Consumption and Leisure Model and Producer Profit Maximization

ECO 305: Intermediate Macroeconomics

Goals

Develop a *microfounded* model to describe the following behaviors:

1. Consumption demand
2. Labor supply
3. Labor demand
4. Production Decisions

Reading and Exercises

- Williamson, Chapter 4, pp. 98-117
- Williamson, Chapter 4, pp. 122-135
- **Canvas Quiz due Wednesday 11:59 PM**. Multiple-choice, 10 questions, unlimited attempts allowed, only best score counts
- **Homework/In-class Exercise due Friday 11:59 PM**. We will work together in class on Thursday

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Microfounded Macroeconomics Modeling

Microeconomic Behavior

- Individual optimizing behavior
- Utility maximizing consumers
- Profit maximizing producers (next module)

Representative Consumer

- Model one consumer's behavior to represent all consumers
- Useful: Explains macroeconomic consequences to changing conditions or incentives
- Not useful: Cannot explain income inequality or even unemployment
- Heterogenous agent models: Possible to extend the model with multiple consumers (beyond the scope of this class)

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Utility

Utility

Utility is a "quantity" of satisfaction gained from consuming goods, services, or leisure.

- **Consumption:** A general single "good" representing all final goods and services that consumers purchase
- **Leisure:** Any time spent not working for compensation.
- **Marginal utility (MU):** additional utility derived from one additional unit of a good, service, or leisure.

Assumptions

- Marginal utility is always positive
- **Diminishing marginal utility:** as consumption of something increases, the marginal utility decreases.

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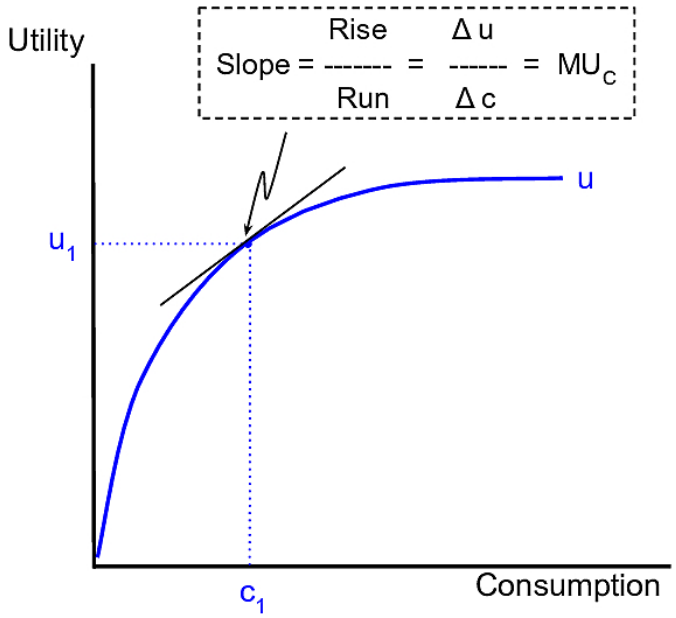
- Utility function slope = Marginal utility
- Upward sloping $\rightarrow$ always positive marginal utility
- Concave $\rightarrow$ diminishing marginal utility



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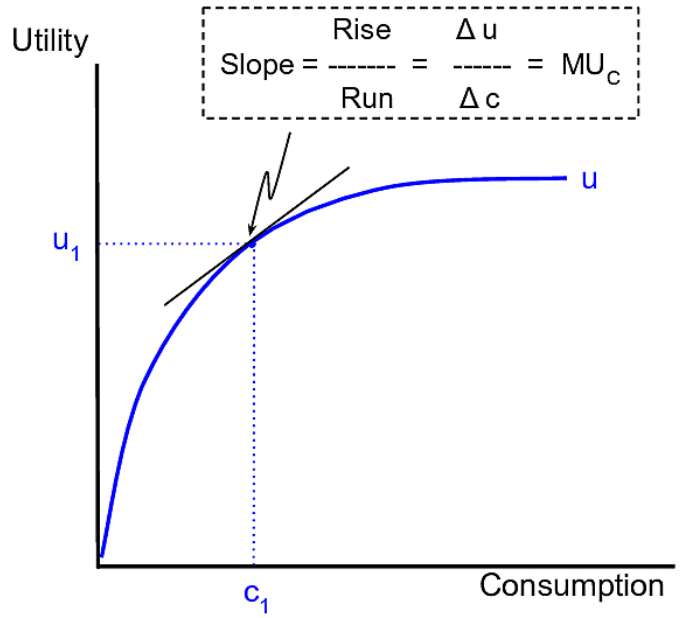

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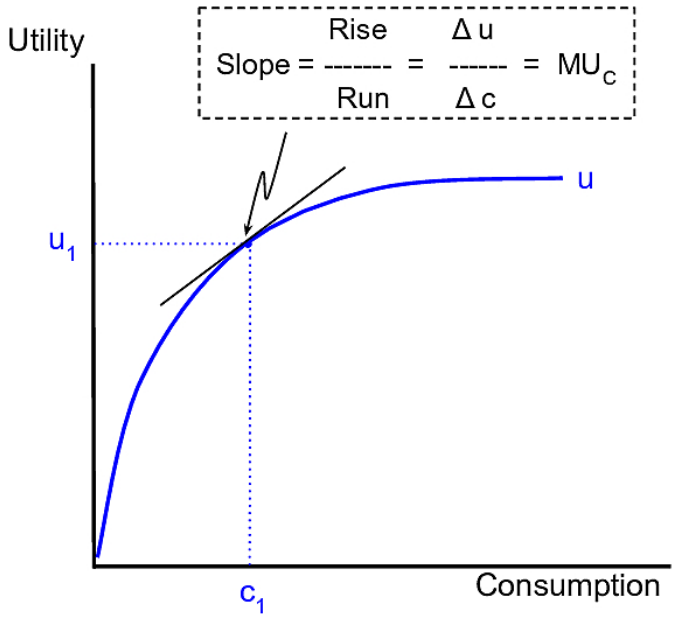

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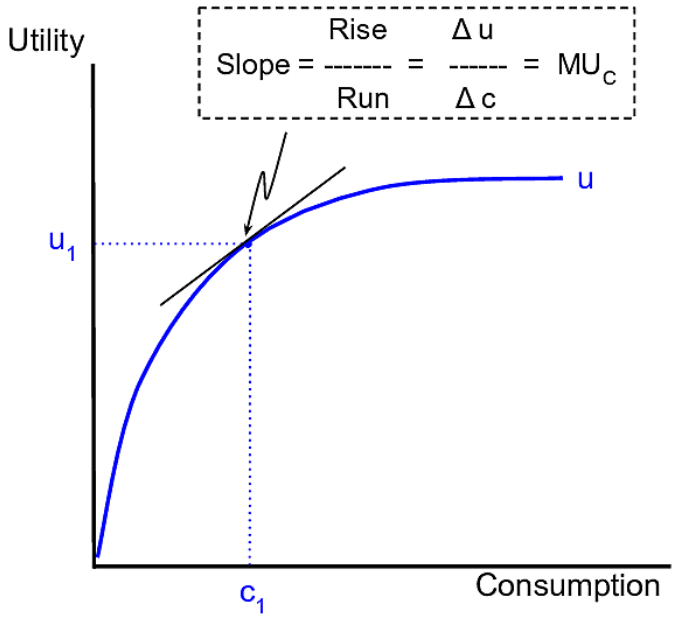

Indifference Curves

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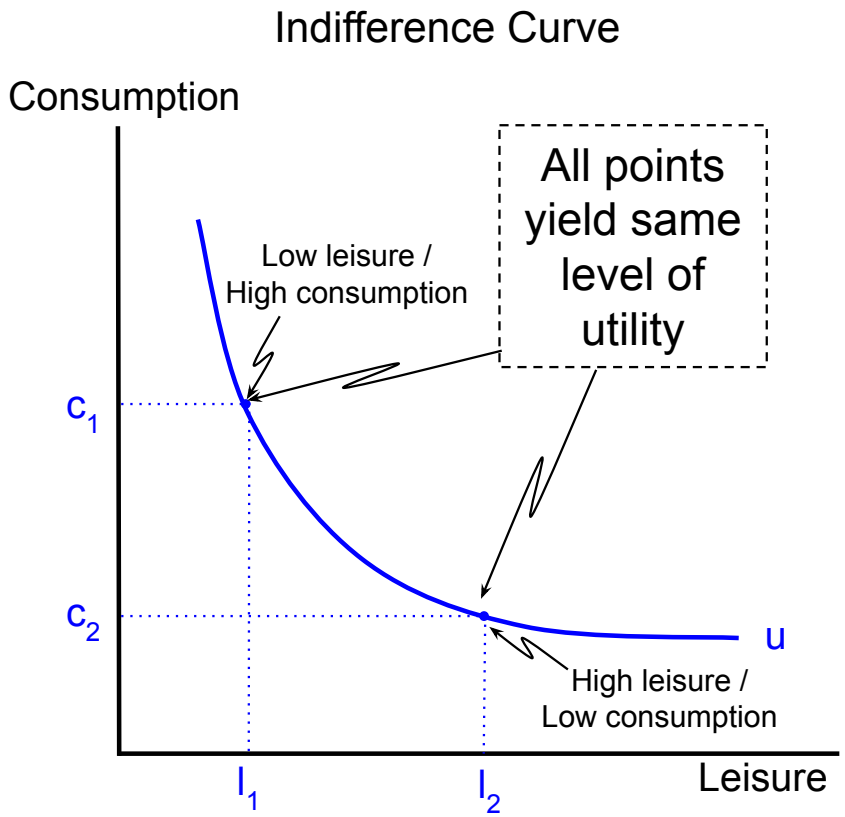
- Alternative combinations of quantities of two types of goods that yield the same level of utility.
- Indifference curves are downward sloping → To keep same level of utility, give up one good when gaining another



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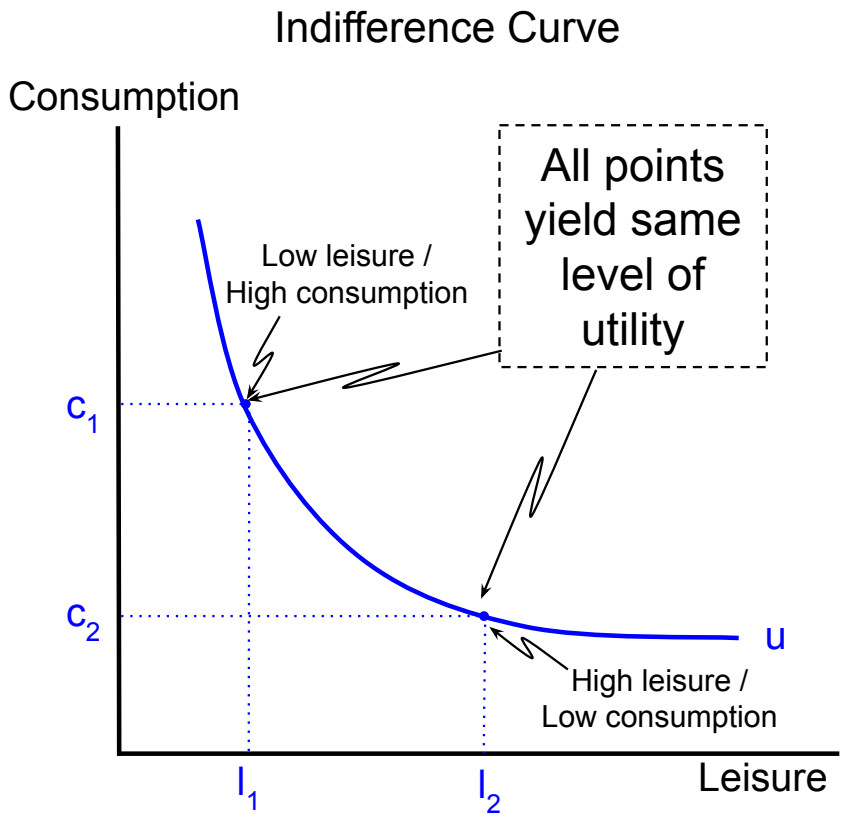

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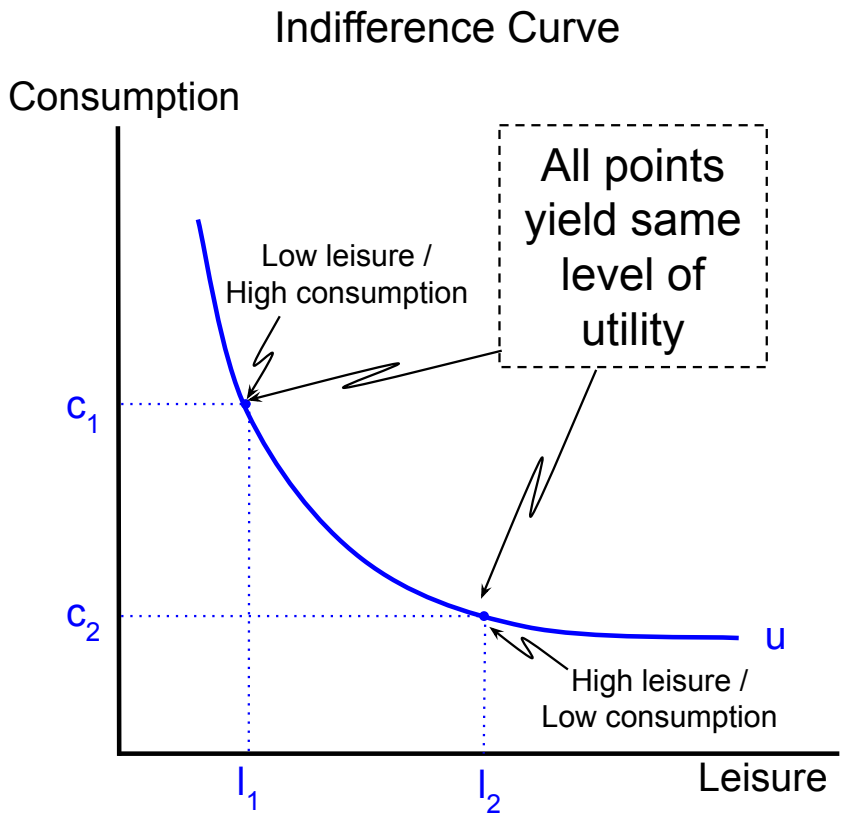
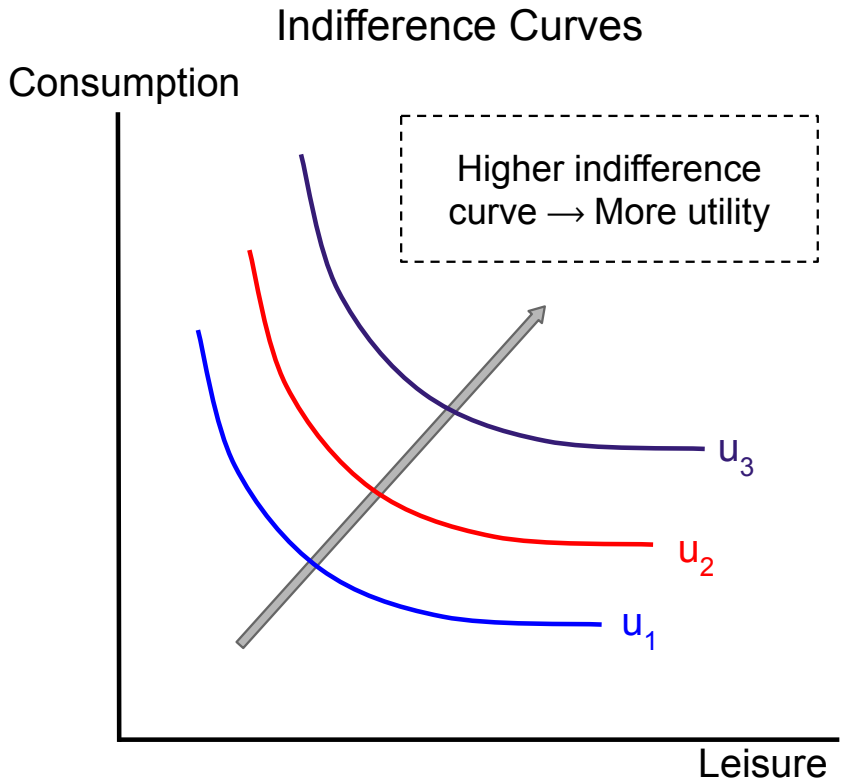


Indifference Curves with Increasing Utility

Indifference Curves

- Higher indifference curves have larger quantities of goods → yield higher utility
- Indifference curves never cross
- Utility-maximizing consumers: Choose consumption and leisure to get on highest indifference curve possible



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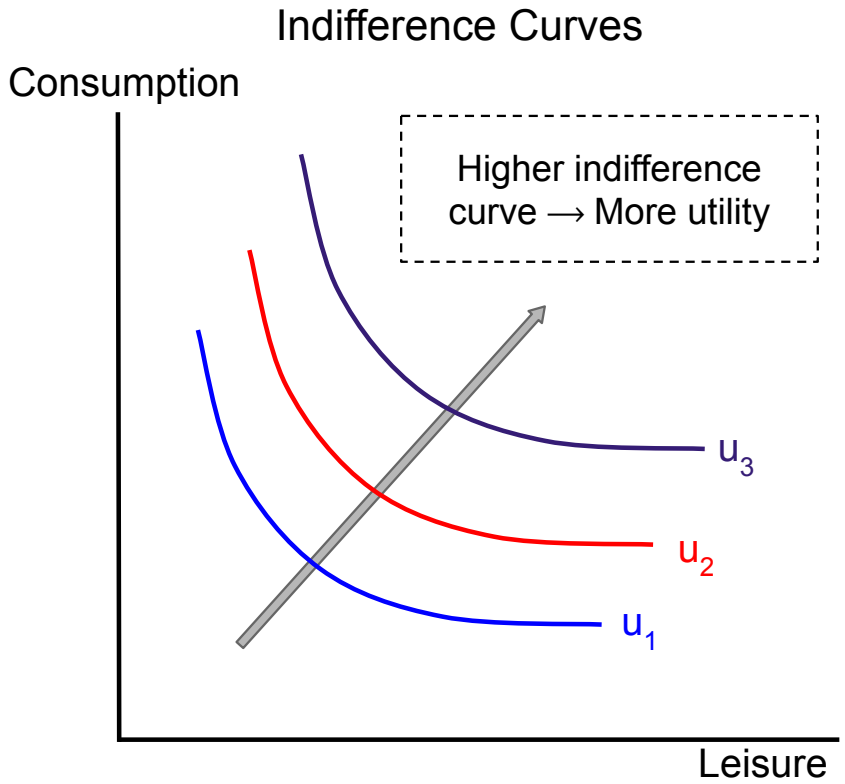

