amounts of all commodities.

Expenditure Minimization Problem. Consumer choice between goods that will minimize total spending while achieving a given level of utility.

To keep things simple, time is not a factor of the budget line.

Let $U(x, y)$ represent the consumer's utility from purchasing x units of good one, and y units of good two.

Let max $U(x, Y)$ represent the values (x, y) that give the maximum utility.

Figure 2 shows the graph of indifference curves, where the further out a curve is, the higher the utility.

At the optimal basket A the budget line is tangent to an indifference curve. This is the curve with the highest attainable utility. Any other basket would be unobtainable because it would be higher than the income of the buyer.

A slight movement along the budget line results in a change in the utility. This is because the indifference curves slope inwards towards the origin.

The slope of the indifference curve is

$$\frac{-MU_x}{MU_y} = -MRS_{(}x, y)$$

where MU is the marginal utility, and MRS is the marginal rate of substitution. This equation can be rewritten as

$$\frac{-MU_x}{P_x} = -MRS_{(}MU_y, P_y)$$

which shows that an interior optimum is found when any surplus dollar spent on one good gives the same utility if it were spent on the other good.

In figure 2 we are given an indifference map comprised of utility functions given by $U(x, y) = xy$. As learned in the previous chapter, $MU_x = y$, and $MU_y = x$. Point B in the graph would have $MU_x = B2$ and $MU_y = A2$. It is clear that this is not equal to the slope of the indifference curve, therefore basket B is not optimal.

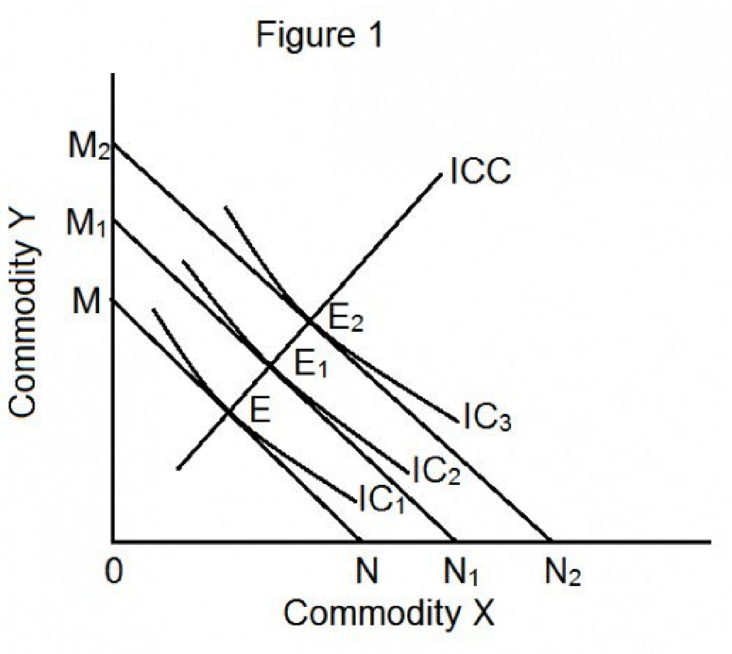

Figure 3: Expenditure Minimization

4.3 Consumer Choice with Composite Goods

Composite Good. A good that represents the collective expenditures on every other good except the commodity being considered.

It is often useful to plot a specific good on the horizontal axis, and every other good in the market on the vertical axis. The good on the vertical axis is called a composite good because it is made up of many goods. By convention, the price of a composite good is $P_y = 1$. The total expenditure on the compisite good is therefore $P_y y = y$.

