MICRO-ECONOMICS: DEMAND, SUPPLY, EQUIMARGINALISM, SHADOW VALUE

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ITALIAN AGENCY
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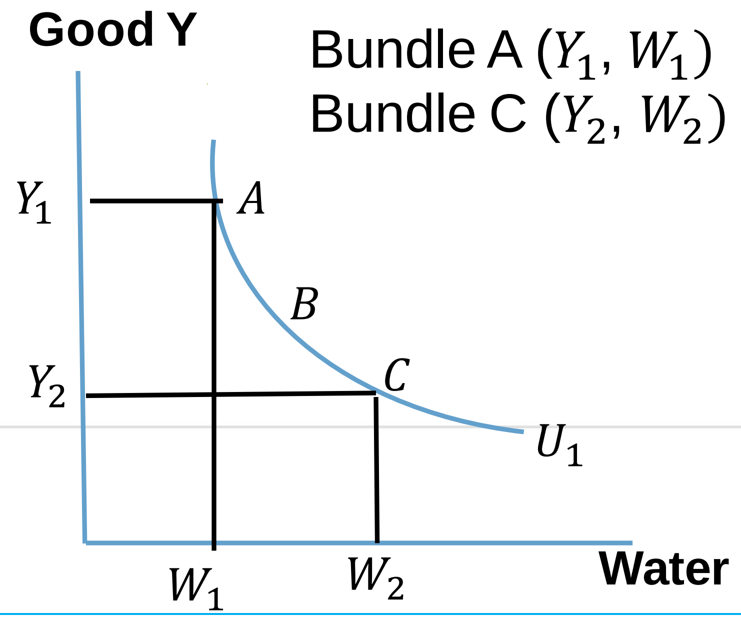
COOPERATION

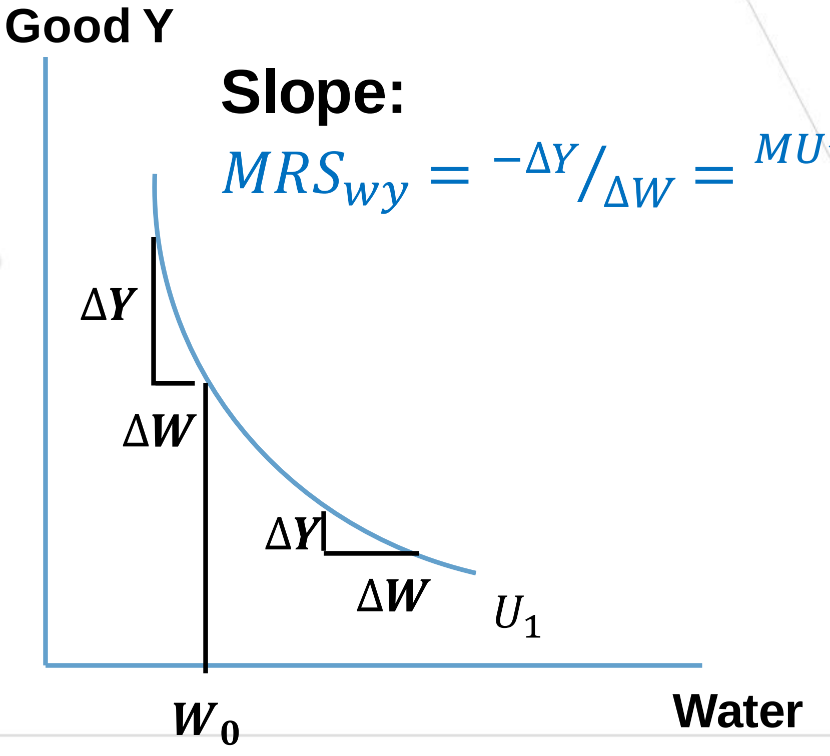
PREFERENCES, BUDGET CONSTRAINT, AND UTILITY MAXIMIZATION

- Consider a consumer that relies on two goods: **water** and a composite **good Y**
- The consumer derives utility (satisfaction) form the consumption of the two goods
- The preference of the consumer between the two goods is indicated in an indifference curve