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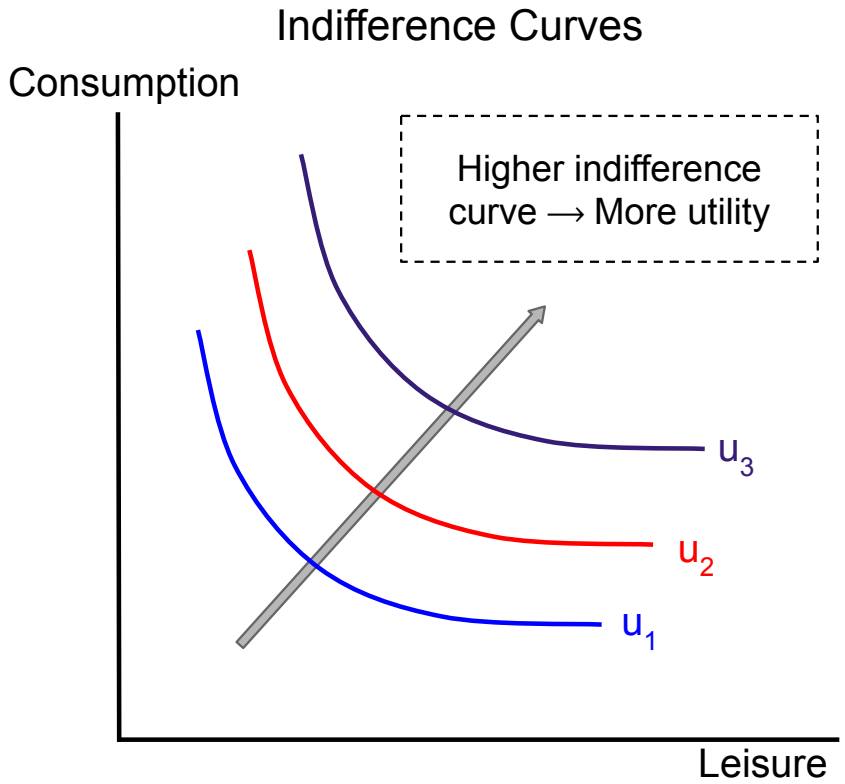

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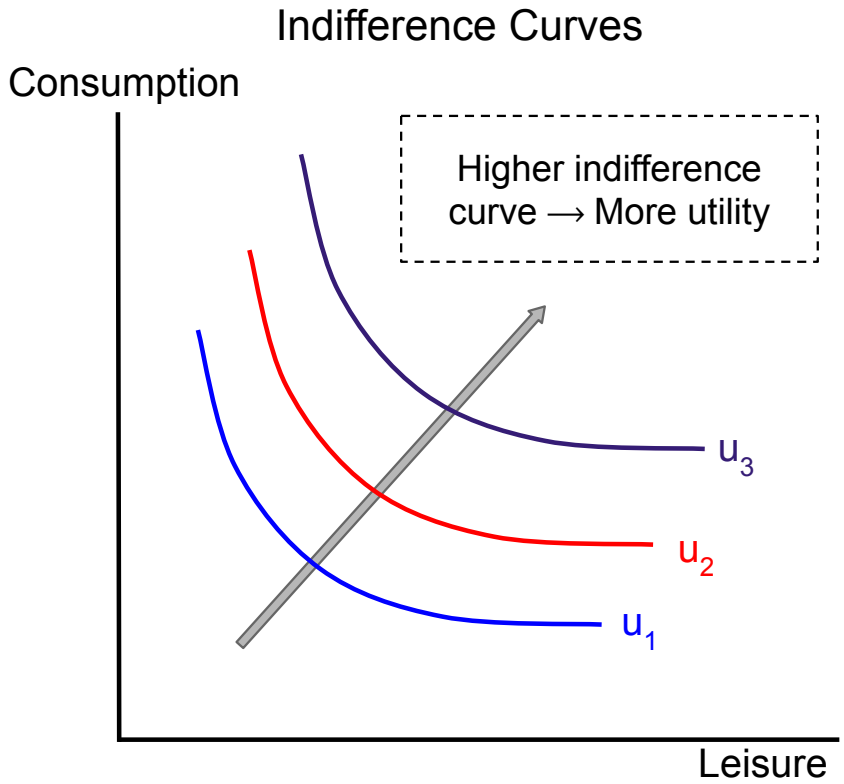


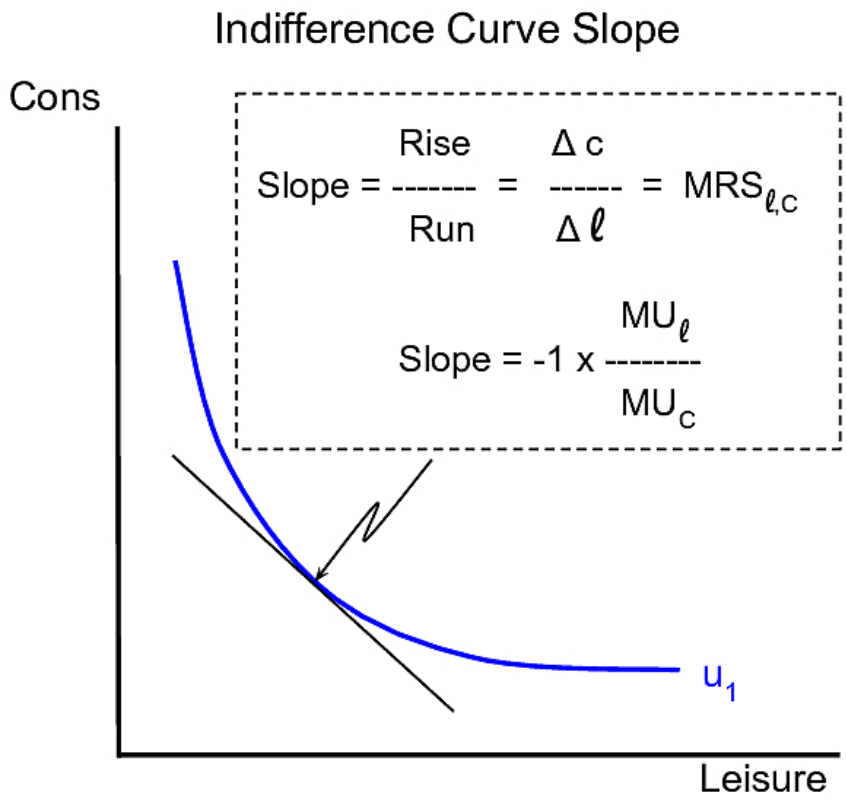
Marginal Rate of Substitution

Marginal Rate of Substitution

The quantity of good Y that a consumer is willing to give up to gain one more unit of good X.

Slope of the indifference curve $= -MRS_{X,Y}$:

$$MRS_{X,Y} = -\frac{MU_X}{MU_Y}$$



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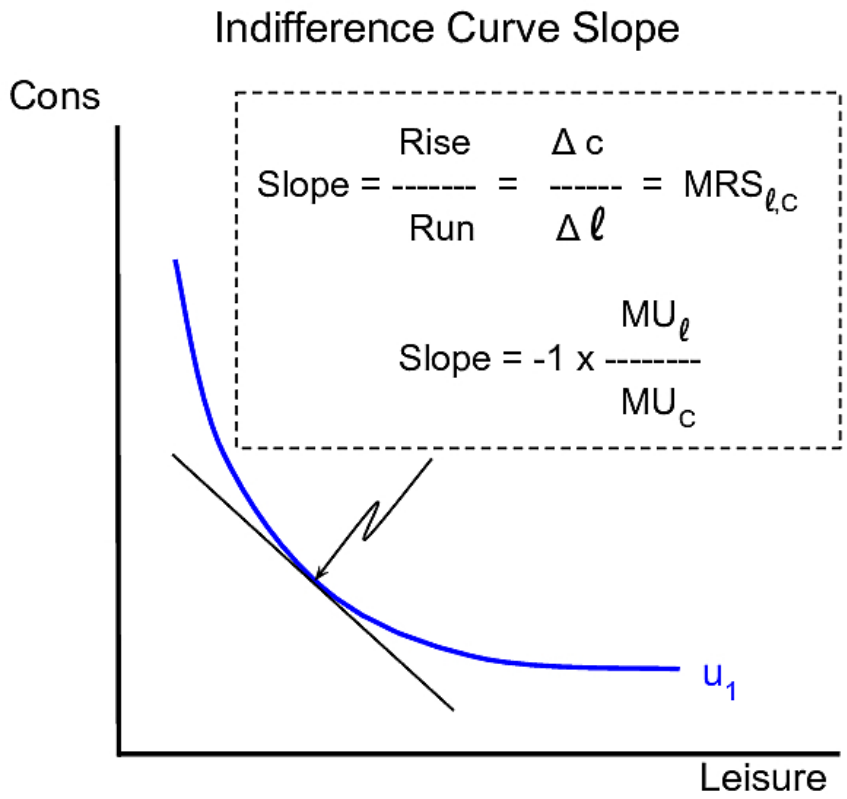

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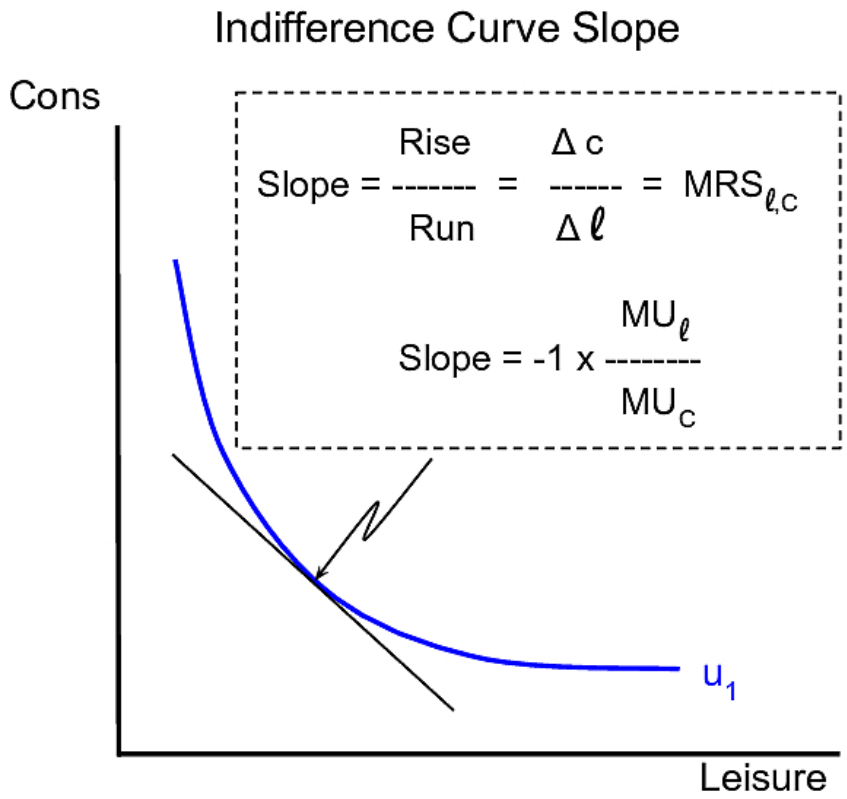

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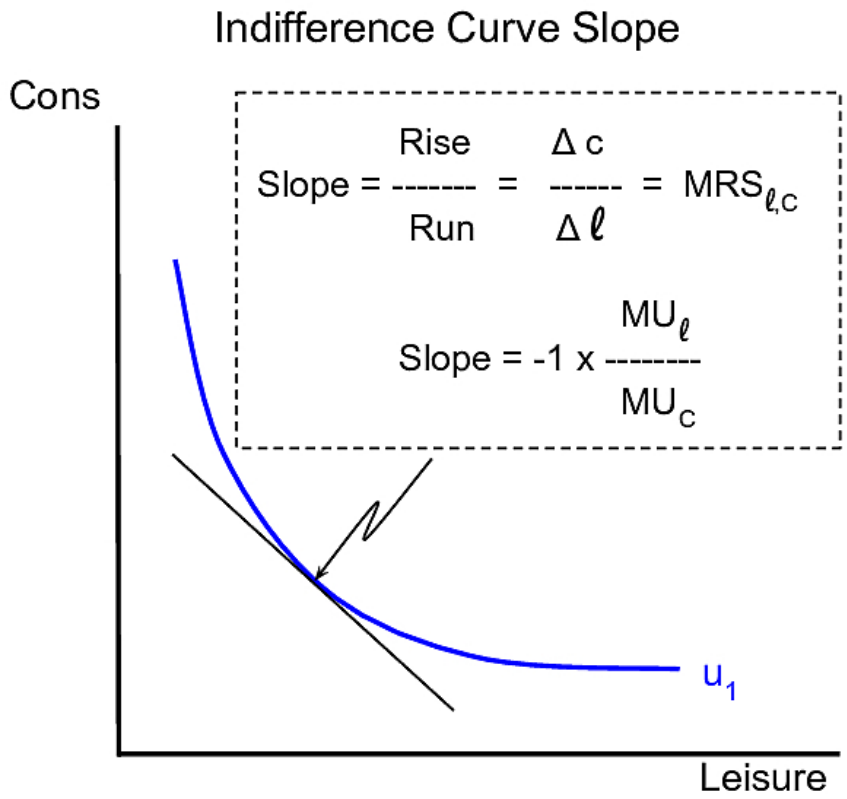
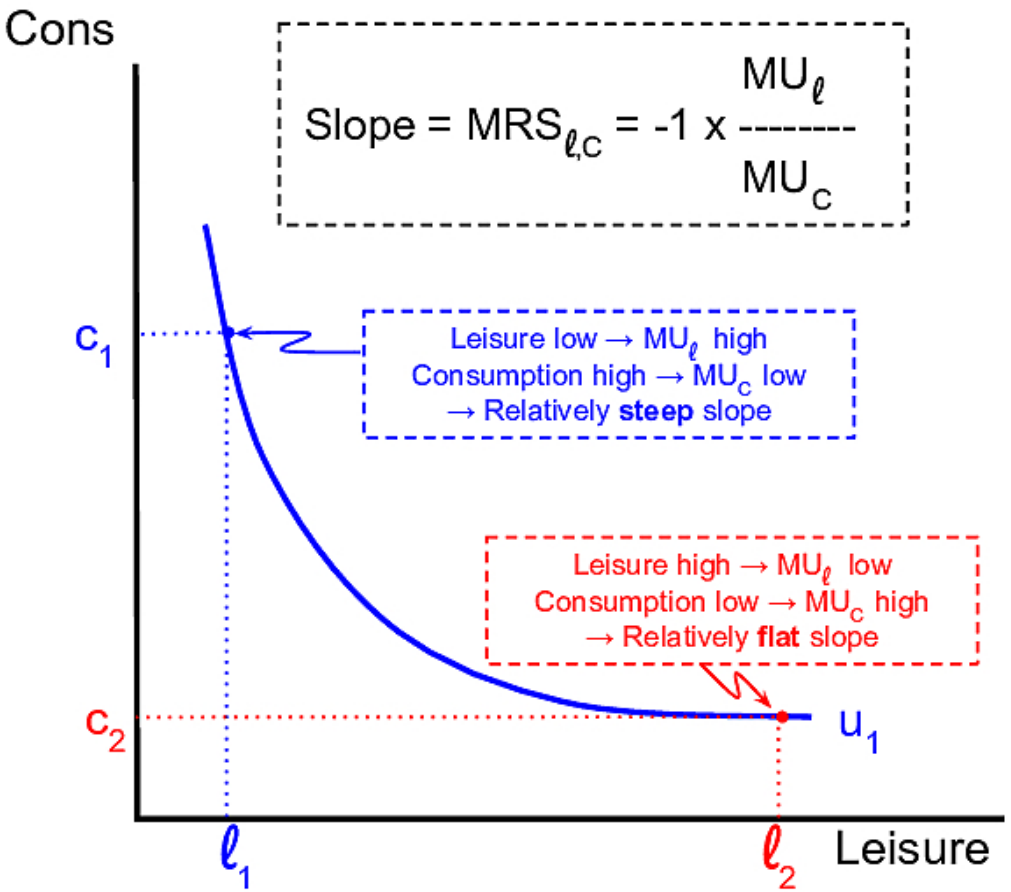


Slope of Indifference Curves



Diminishing marginal utility gives indifference curves the convex shape

Budget constraint

$$Pc = W(h - l) + \Pi - T \quad (1)$$

- P: Price of consumption good (aggregate price level, eg: GDP Deflator)
- c: Real quantity of consumption (Real consumption in aggregate expenditure equation)
- W: Nominal wage rate
- h: total time available for work and leisure
- $h - l$: time spent working (total employment / labor supply)
- Π: non-wage income = dividends earned from owning stock in firms.
- T: Net lump sum taxes, net of transfers