$$P_y = 1$$
$$\frac{-P_h}{P_y} = -P_h$$

4.4 Revealed Preference

TODO

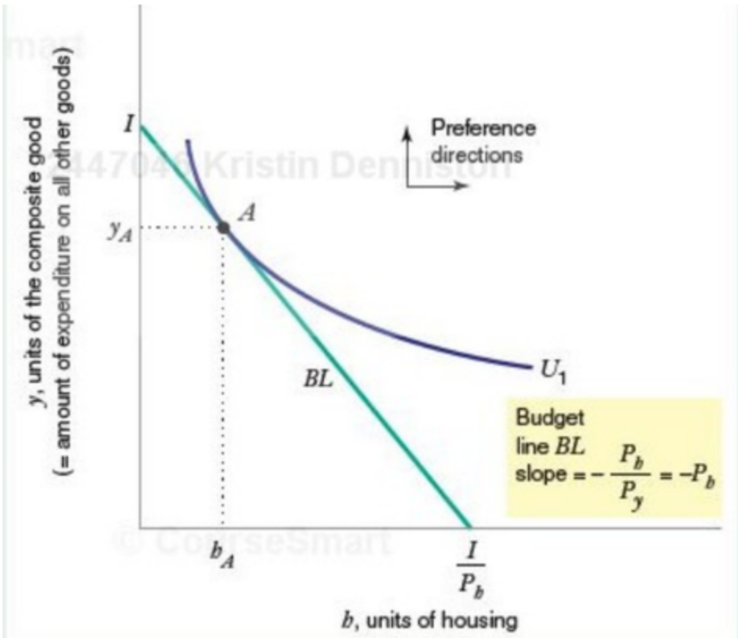

Figure 4: composite good

5 THE THEORY OF DEMAND

5.1 Optimal Choice and Demand

Price Consumption Curve. The set of utility-maximizing baskets as the price of one good varies (holding constant the prices of other goods and income.

Income Consumption Curve. The set of utility-maximizing baskets as income varies (and prices are held constant

Engel curve. A curve that relates the amount of a commodity purchased to income, holding constant the prices of all goods.

Normal Good. A good that a consumer purchases more of as income increases. Elasticity is positive.

Inferior Good. A good that consumers purchase less of as income increases. Elasticity is negative.

In figure 5 notice that as the price of biscuits falls, more biscuits can be purchased, resulting in a higher utility.

In figure 6 it can be seen how as an individual's income changes, the budget line is redrawn (with the same slope) in the direction of the shift in income.

Another way to show how an individual's choice of a particular good changes with income is to draw an Engel curve, a graph relating the amount of food consumed to the level of income. Food is shown (in units consumed) on the x-axis, income on the y-axis.

5.2 Change in the Price of a Good: Substitution Effect and Income Effect

Substitution Effect. The change in the amount of a good that would be consumed as the price of that good changes, holding constant all other prices and the level of utility

Income Effect. The change in the amount of a good that a consumer would buy as purchasing power changes, holding all prices donstant.

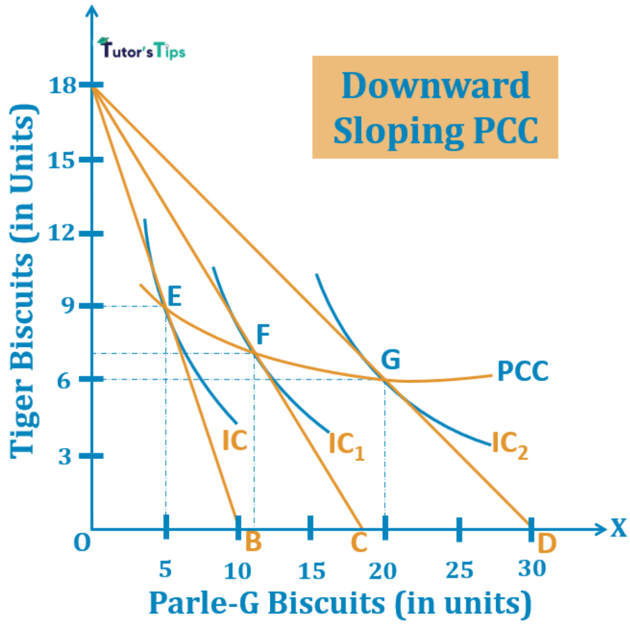

Figure 5: Price Consumption Curve

Griffen good. A good so strongly inferior that the income effect outweighs the substitution effect, resulting in an upward-sloping demand curve over some region of prices.

5.3 Change in the Price of a Good: The Concept of Consumer Surplus

Consumer Surplus. The difference between the maximum amount a consumer is willing to pay for a good and the amount he or she must actually pay when purchasing it.