- **Indifference curve:** shows the various combinations of **good Y** and **water** that provide the consumer the same level of utility (satisfaction).
- The consumer is indifferent between the bundles of good Y and water represented by point A, B, and C on U_1
- All bundles on the indifference curve yield the same level of utility to the consumer

CONSUMER PREFERENCE



Slope:

$$MRS_{wy} = {}^{-\Delta Y}/_{\Delta W} = {}^{MU_W}/_{MU_Y}$$

Total vs marginal utility

- **Total utility**: total satisfaction received from consuming a good
- **Marginal utility:** the extra utility received from consuming one additional unit of a good.

- The slope of the indifference curve - Marginal rate of substitution (MRS) between water and good Y
- The slope measures the amount of good Y the consumer is willing to give up to get an additional unit of water.
- The slope of the curve declines – the consumer is willing to give up less and less of good Y to get more water.

BUDGET CONSTRAINT

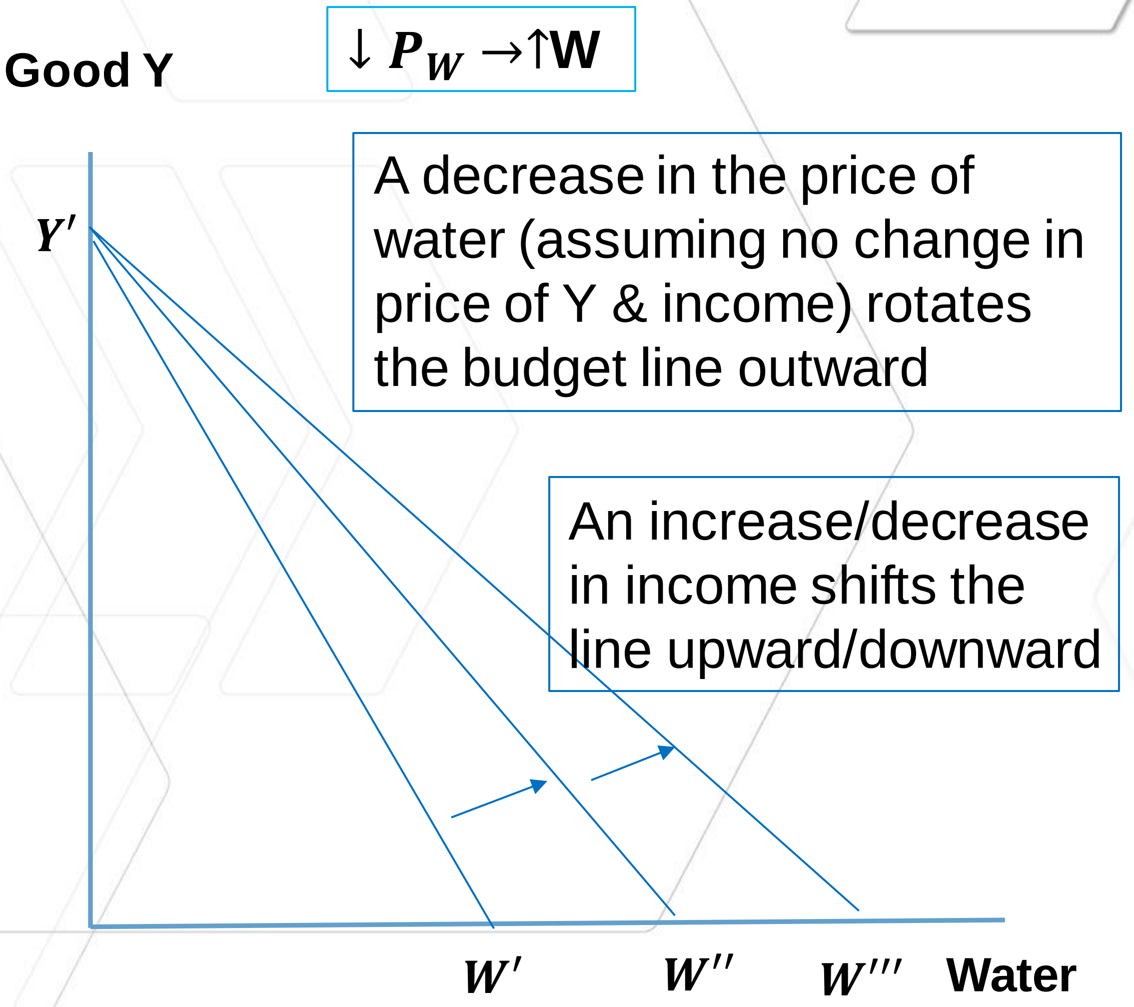
- The consumer cannot consume whatever combination of good Y and water she wants.
  - She is constrained by her budget
- Consumers' incomes are limited and goods have prices
- Budget constraint: $P_Y Y + P_W W = I$