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Real Budget Constraint

Divide everything by P to get the budget constraint, in *real terms*:

$$c = w(h - l) + \pi - t \tag{2}$$

(lowercase letters are real variables)

Re-arranging:

$$c + wl = wh + \pi - t \tag{3}$$

- Goods c and l appear on left-side as "goods" to buy
- Income appears on right-side
- That is, this looks *just like*:

$$Price_X\ (Qty\ X) + Price_Y\ (Qty\ Y) = Income$$

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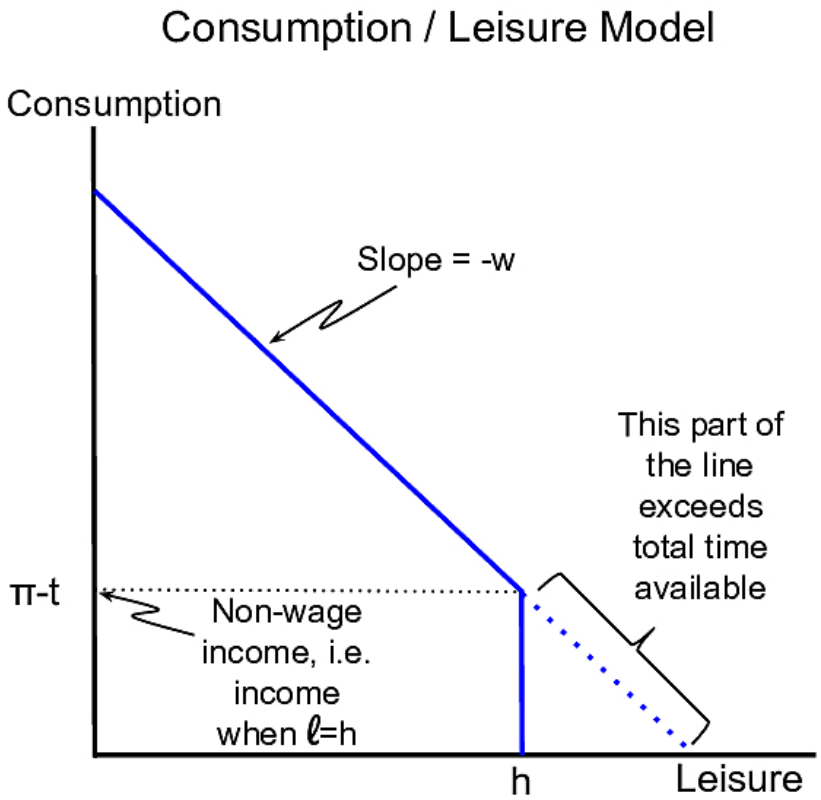
Equation: $c + wl = wh + \pi - t$

- Points on the line: largest quantities of consumption and leisure the consumer can afford
- Slope of the line = -w
- Vertical height changes with amount of non-wage income



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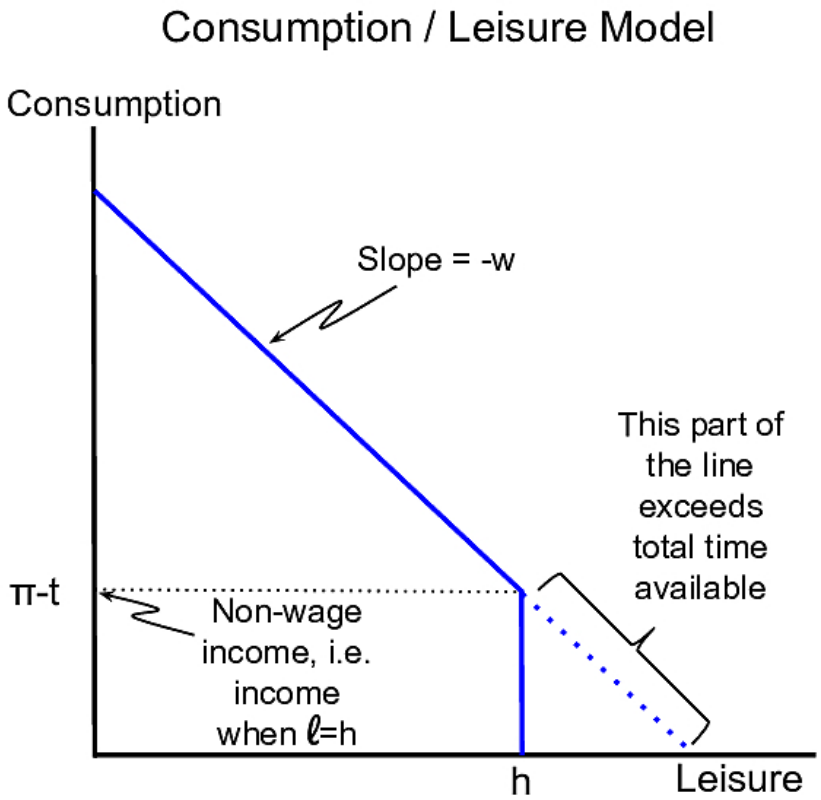

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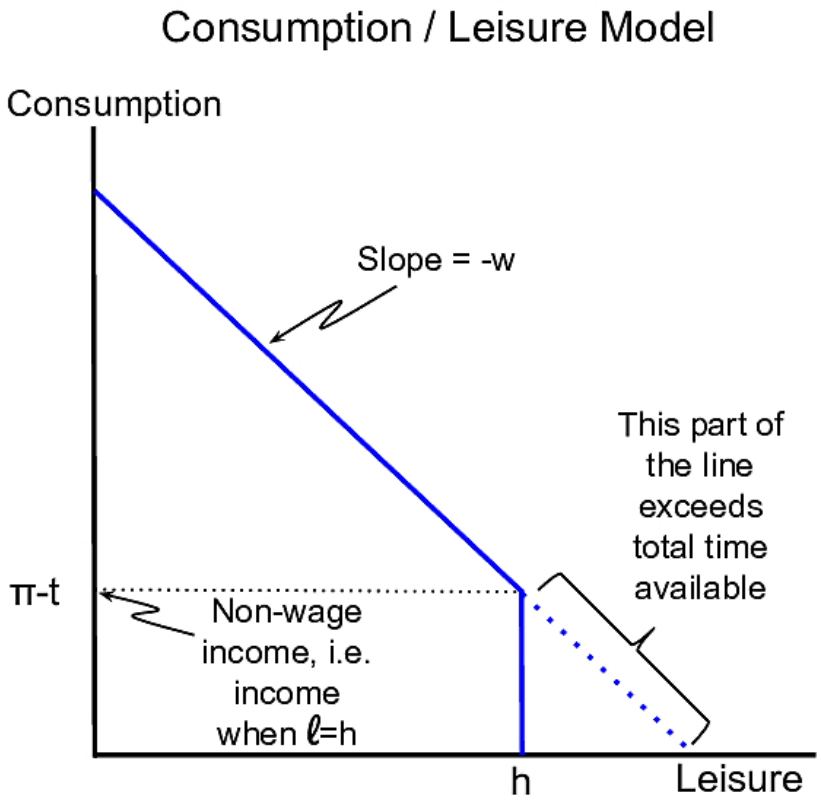

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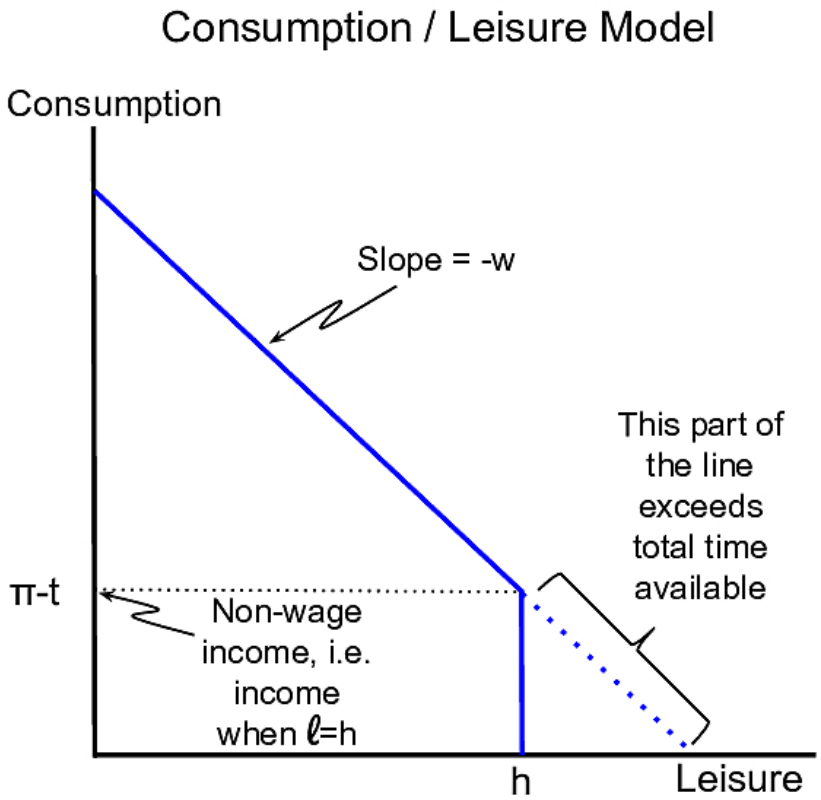

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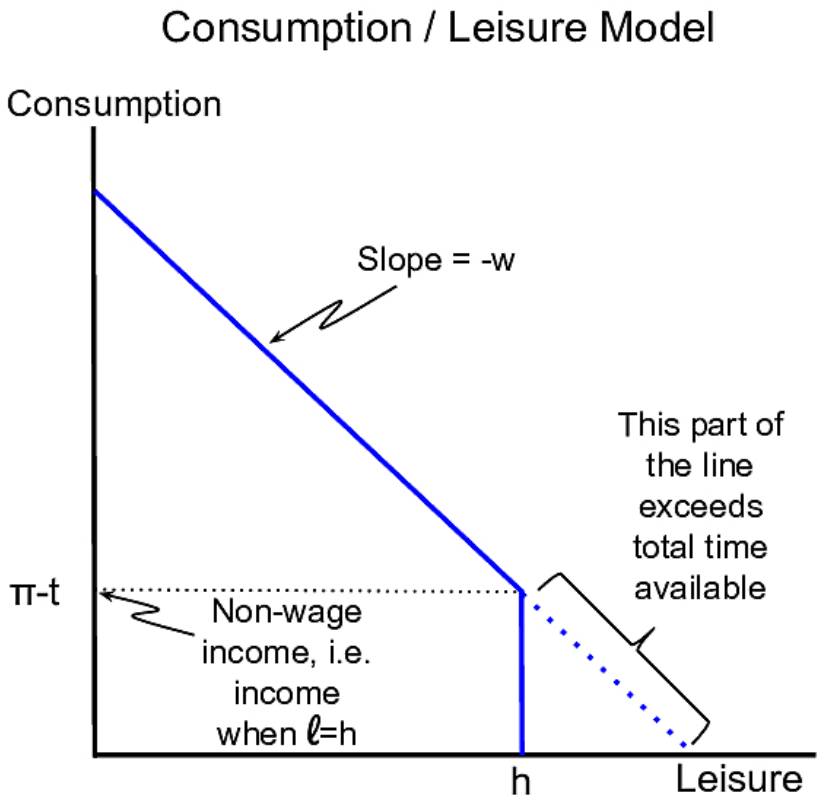
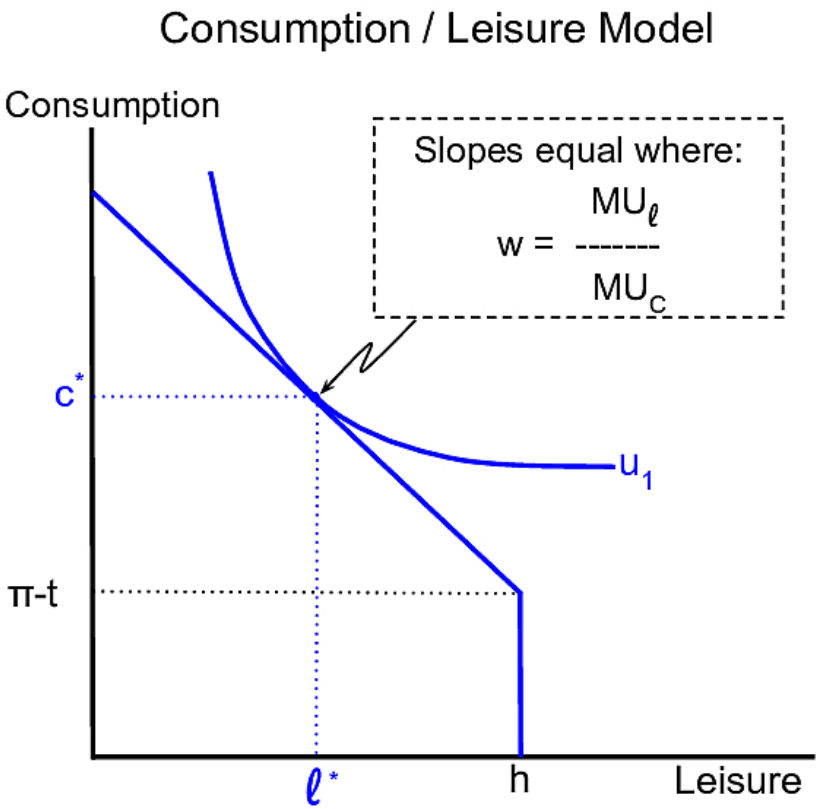


Utility Maximization

Utility Maximizing Choice

- Maximize utility subject to budget constraint
- Get on the highest indifference curve that is affordable
- Highest indifference curve *is tangent* to the budget line
- Optimal choice is where *slopes are equal*:

$$\frac{MU_l}{MU_c} = w$$



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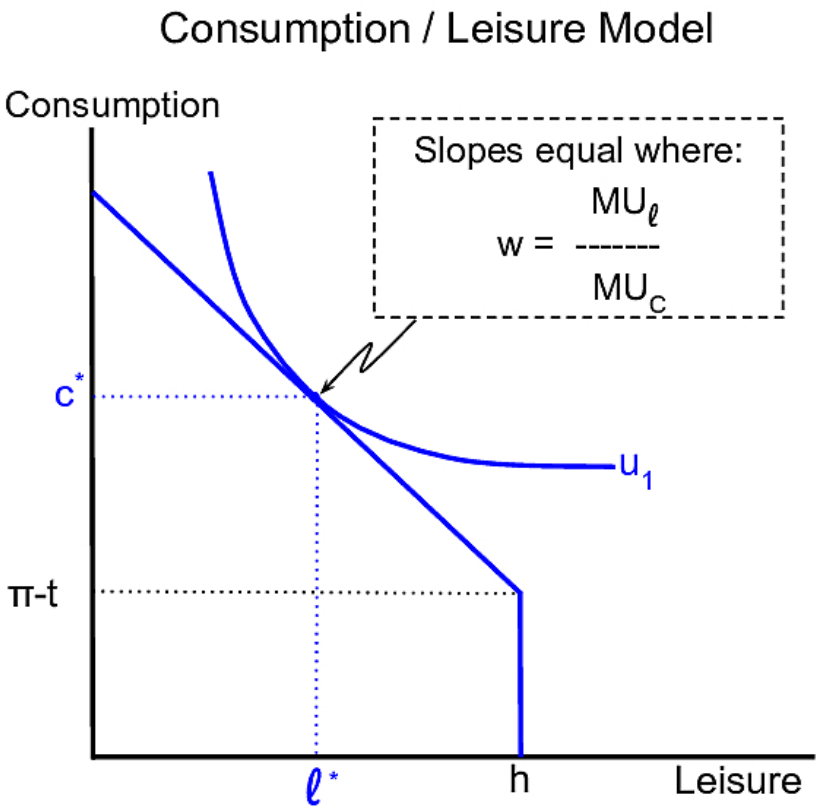
- Get on the highest indifference curve that is affordable
- Highest indifference curve *is tangent* to the budget line
- Optimal choice is where *slopes are equal*:

$$\frac{MU_l}{MU_c} = w$$



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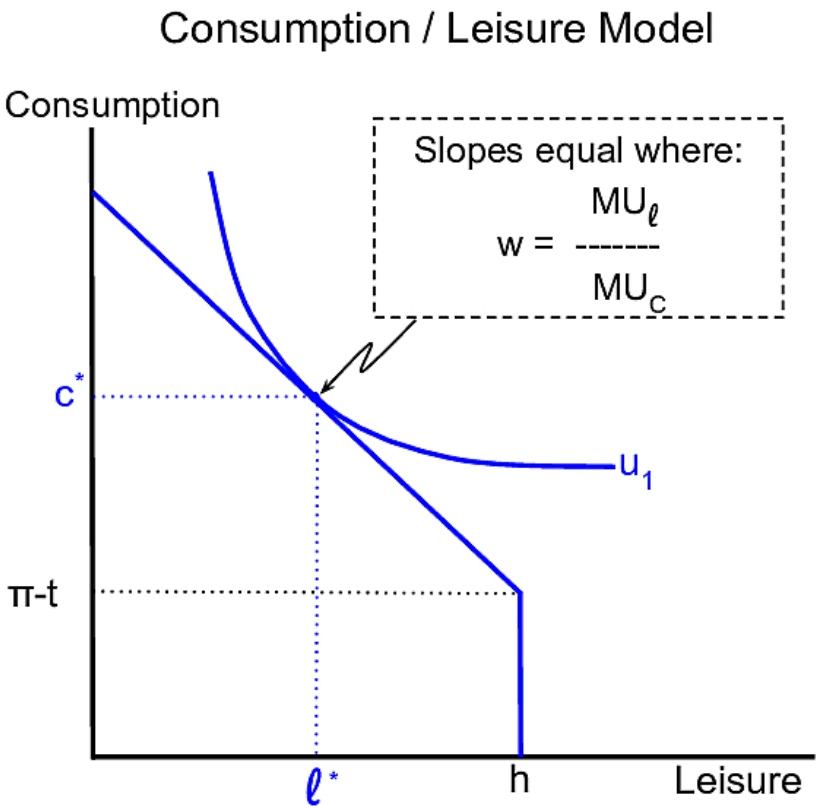