Compensating Variation. A measure of how much money a consumer would be willing to give up after a reduction in the price of a good to be just as well off as before the price decrease

Equivalent Variation. A measure of how much additional money a consumer would need before a price reduction to be as well off as after the price decrease.

5.4 Market Demand

Network Externalities. A demand characteristic present when the amount of a good demanded by one consumer depends on the number of other consumers who purchase the good.

Bandwagon Effect. A positive network externality that refers to the increase in each consumer's demand for a good as more consumer buy the good.

Bandwagon Effect. A negative network externality that refers to the decrease in each consumer's demand as more consumers buy the good.

5.5 The Choice of Labor and Leisure

5.5.1 *As wages rise, leisure first decreases, then increases*

Leisure refers to all nonwork activities. The consumer's utility U depends on the amount of leisure time and number of units of a composite good he can buy. The

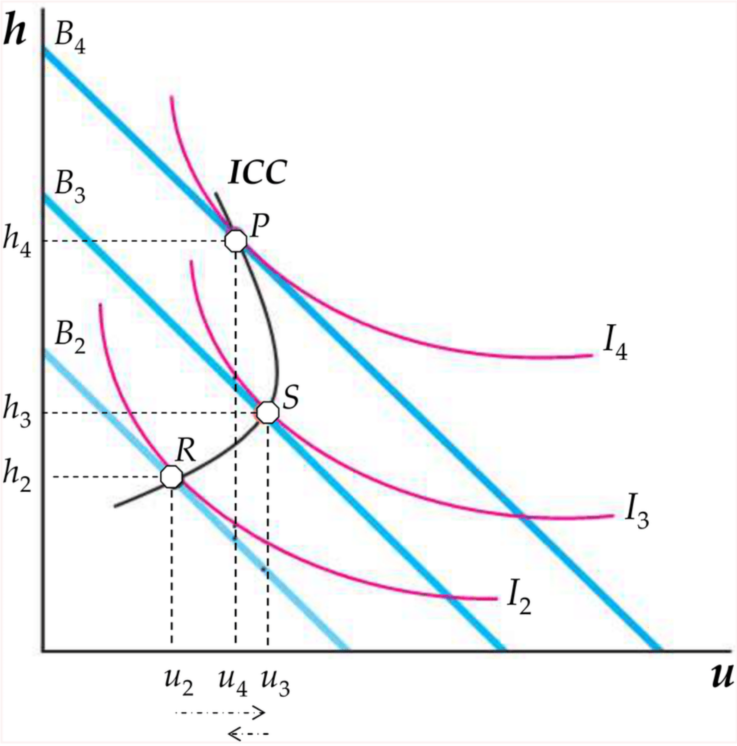

Figure 6: Income Consumption Curve

consumer's decision can be represented on the optimal choice diagram, with leisure on the x-axis, and composite goods and income on the y-axis.

5.5.2 *Backward-bending Supply of Labor*

Higher wages decreases the supply of labor, this is because people don't need to work as much to earn enough for leisure. This results in a backward bending labor supply curve.

This induces the consumer to substitute composite goods for leisure, resulting in an increase of labor supplied.

5.6 Consumer Price Indices

The ideal CPI (Consumer Price Index) would be a ratio between this year's expenses to last year's expenses. If this year's expenses are \$720, and last years were \$480, the ideal CPI calculation would be $\frac{\$720}{\$480} = 1.5$ This implies that the cost of living this year is 50% more expensive than last year.

Historically the government has tracked the price of a fixed market basket of goods in order to calculate CPIs.