  Where P_Y = Price of Y; Y = Quantity of Y;

  P_W = Price of water; and

  W = Quantity of water.
- Rearranging: $Y = I - \frac{P_W}{P_Y} W$

→Slope of the budget constraint : $-\frac{P_W}{P_Y}$



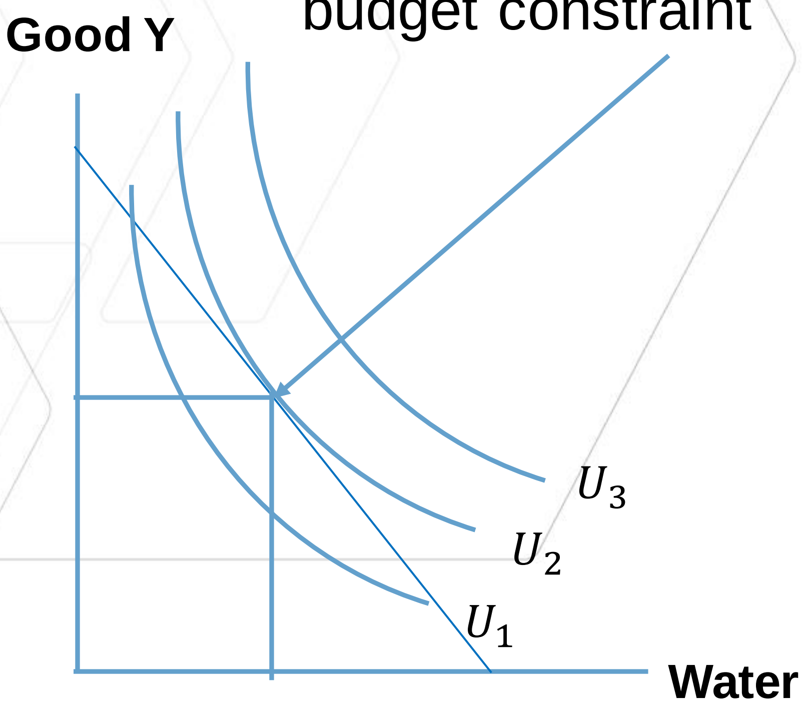
UTILITY MAXIMIZATION

- The consumer chooses the bundle that maximizes her utility given her budget constraint
- Profit maximization: slope of indifference curve equals slope of budget line.

$$MRS_{wy} = \frac{P_W}{P_Y} \rightarrow \frac{MU_W}{MU_Y} = \frac{P_W}{P_Y}$$

- **Equi- marginalism** in choosing consumption
  - Utility is maximized where $\frac{MU_W}{P_W} = \frac{MU_Y}{P_Y}$
  - The consumer equalize the Marginal Utility Per Dollar Spent

Most preferred affordable bundle combines the highest achievable indifference curve and the budget constraint