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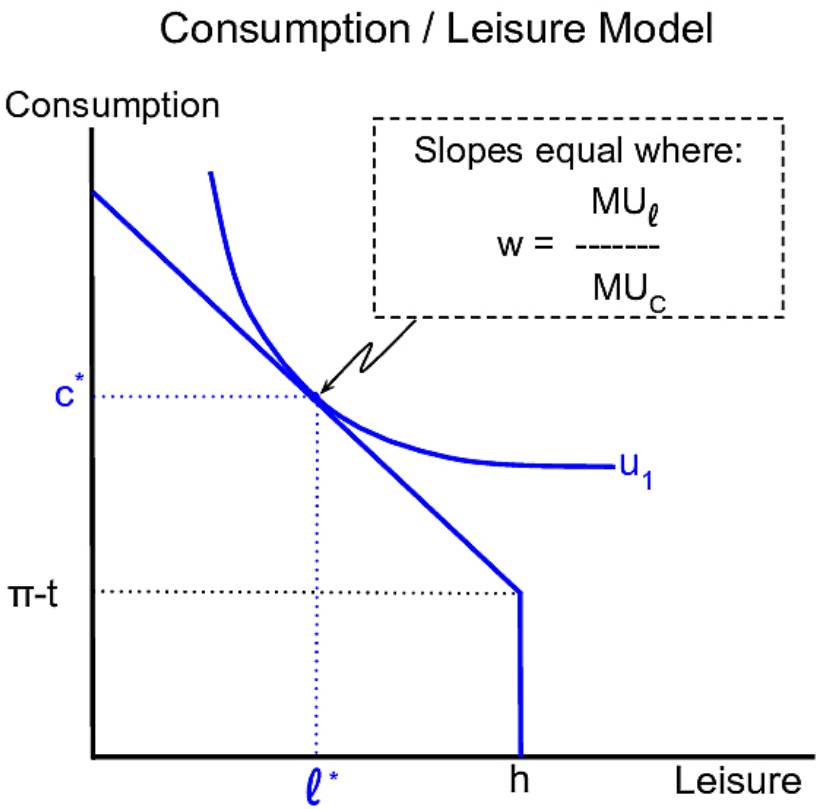

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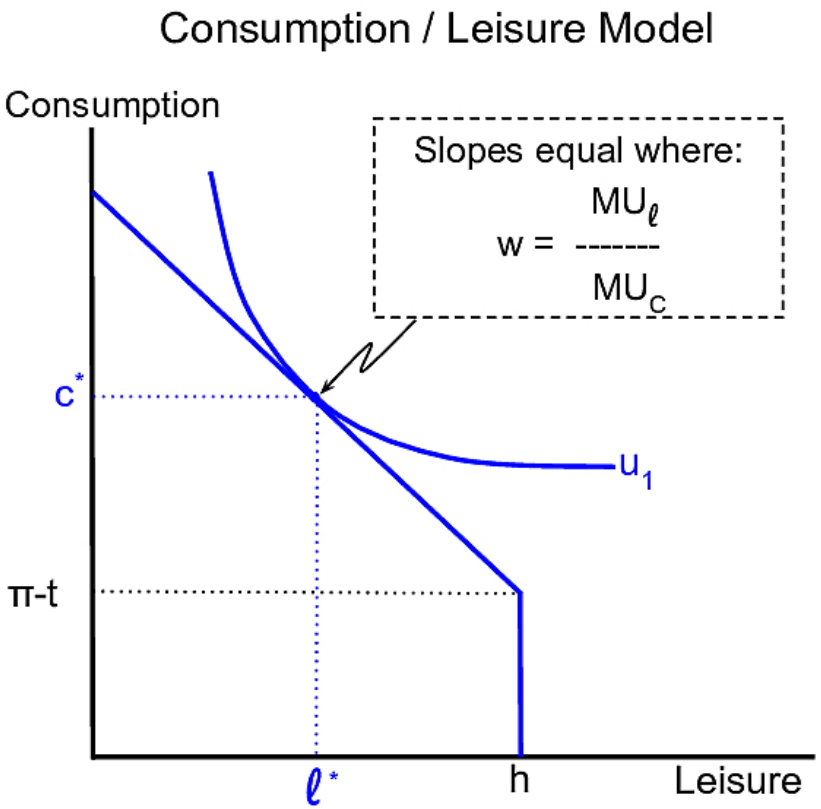

Increase in Non-Wage Income

Utility Maximizing Choice

- Examples: Property tax cut, lump sum tax rebate, increase in asset (stock market) values
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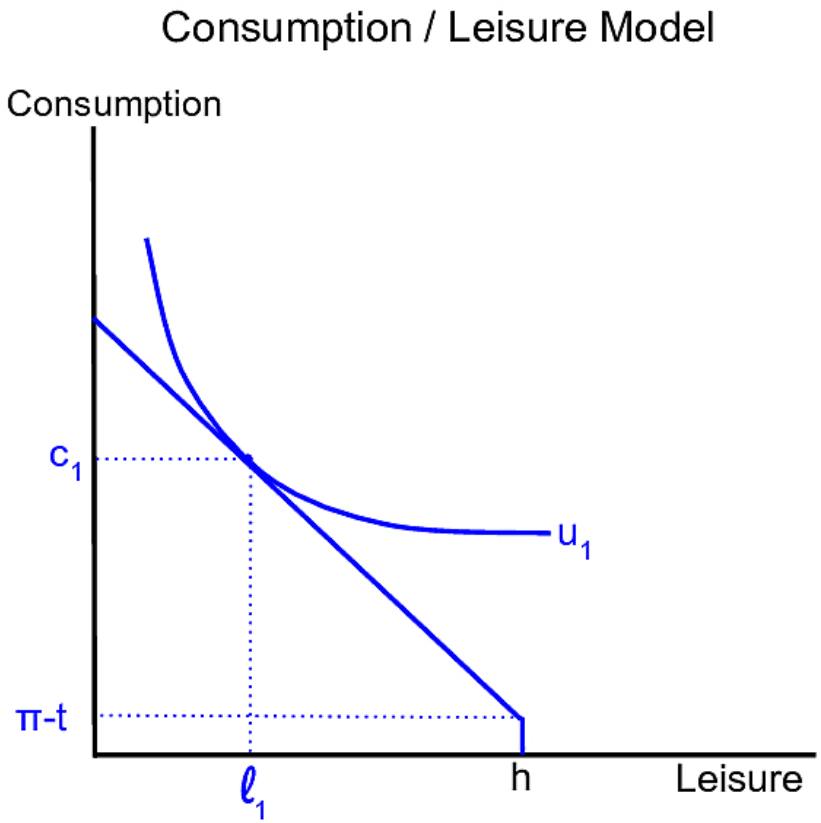

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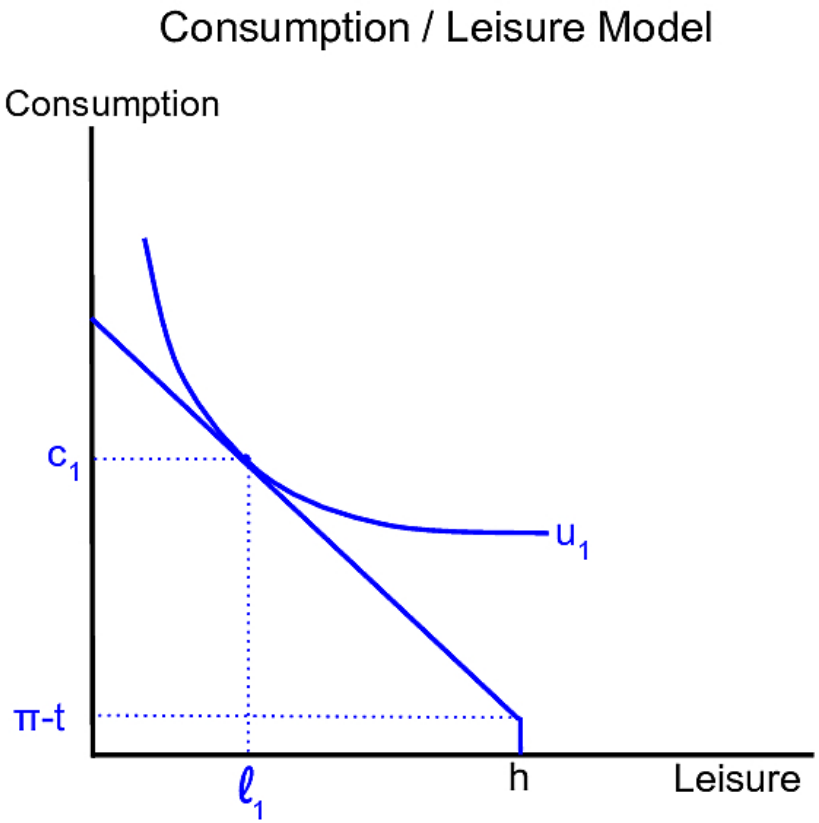

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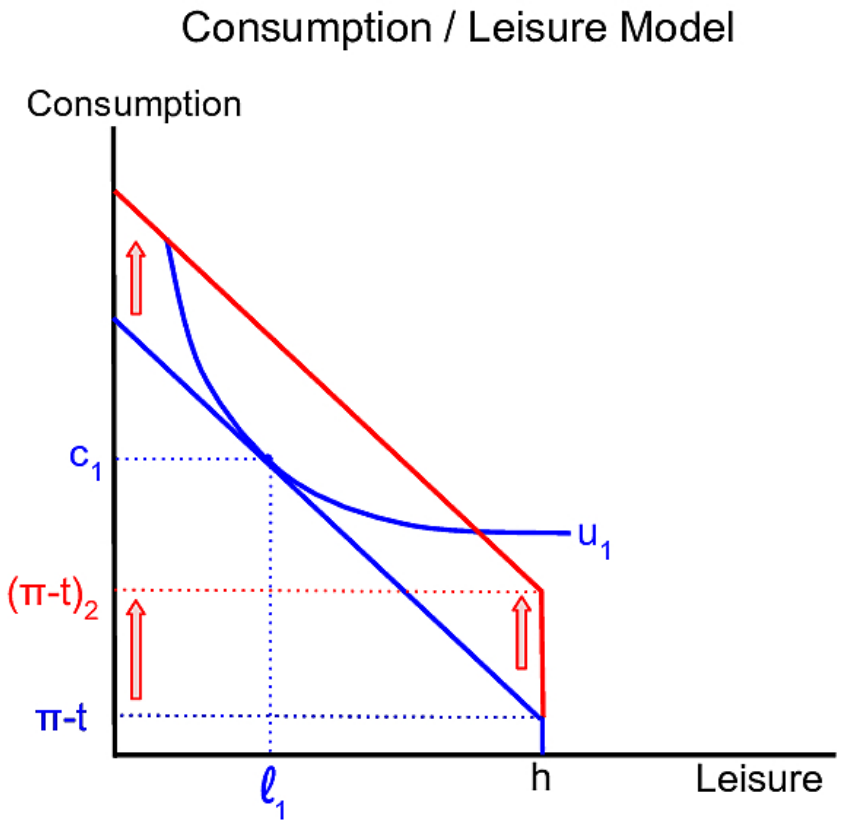

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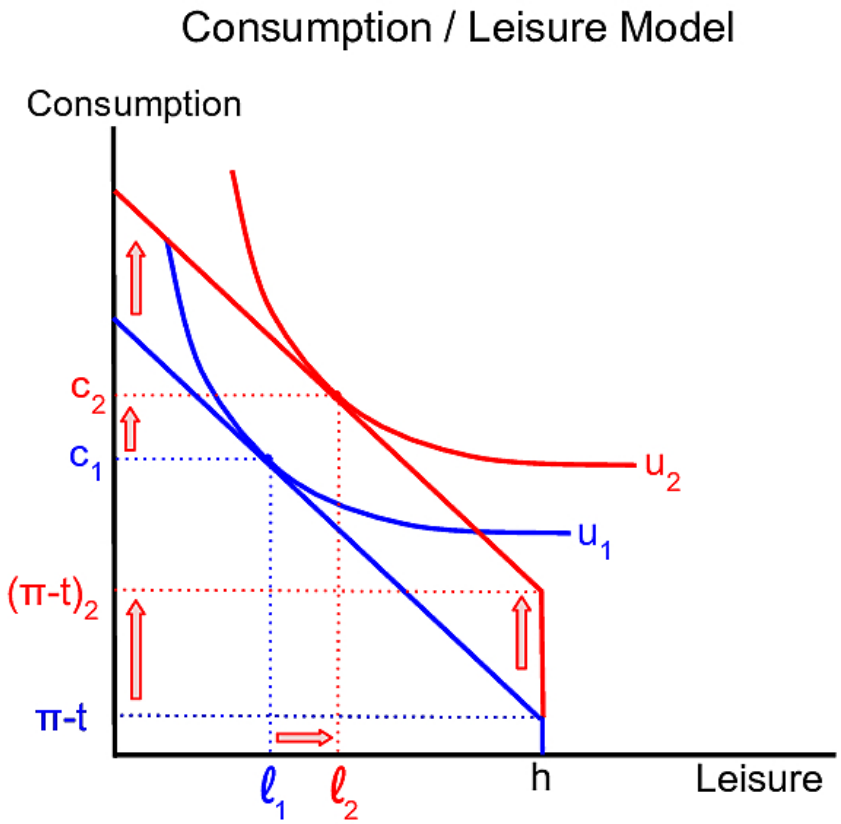

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- Budget constraint gets steeper at kink/pivot point
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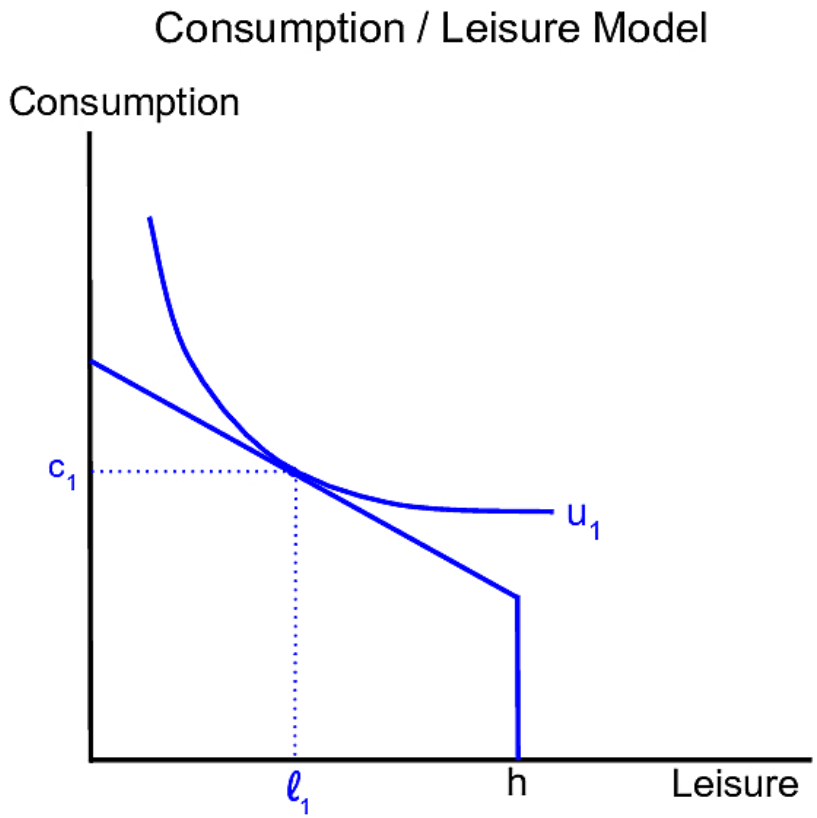

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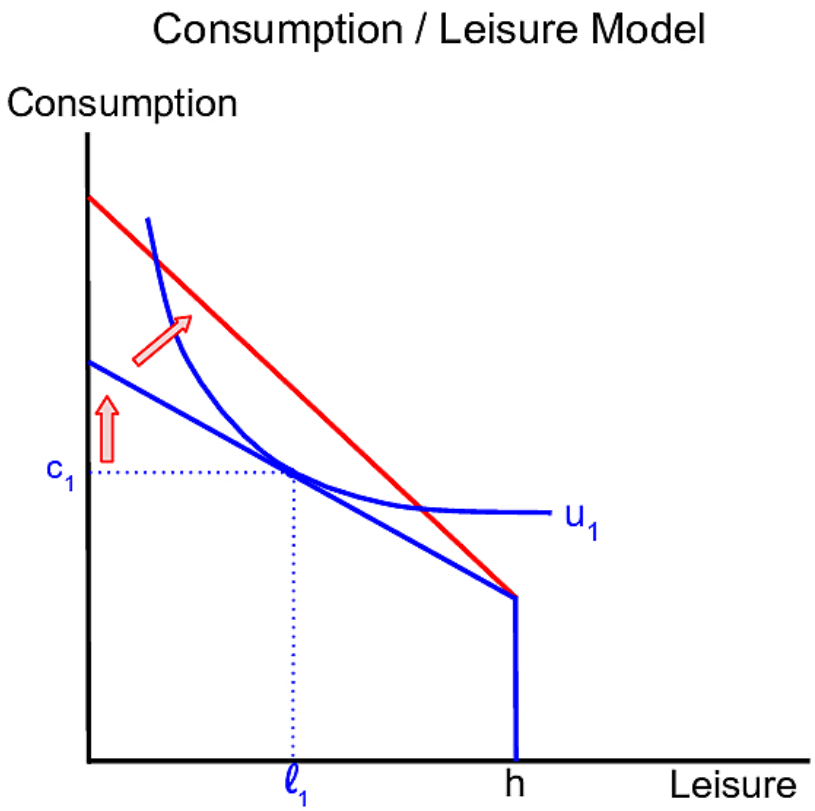