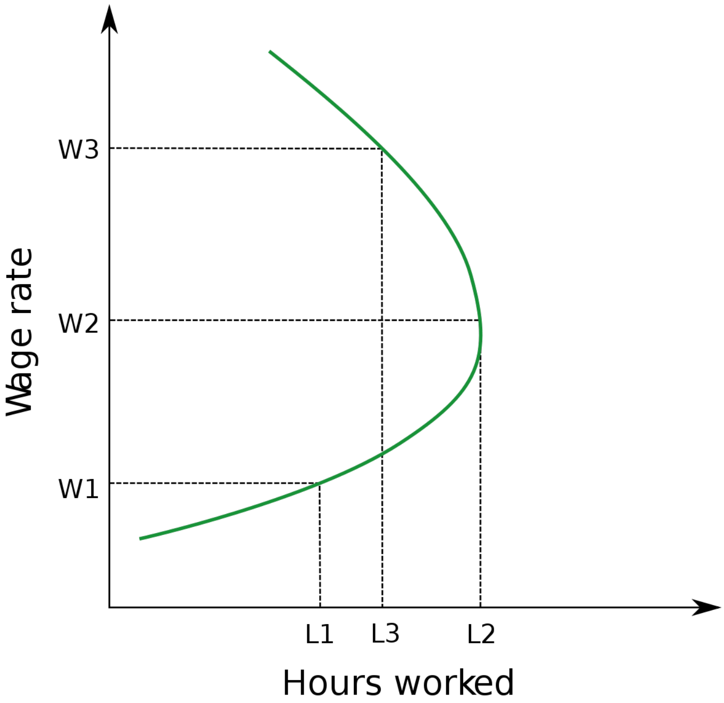

Figure 7: Labor Supply Curve

6 INPUTS AND PRODUCTION FUNCTIONS

6.1

6.2

6.3

Production Function. Function that shows the maximum quantity of output a firm can produce given a quantity of inputs.

$$Q = f(L, K)$$

Production Set. Set of feasible combinations of inputs and outputs.

Technically Inefficient. Set of points in the production set at which the firm is producing less from it's labor than it could.

Technically Efficient. Set of points in the production set where the firm is producing as much output as possible given the inputs.

Labor Requirements Function. A function that indicates minimum labor required to produce a given amount of output.

$$L = g(Q)$$

For example, if $Q = \sqrt{L}$ then $L = Q^2$.

Increasing Marginal Returns to Labor. Region along the total product function where output rises with additional labor at an increasing rate.

Diminishing Marginal Returns to Labor. Region on the curve where output increases with additional labor, but at a decreasing rate.

Diminishing Total Returns to Labor. Region on the total product function where an increase in labor decreases output.

Average Product of Labor. The average amount of output per unit of labor.

$$AP_L = \frac{\text{total product}}{\text{quantity of labor}} = \frac{Q}{L}$$

Average Product of Labor. Rate at which total output changes as quantity of labor used is changed.

$$MP_L = \frac{\text{change in total product}}{\text{change in quantity of labor}} = \frac{\Delta Q}{\Delta L}$$

Law of Diminishing Marginal Returns. As the usage of one input increases, the quantities of other inputs being held fixed, a point will be reached beyond which the marginal product of the variable input will decrease.

Total Product Hill. A three-dimensional graph of a production function.

Isoquant. A curve that shows all combinations of labor (L) and capital (K) that can produce a given level of output.

Uneconomic Region of Production 1. Region of upward-sloping/backward-bending isoquants. At least one input has a negative marginal product.

Economic Region of Production 1. The region where the isoquants are downward sloping.

Marginal Rate of Technical Substitution of Labor for Capital. Rate at which the quantity of capital can be reduced for every one-unit increase in the quantity of labor, holding output constant. $MRTS_(L, K)$ is a measure of the negative slope of an isoquant.

Diminishing Marginal Rate of Technical Substitution. The marginal rate of technical substitution of labor for capital diminishes as the quantity of labor increases along an isoquant (feature of a production function).

$$\Delta Q = \text{change in output}$$

$$\text{change in output from change in quantity of capital} = (\Delta K)(MP_K)$$

$$\text{change in output from change in quantity of labor} = (\Delta L)(MP_L)$$

$$\Delta Q = \text{change in output from change in quantity of capital}$$

$$+\text{change in output from change in quantity of labor}$$

$$\frac{-\Delta K}{\Delta L} = \frac{MP_L}{MP_K}$$

This shows that the marginal rate of technical substitution of labor for capital ($MRTS_{L,K}$)is equal to the ratio of the marginal product of labor (MP_L) to the marginal product of capital (MP_K).