THE DEMAND FOR WATER

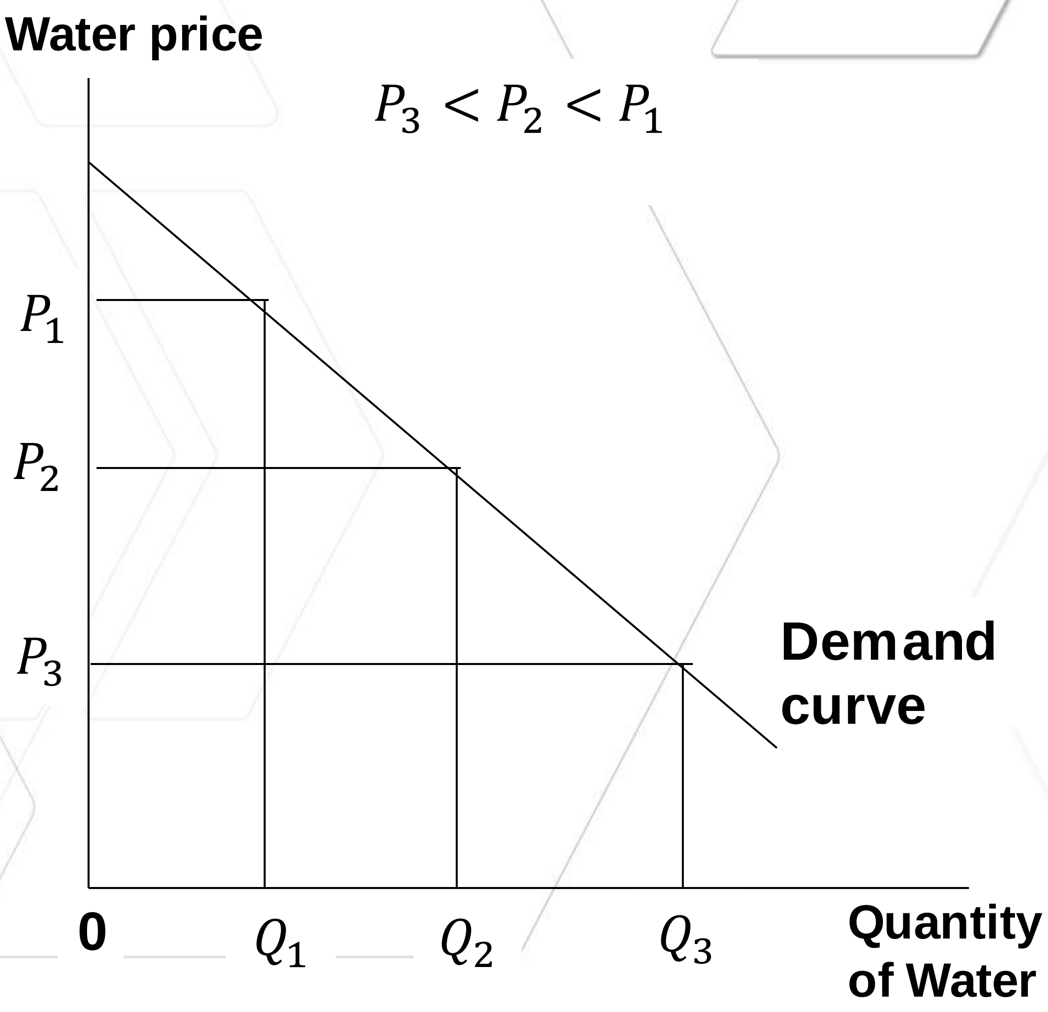
- The demand for water depends on several factors:
  - The price of water, Income, Prices of other goods (substitutes and complements, taste or preference for garden, weather, etc.
- Demand curve relates prices and quantity demanded, assuming all other factors remain unchanged
- Demand curve slopes downward - Consumers buy less water as water price rises and vice versa
- **Law of demand**: inverse relationship between price and quantity demand
  - Explained by Income effect and Substitution effect
- A change in the price of a good changes
  - Relative price of the good (the substitution effect) and
  - Overall purchasing power of the consumer (the income effect)

MARGINAL AND TOTAL BENEFIT

- The height of the demand curve measures the price (P) or the marginal willingness to pay (MWTP) consumers are willing to pay for the last unit of water
  - P_1 is the price or MWTP of Q_1 units of water
- MWTP measures marginal benefit (MB).