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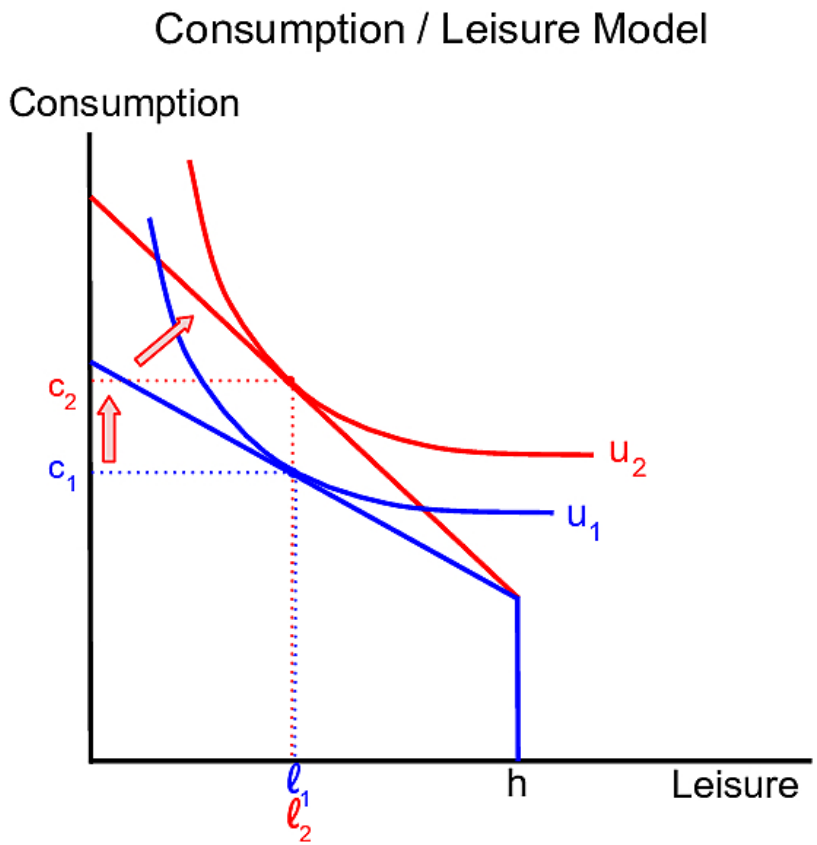

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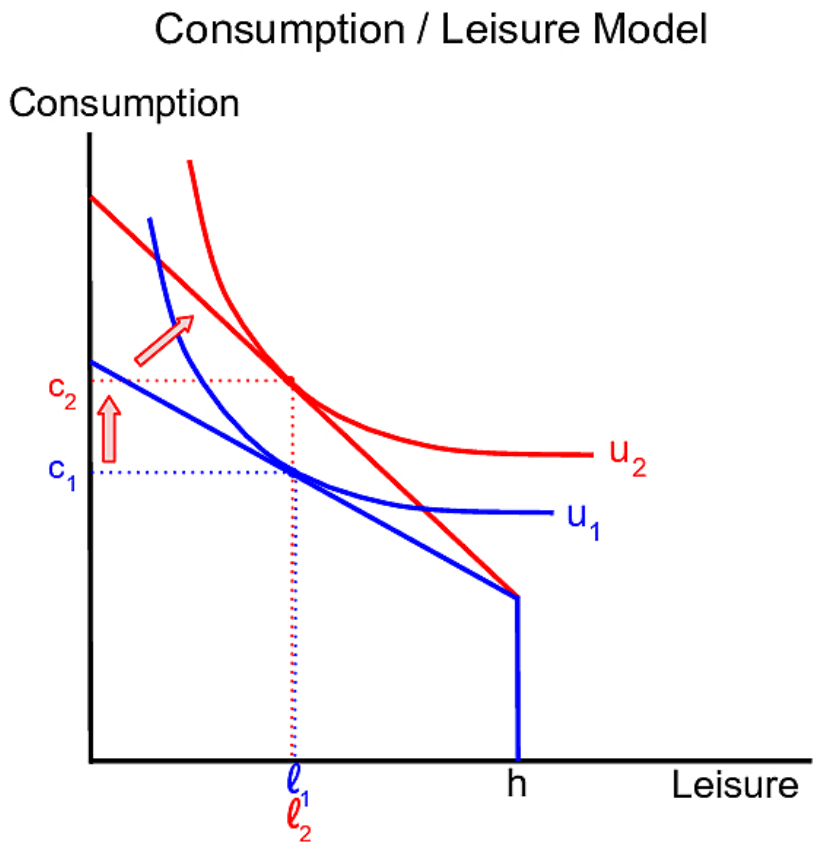

Substitution and Income Effects

Substitution Effect

- The effect from *only* the increase in the relative price of the good, holding constant the effect price changes have on total purchasing power
- Graphically: Only the effect of the slope, not the effect of being on a higher or lower budget constraint or indifference curve
- Intuition: Increase in wage $\rightarrow$ leisure is more expensive $\rightarrow$ enjoy less leisure, substitute more consumption instead

Income Effect

- The effect of how a price change affects total income
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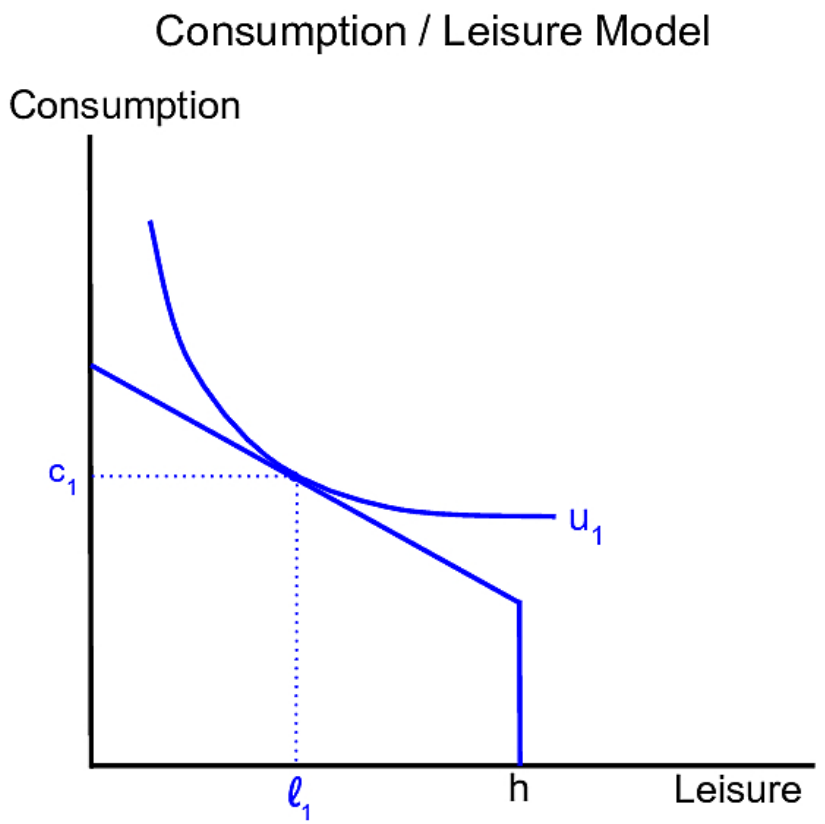

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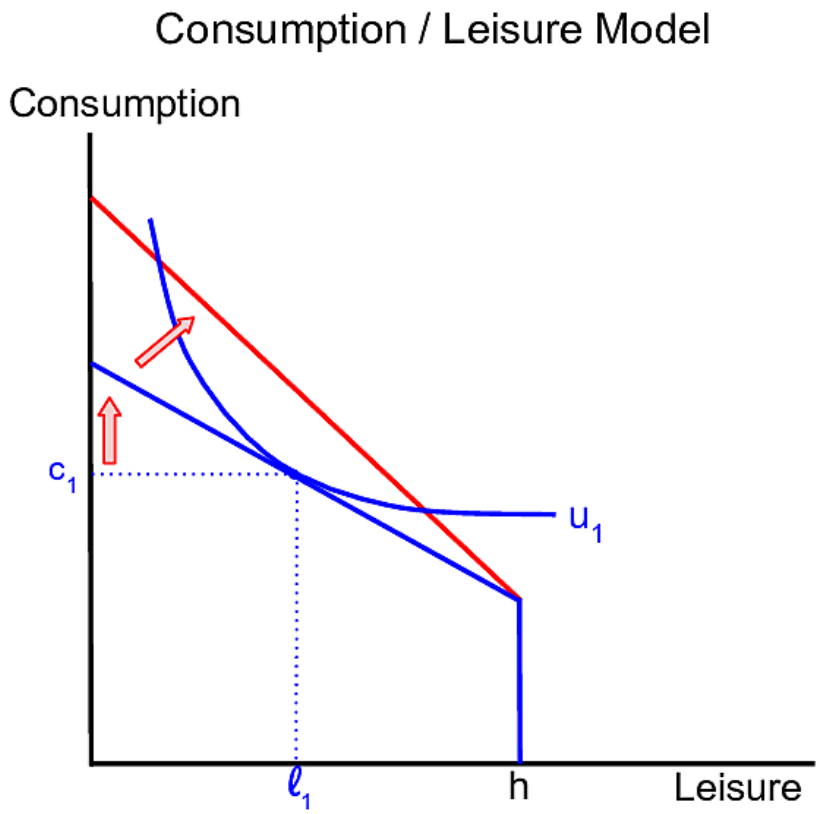

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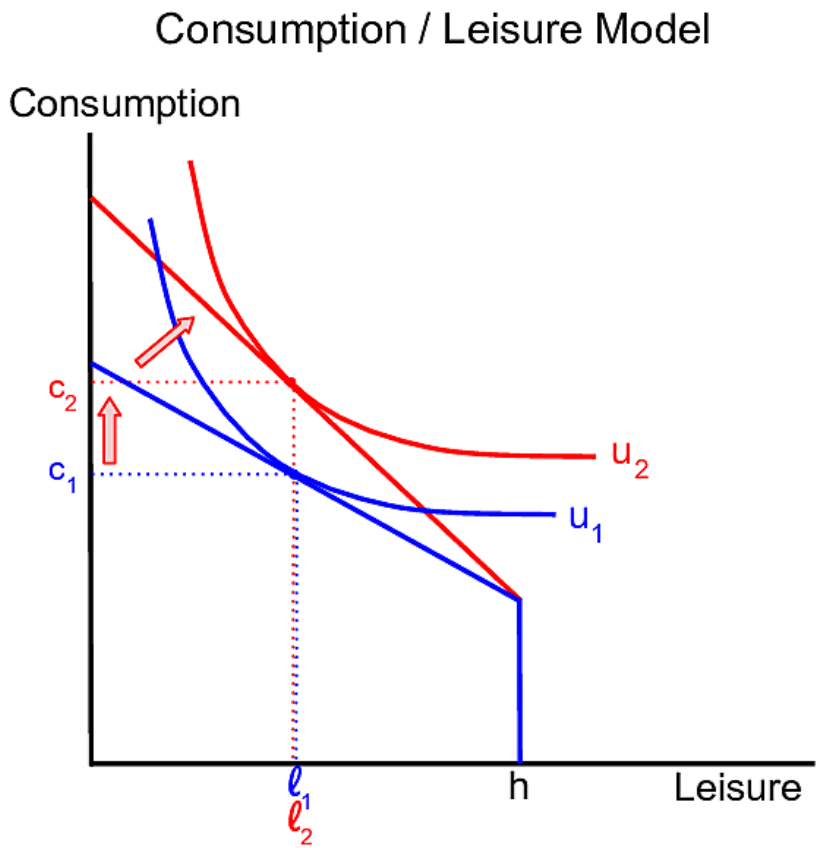

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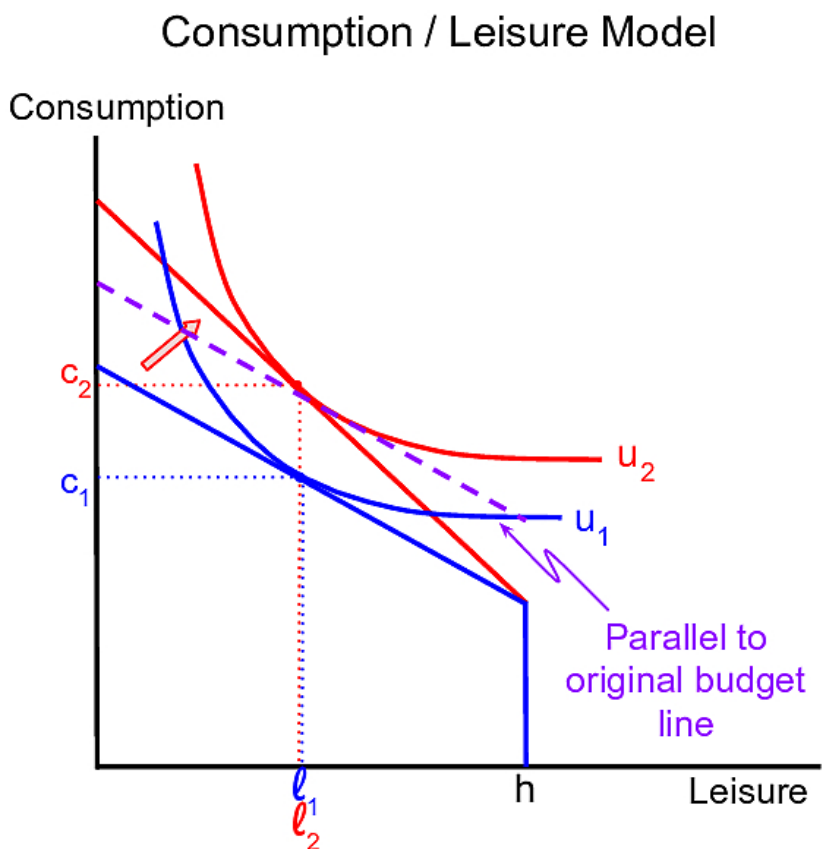

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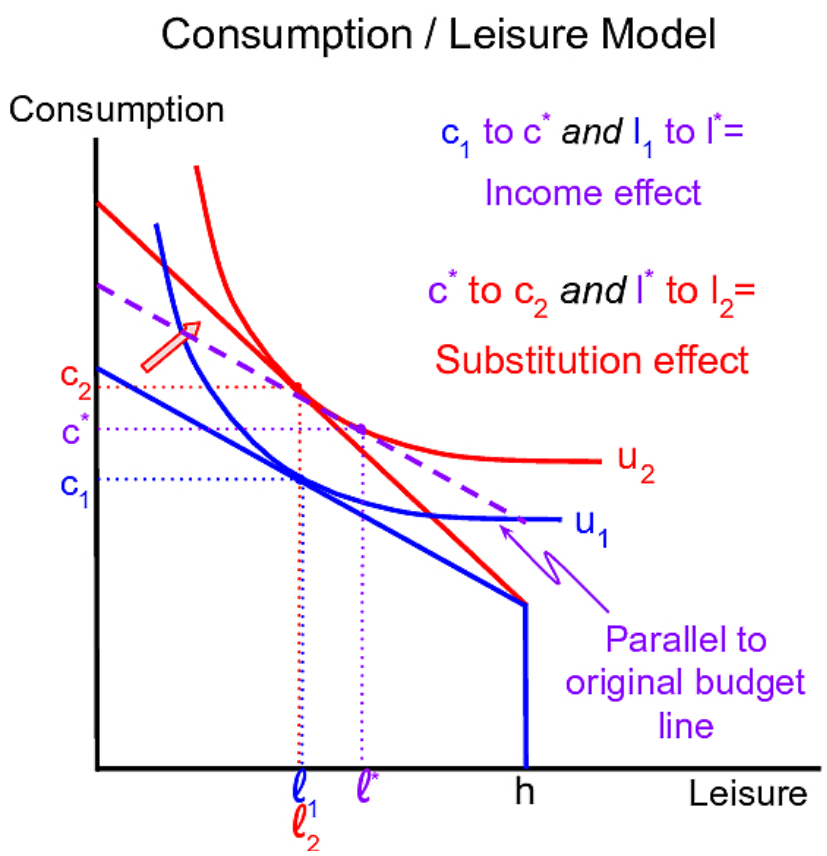

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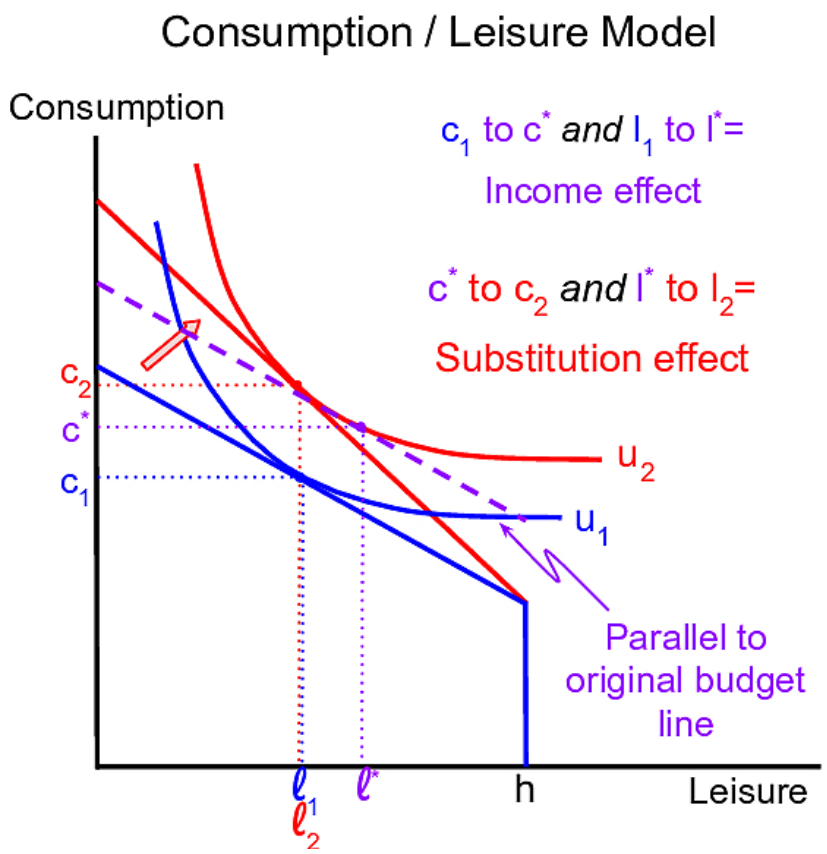