6.4 Substitutability Amog Inputs

Will cover the ease or difficulty with which a firm can substitute between different inputs of production.

These two production functions (Figure 8/6.11) differ in the ease with which the firms can substitute labor (L) and capital (K).

The first curve (a) has limited opportunity for substitution because any increase in one input would yield a small deacrease in the other.

In contrast, the second curve (b) has a more linear slope, which results in a far greater rate of substitution.

A right movement along the curve (a) results in $MRTS_{L,K}$ becoming almost zero (slope is almost zero), while a left movement along the curve results in the $MRTS_{L,K}$ becoming infinite (negative of the slope is very steep).

This suggests the ease or difficulty with which a firm may substitute inputs is directly related to the derivative (slope) of the isoquant.

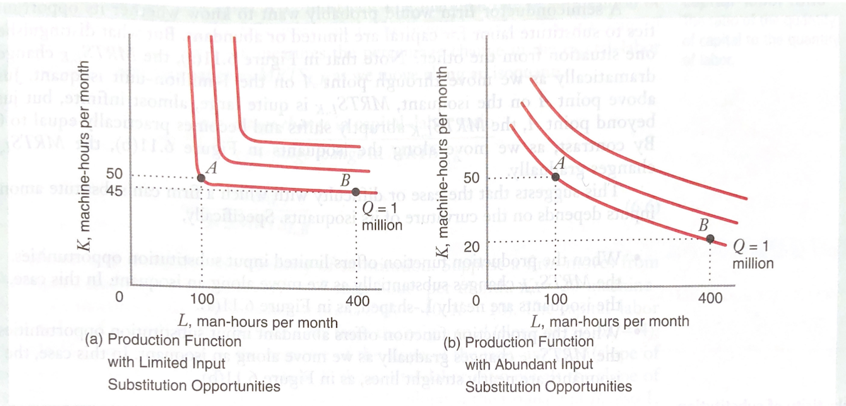

FIGURE 6.11 Input Substitution Opportunities and the Shape of Isoquants
In panel (a), start from point A and move along the isoquant $Q = 1$ million (i.e., holding output constant). If the firm increases one input significantly (either L or K), it will only be able to reduce the other input by a small amount. The firm is in a position where there is virtually no substitutability between labor and capital. By contrast, in panel (b) the firm has abundant substitution opportunities—that is, a significant increase in one input would allow the firm to reduce the other input by a significant amount, holding output constant.

Figure 8: Input Substitution Opportunities

$MRTS_{L,K}$ changes **substantially** along the isoquant if the production function offers limited input substitution opportunitites.

$MRTS_{L,K}$ changes **gradually** along the isoquant if the production function offers substantial input substitution opportunities.

6.4.1 Elasticity of Substitution

elasticity of substitution. Measure of how easily a firm may substitute labor for capital. **Often represented by** $\sigma. Typically any value greater than, or equal to, zero. If \sigma is close to zero, opportunityt$

Figure 9: Elasticity of substitution describes the firm's input substitution opportunities. It describes how quickly the $MRTS_{L,K}$ (marginal rate technical substitution) changes along the isoquant curve (derivative of $MRTS_{L,K}$).

As labor is substituted for capital, the ratio of the **quantity of capital** to the **quantity of labor**, K/L, must fall. This ratio is known as the **capital-labor ratio**. **σ measures the percent change in the capital-labor ratio for each 1% change in $MRTS_{L,K}$ (as we move along the isoquant).**

$$\begin{aligned} \sigma &= \frac{\%\text{ change in capital labor ratio}}{\%\text{ change in } MRTS_{L,K}} \\ &= \frac{\%\Delta \frac{K}{L}}{\%\Delta MRTS_{L,K}} \end{aligned} \tag{1}$$

Figure 9 illustrates the elasticity of substitution. Given the production function $f(L,K)$, as a firm moves from $f(5,20)$ to $f(10,10)$, the capital-labor ratio changes from $\frac{20}{5} = 4$ to $\frac{10}{10} = 1$ (-75%), as does the $MRTS_{L,K}$. Thus,

$$\begin{aligned} MRTS_{L,K} &= -\frac{\Delta K}{\Delta L} \\ MRTS^{A}_{L,K} &= -\frac{20}{5} = -4 \\ MRTS^{B}_{L,K} &= -\frac{10}{10} = -1 \end{aligned}$$