  i.e., MWTP = MB = P
- The area under the demand curve from the origin to the amount of water purchased measures consumers' Total willingness to pay (TWTP) .
  - E.g., Area under the demand curve between 0 and Q_1 is the TWTP of purchasing Q_1 units of water
- TWTP measures total benefits (TB),

  i.e., TWTP = TB

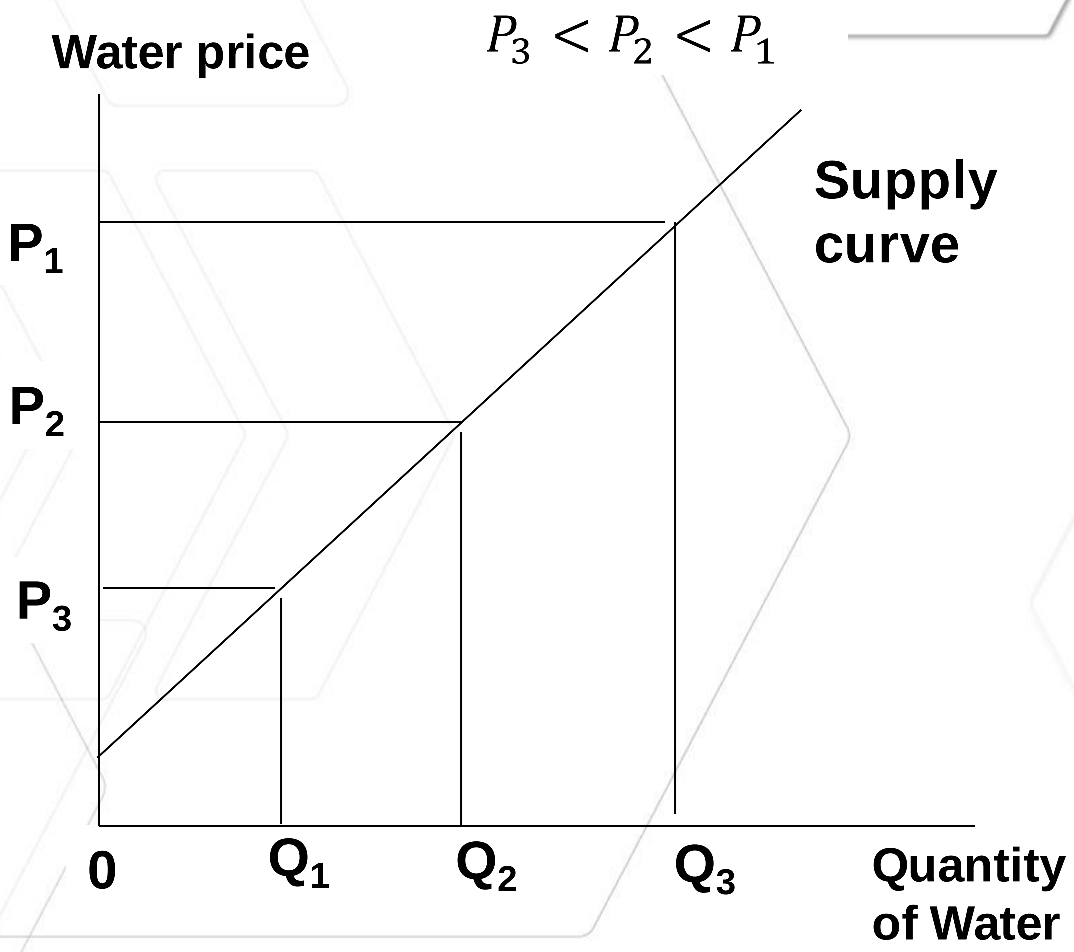


WATER SUPPLY

- Water suppliers could be water utilities or private firms
- Customers include household, irrigators commercial establishments or public facilities
- Water supply involves processing and delivering and requires the use of inputs (labor, capital, etc.)
- Water supply depends on the price of water, price of input (labor, capital), prices of alternative products, technology etc.
- supply curve relates prices and quantity supplied, assuming all other factors remain unchanged
- Supply curves measure the amount of a particular good producers would be willing to supply at various prices.
- **Law of supply**: Direct relationship between price and quantity supplied