Production Functions

- First produce a single output good, y
- Corresponds with real GDP in aggregate expenditure equation
- Firms produce y using labor (n) and capital (k)

Production Function:

$$y = zf(k, n)$$

- $f(.)$ some mathematical function that describes how capital and labor influence total production
- z: Total factor productivity, i.e. technological and practical possibilities
- Improvements in technology $\rightarrow$ increase in z
- Global production disruptions $\rightarrow$ decrease in z

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Marginal Products

- **Marginal Product of Labor:** Additional output that can be produced with one additional unit of labor
- **Marginal Product of Capital:** Additional output that can be produced with one additional unit of capital
- Assume both are always positive

Law of Diminishing Returns

- **Diminishing Marginal Product of Labor:** As producer (or whole economy) increases employment, while capital stock and all else remains the same, marginal product of labor decreases
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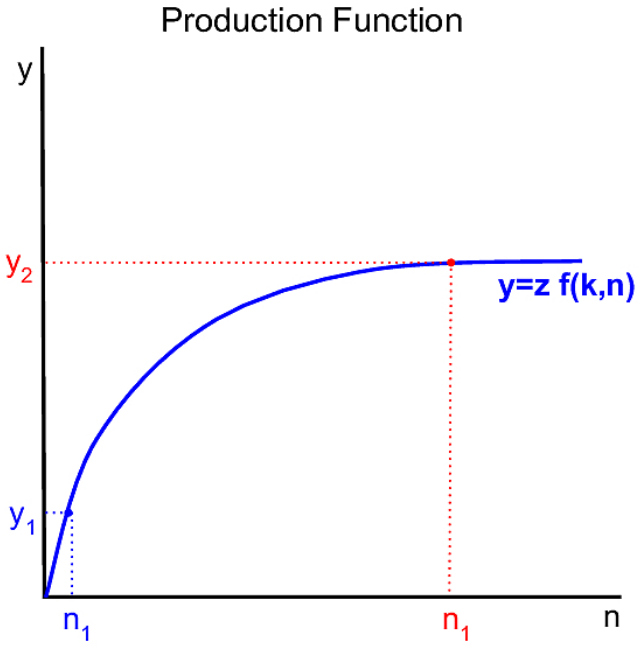
Production Function w/r to Labor

- Curve showing how different levels of employment lead to different production levels
- Upward sloping, because marginal product of labor is always positive
- Slope is the marginal product of labor



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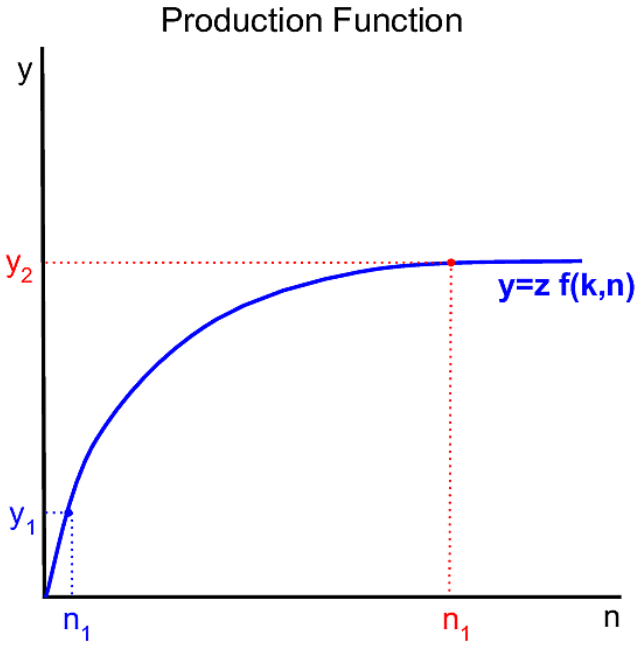

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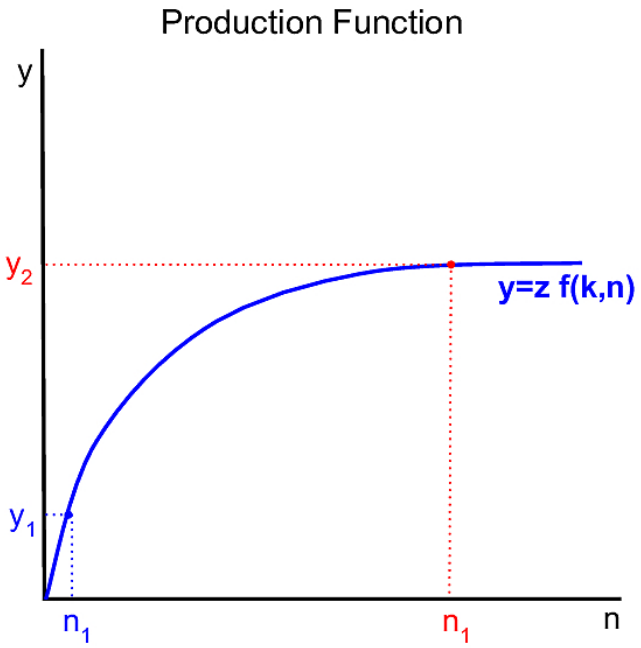

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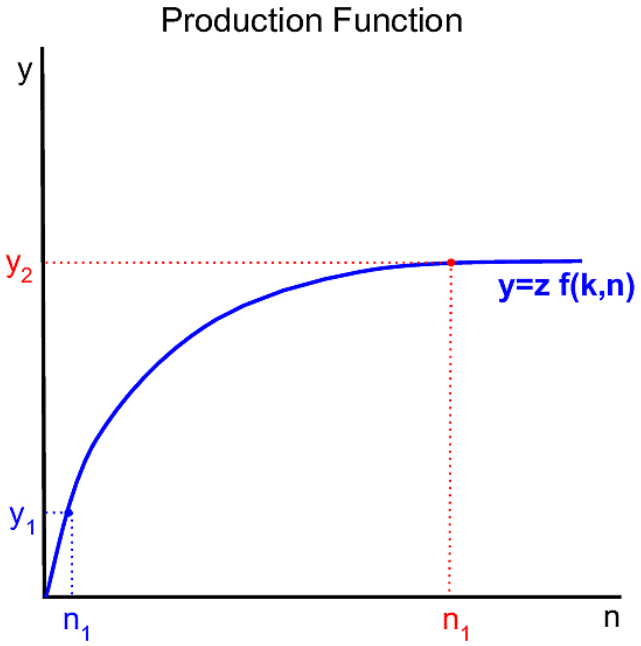

Slope of the Production Function

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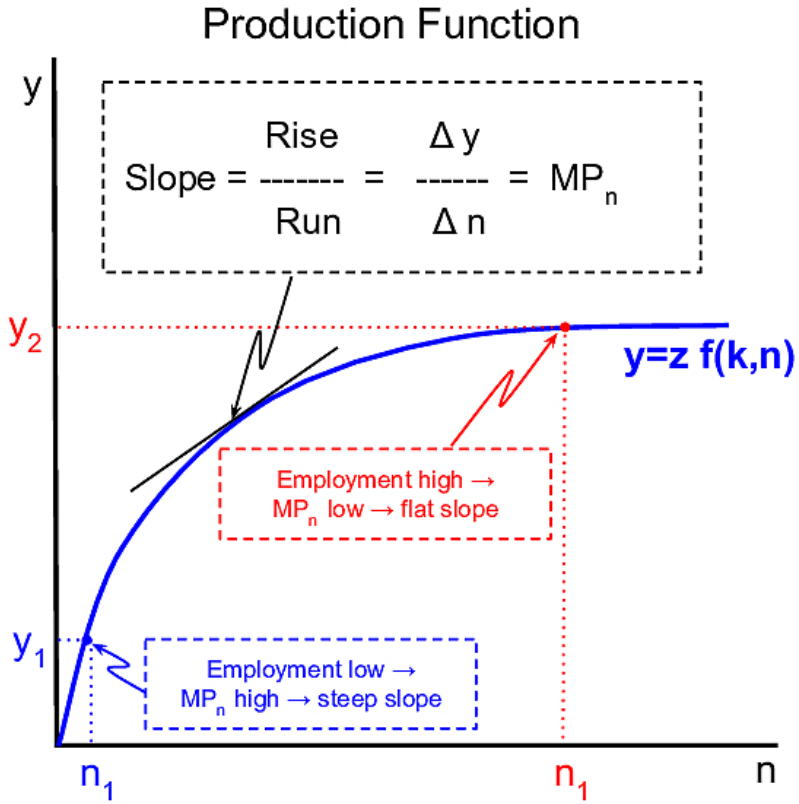
- Diminishing returns gives it its concave shape



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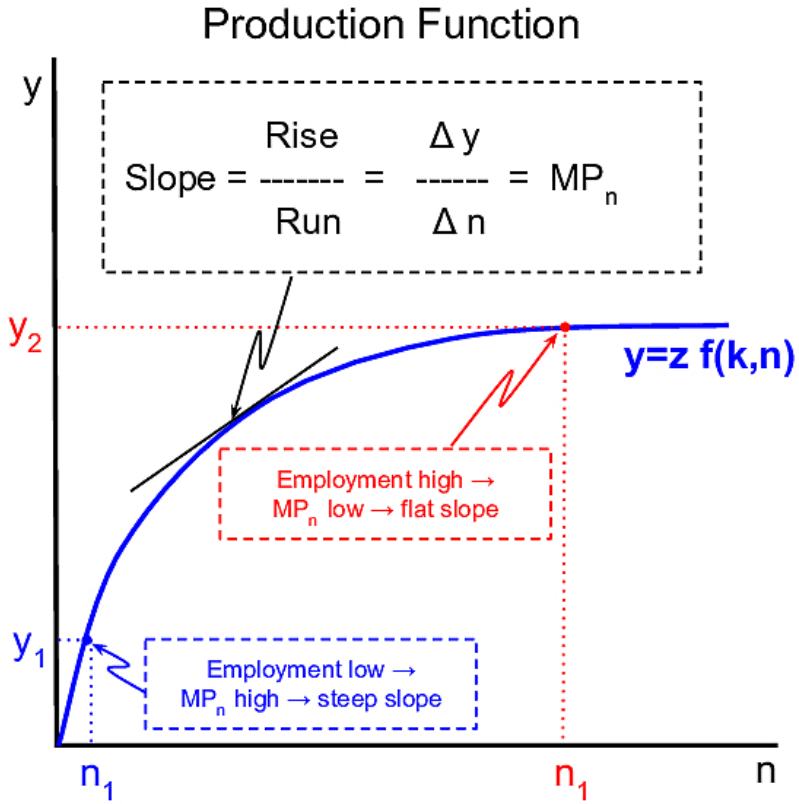

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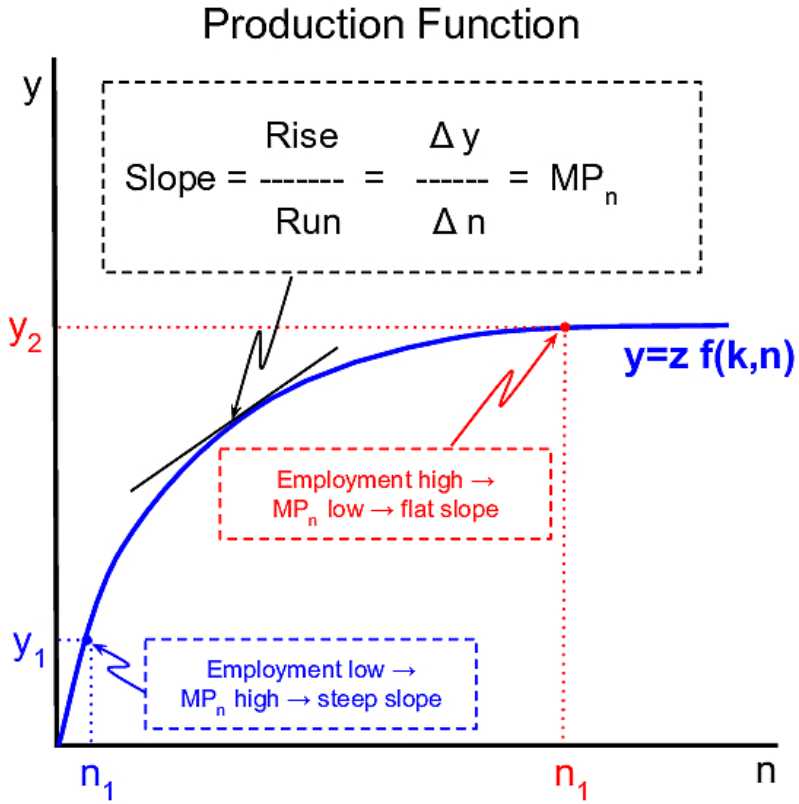

Profit Maximization

Big Assumptions

- Perfectly competitive firms in the labor market, take wage as given
- Single point in time, capital pre-determined

Maximize Profits

- Objective: Choose employment, n, to maximize profits
- Total Revenue $= P\ y$
- Total Cost $= W\ n$
- Total Profit: $\Pi = P\ y - W\ n$
- Real profit: $\pi = y - wn$

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Graphical Profit Maximization

Total Revenue and Total Costs

- Real revenue is equal to y, i.e. production function
  - What is the slope of the production function?
- Real total cost is equal to upward sloping line, $w\ n$
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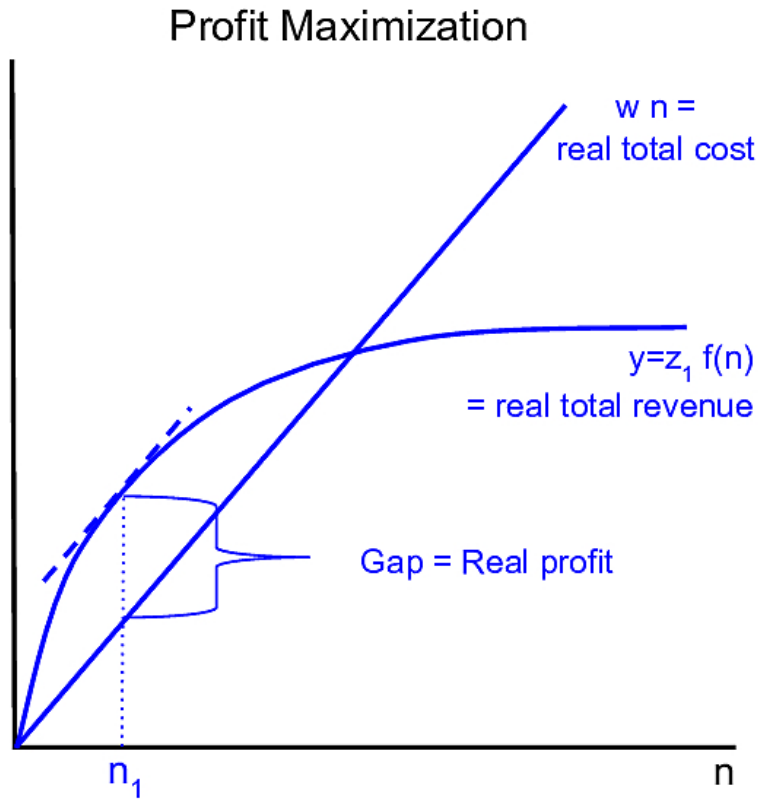

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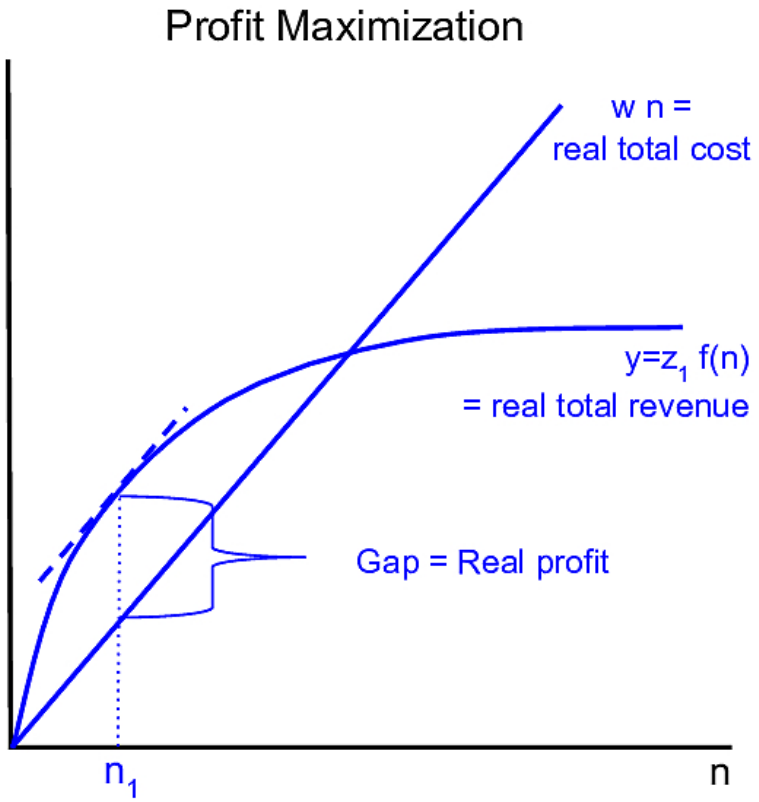