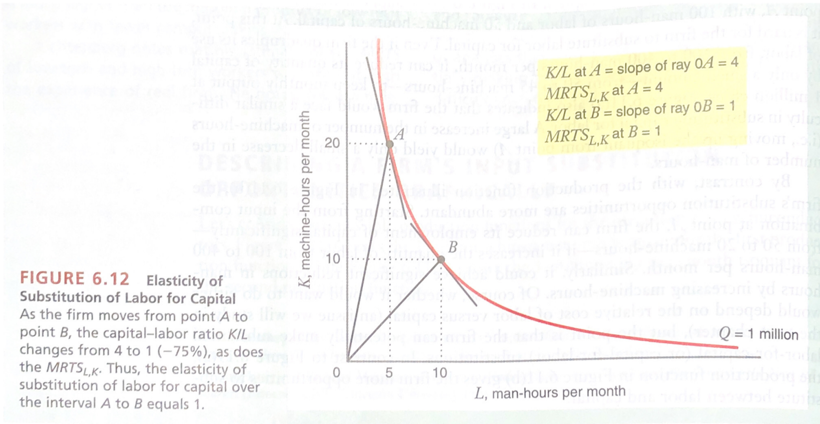

Figure 9: Elasticity of Substitution of Labor for Capital

$$
\begin{aligned}
\sigma &= \frac{\%\Delta \frac{K}{L}}{\%\Delta MRTS_{L,K}} \\
&= \frac{100(\frac{4-1}{4})}{100(\frac{(-4)-(-1)}{-4})} \\
&= \frac{\frac{4-1}{4}}{\frac{4-1}{4}} \\
&= 1
\end{aligned}
$$

the elasticity of substitution over this interval is 1 $(-75\%/-75\% = 1)$.

Calculating the Elasticity of Substitution from a Production Function Problem

Consider a production function $Q = \sqrt{KL}$, with marginal products $MP_L = \frac{1}{2}\sqrt{\frac{K}{L}}$ and $MP_K = \frac{1}{2}\sqrt{\frac{L}{K}}$.

Show that the elasticity of substitution for this production function is equal to 1 no matter the values of K and L.

Solution

First, note that

$$MRTS_{L,K} = \frac{MP_L}{MP_K}$$

This implies

$$\begin{aligned} MRTS_{L,K} &= \frac{\frac{1}{2}\sqrt{\frac{K}{L}}}{\frac{1}{2}\sqrt{\frac{L}{K}}} \\ &= \frac{K}{L} \end{aligned}$$

Since $MRTS_{L,K} = \frac{K}{L}$, it follows that $\%MRTS_{L,K}$ will be exactly equal to $\%\Delta\frac{K}{L}$.

In other words, since the marginal rate of substitution of labor for capital equals the capital-labor ratio, the percent change of both is also equal.

Using the definition of the elasticity of substitution,

$$\begin{aligned} \sigma &= \frac{\%\Delta(\frac{K}{L})}{\%\Delta(MRTS_{L,K})} \\ &= \frac{\%\Delta(\frac{K}{L})}{\%\Delta(\frac{K}{L})} \\ &= 1 \end{aligned}$$

- Typically any value greater than, or equal to, zero.
- If σ (elasticity of substitution) is close to zero, opportunity to substitute inputs is low.
- If σ is large, there is substantial opportunity to substitute inputs. This corresponds to the fact that if σ is large, $\%\Delta MRTS_{L,K}$ (percent change $MRTS_{L,K}$) is small.

6.4.2 Special Production Functions

The relationship between

- curvature of isoquants
- input stability
- the elasticity of substitution

is most apparent when contrasting a number of special production functions.

Four frequently used special production functions will be compared:

1. linear production function
2. fixed-proportions production function
3. Cobb-Douglas production function
4. constant elasticity of substitution production function

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