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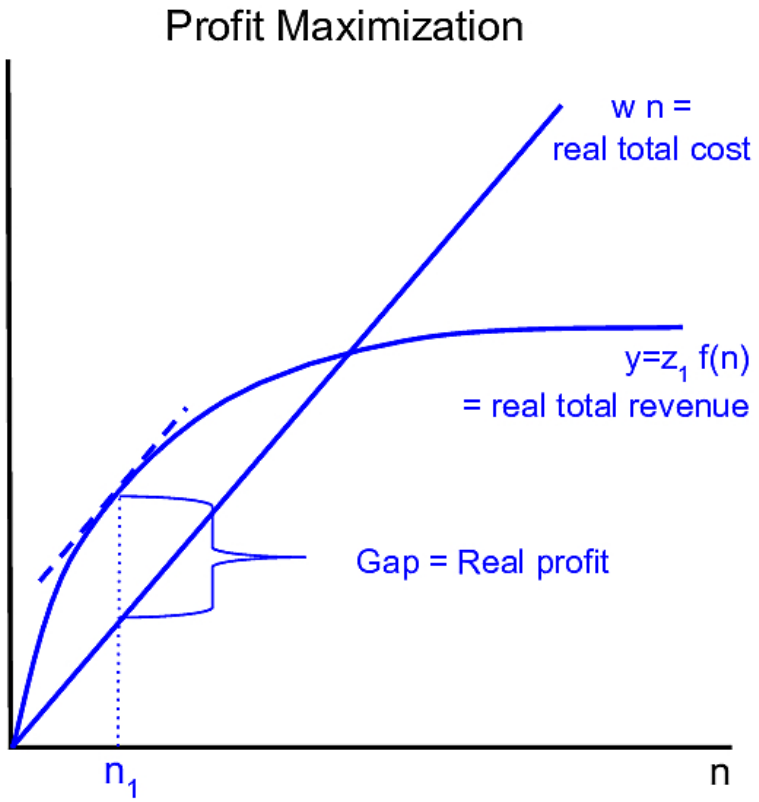

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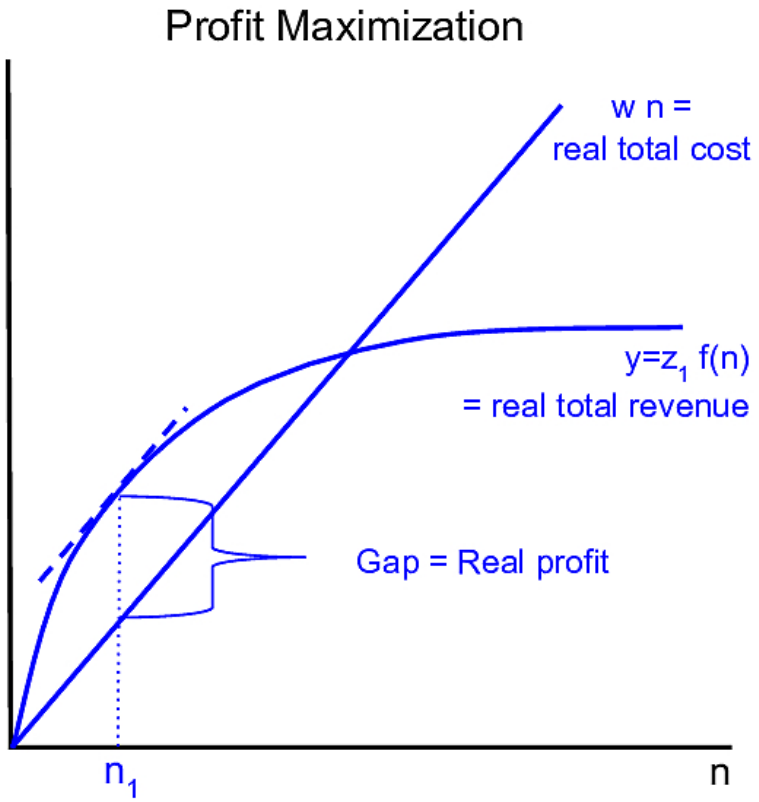

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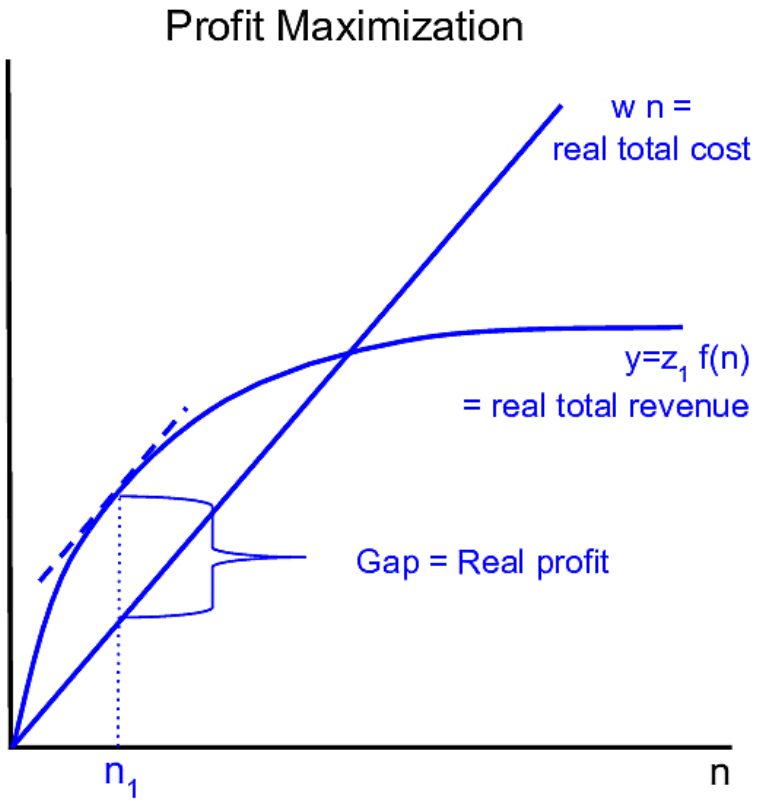

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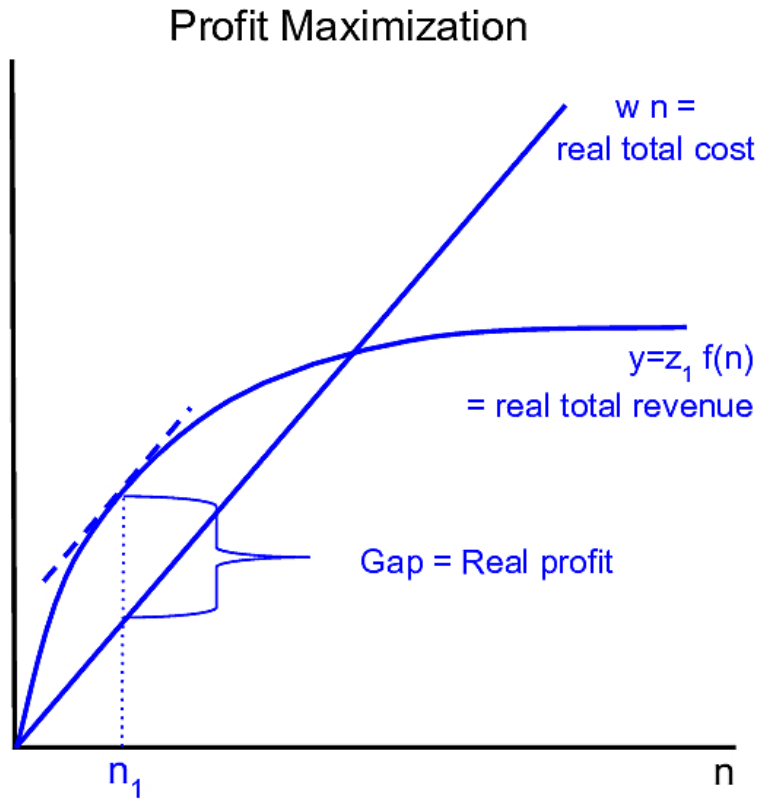
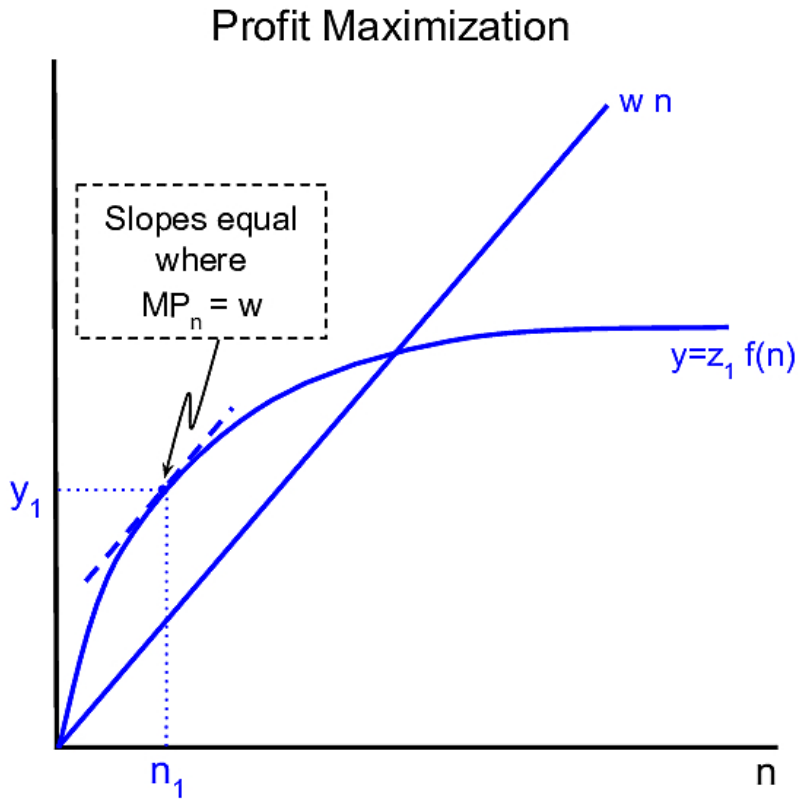


Profit Maximization Choice

Profit Maximizing Decision

- Choice of n is labor demand
- Choice of y is real GDP



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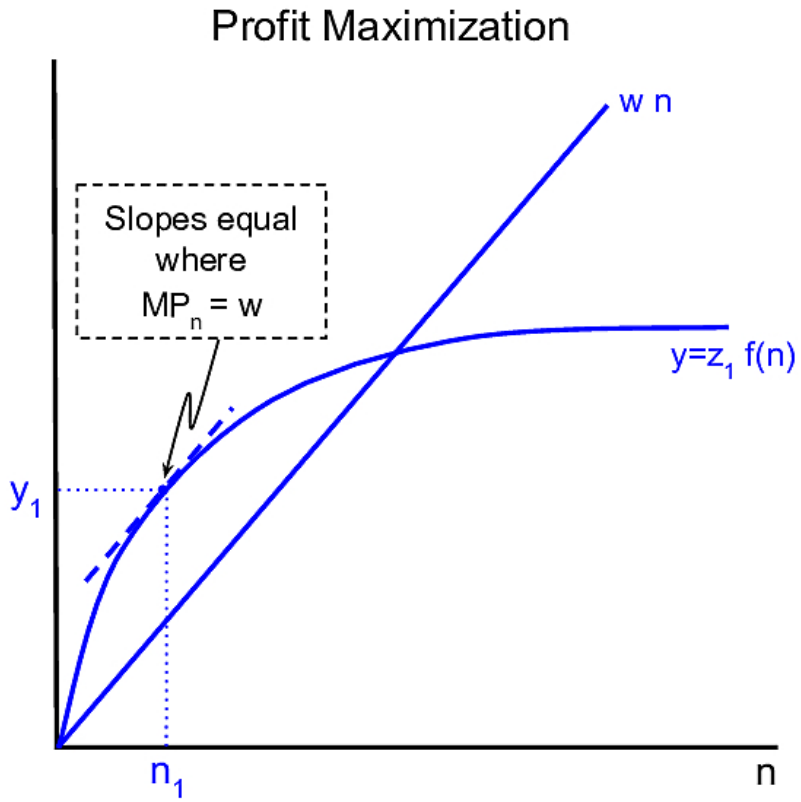

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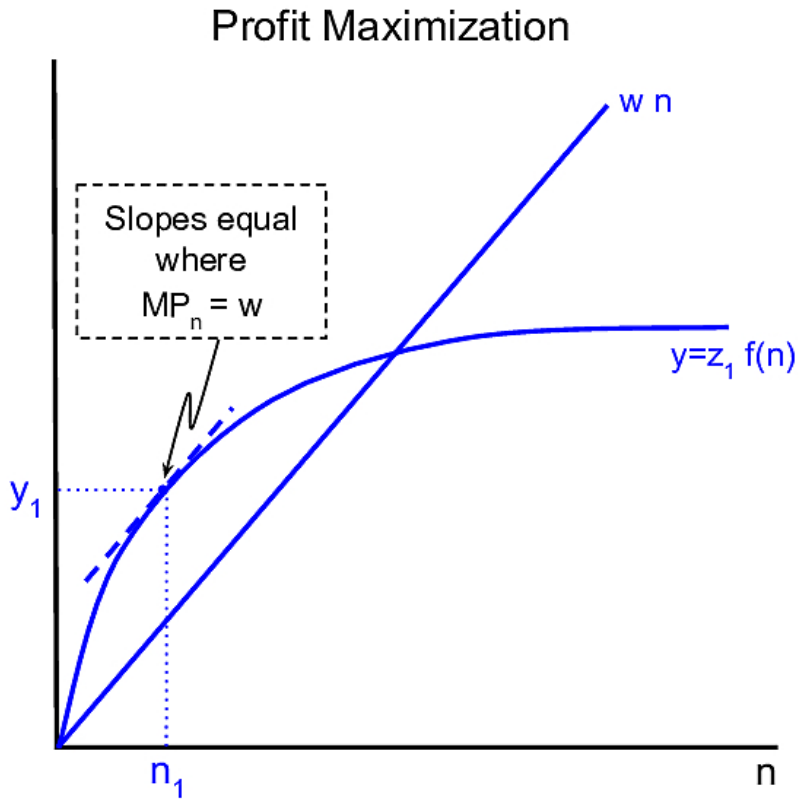

Profit Maximization: Increase in Wages

Increase in Wages

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- Find new place where slopes are equal
- Labor demand (choice of n) decreases
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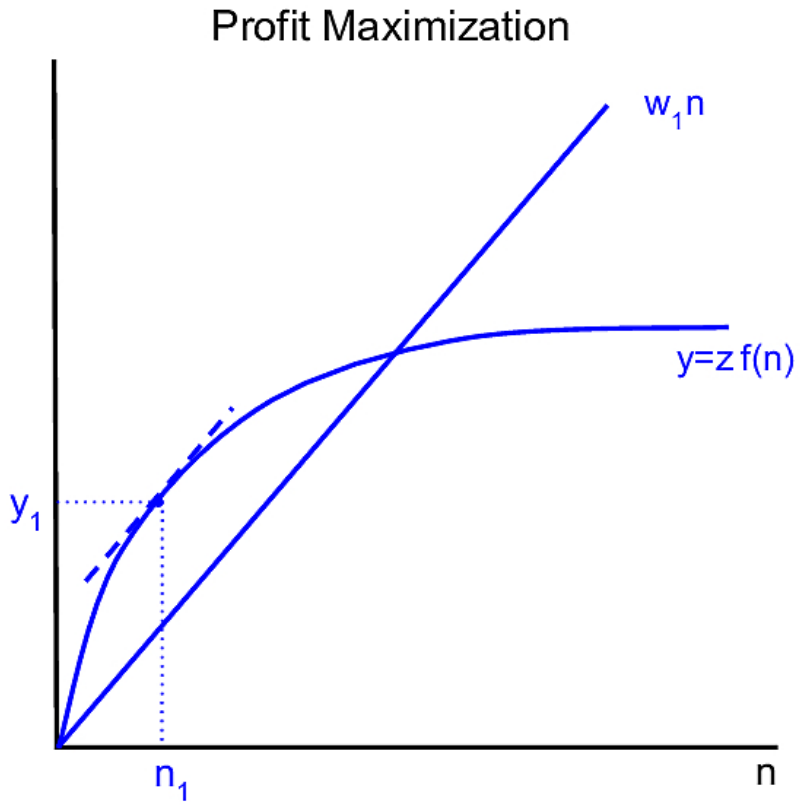

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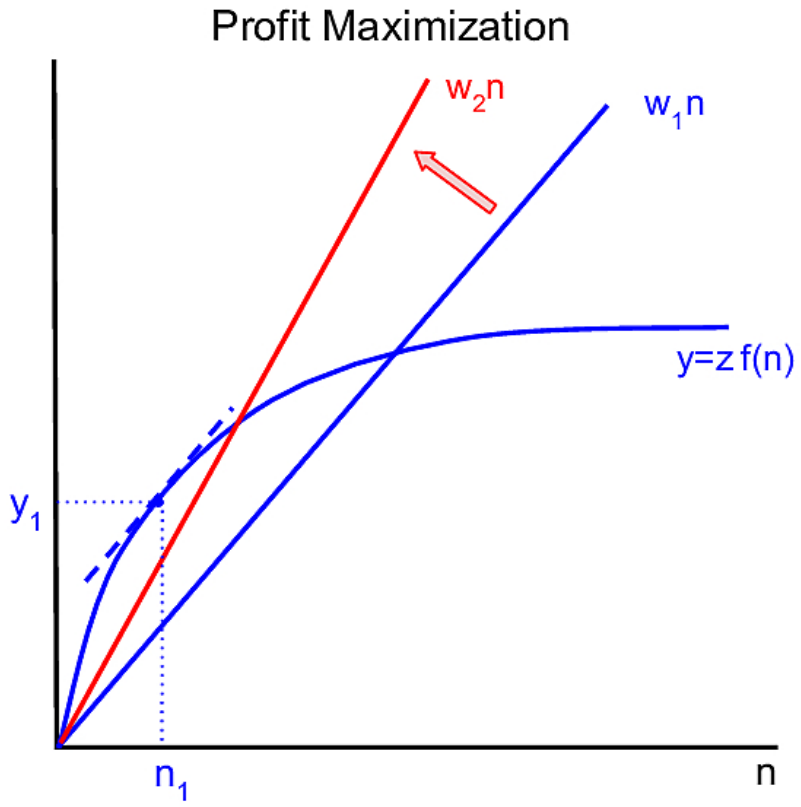

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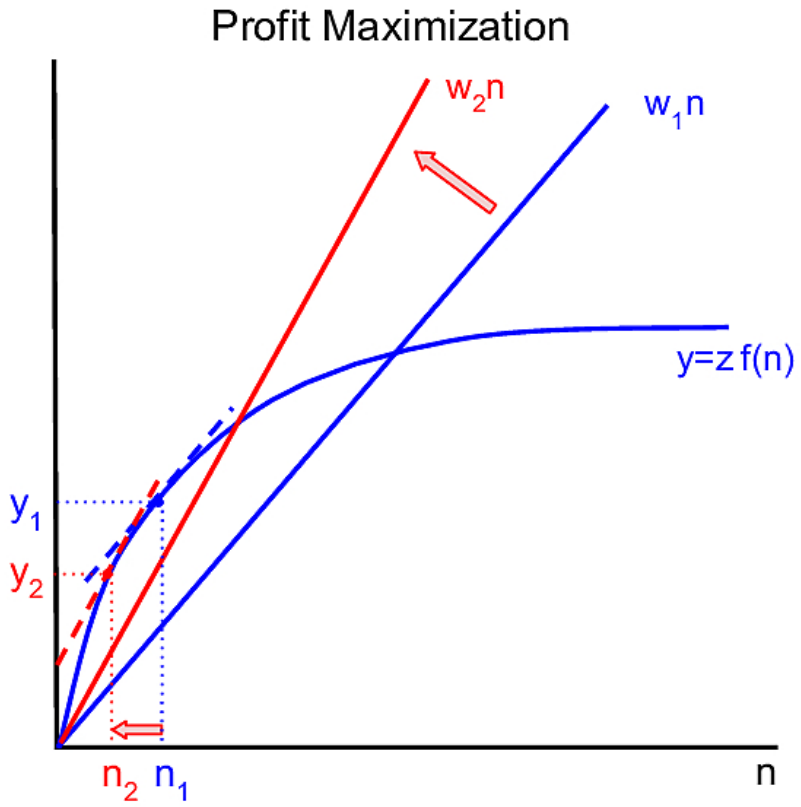

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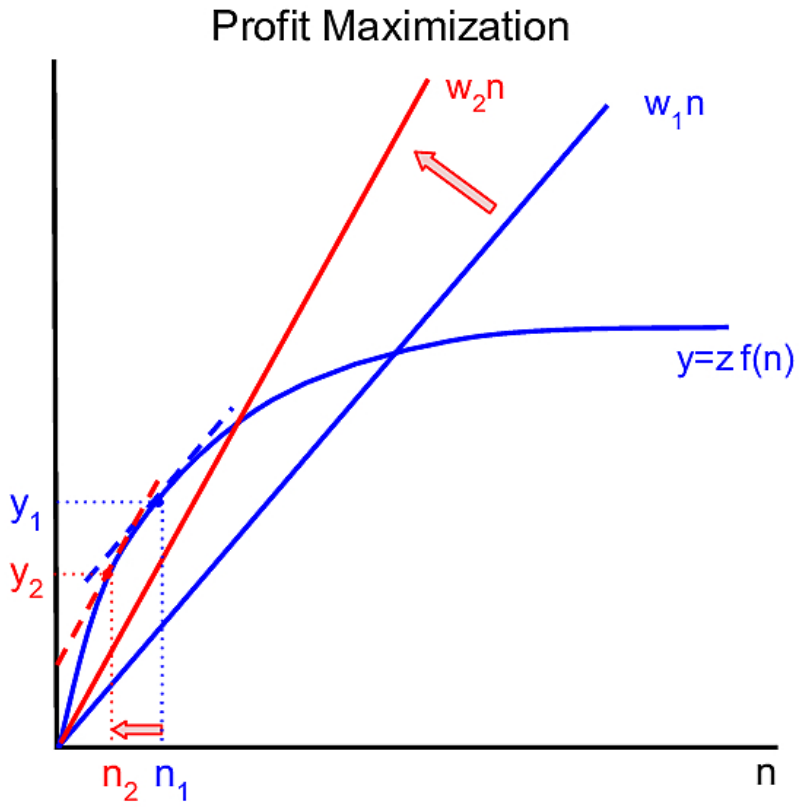

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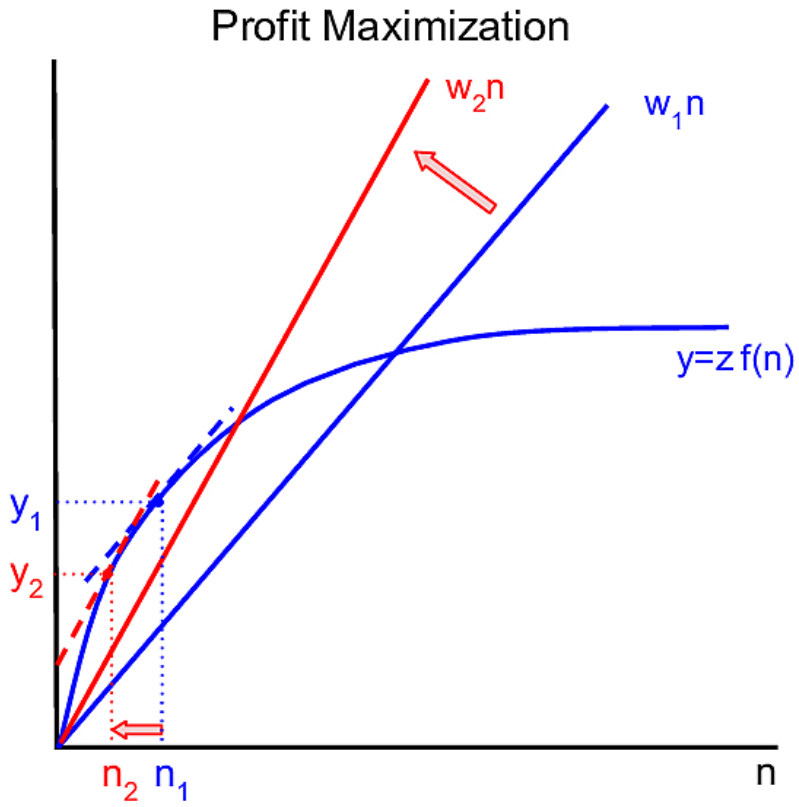

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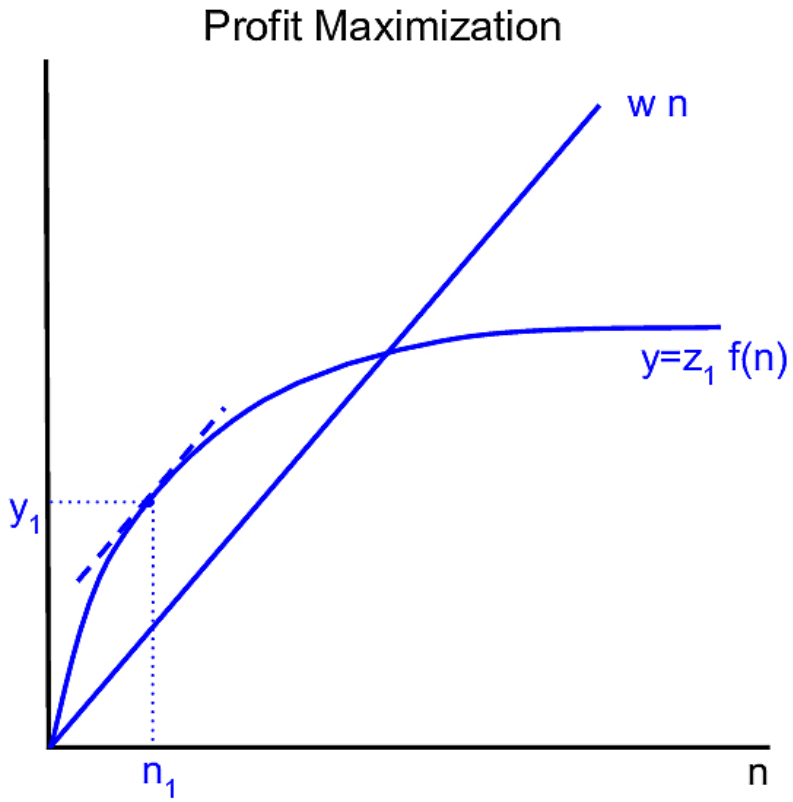

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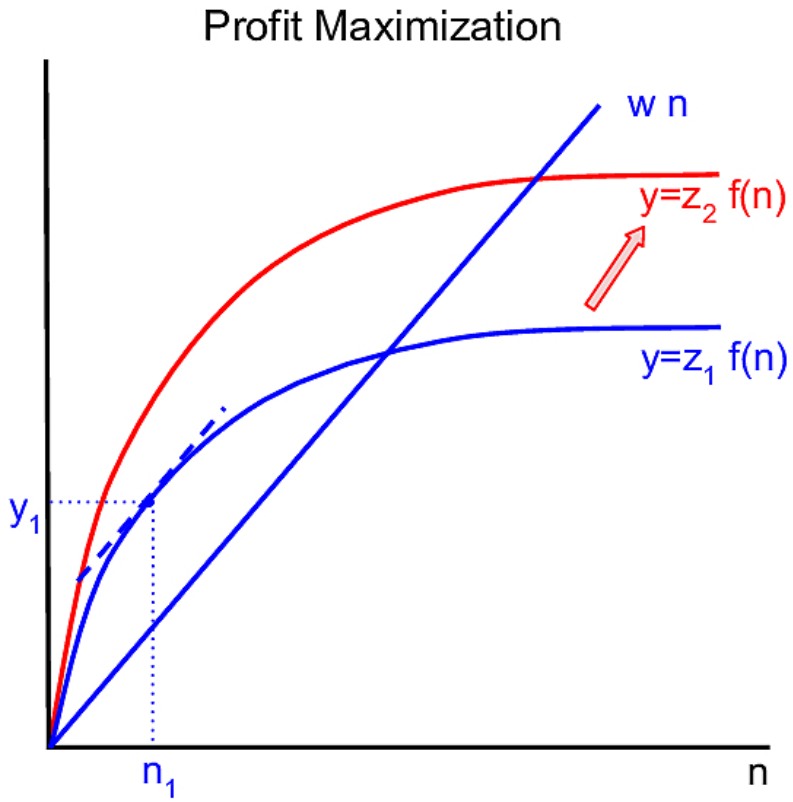

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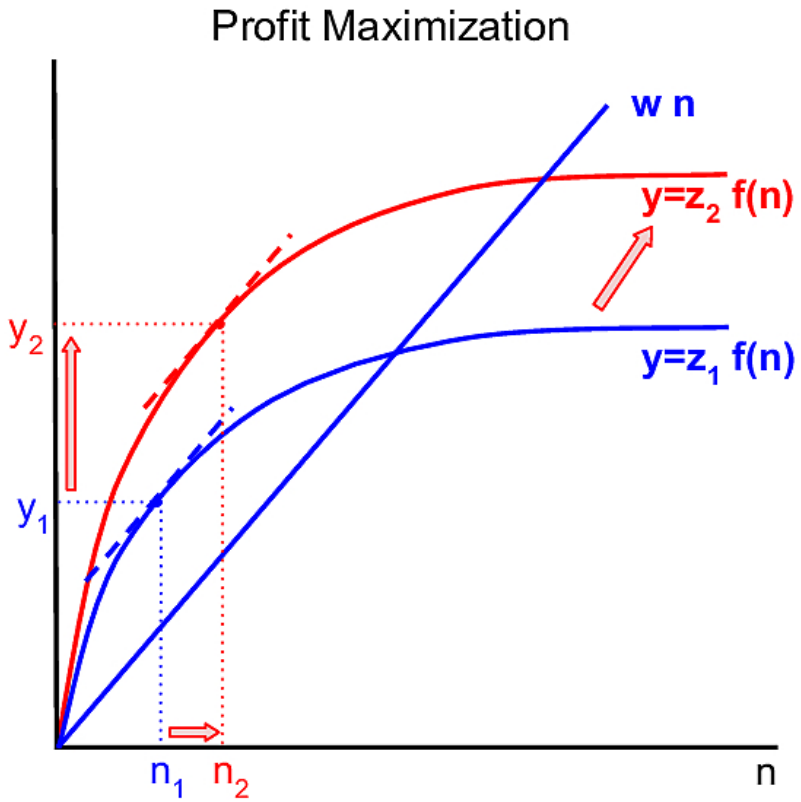

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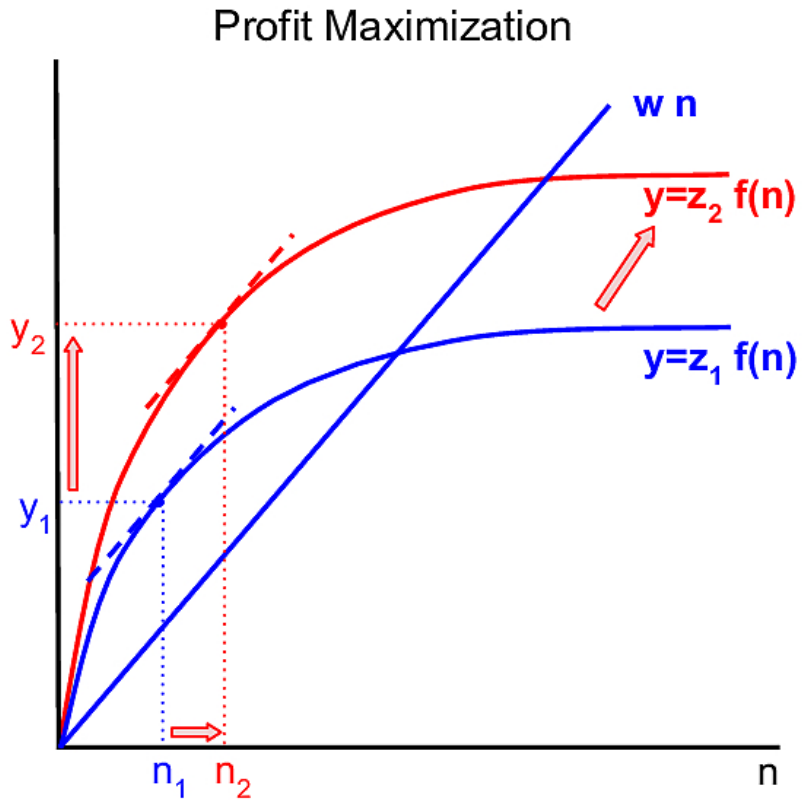

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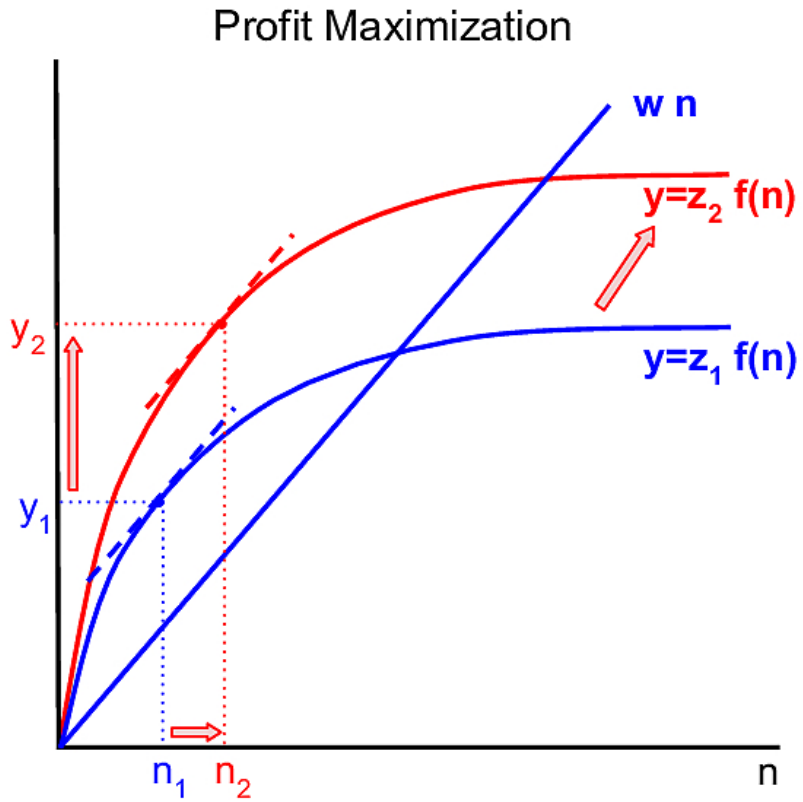

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