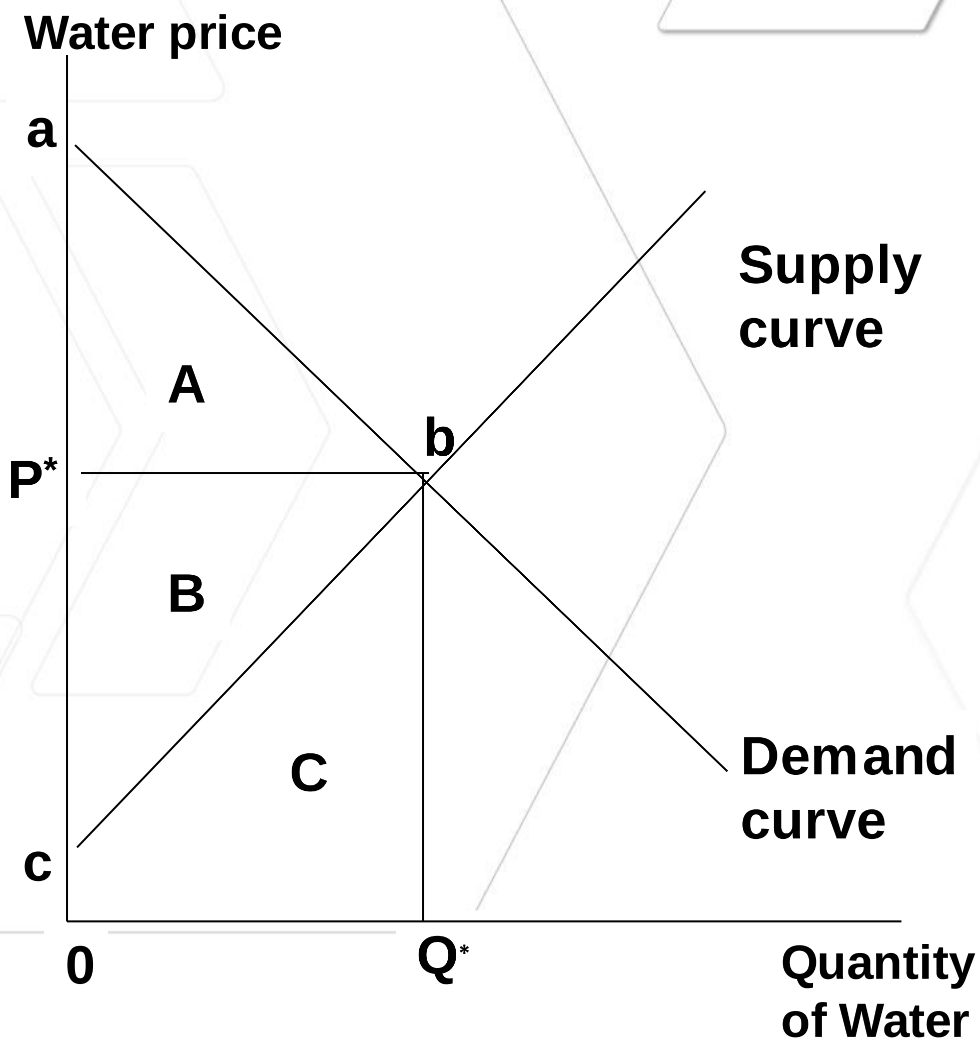
MARGINAL AND TOTAL COST

- The height of the supply curve measures the price (P) or marginal cost (MC) suppliers charge for the last unit of water. i.e., P = MC
- The MC of suppling $\mathbf{Q_1}^{th}$ unit of water is the price of $\mathbf{Q_1}$ units of water, $\mathbf{P_3}$
- The area under the supply curve from the origin to the quantity supplied measures total cost (TC)
  - E.g., The TC of producing $\mathbf{Q_2}$ units of the water is the area under the supply curve between zero and Q_2 units



PULLING WATER DEMAND AND SUPPLY TOGETHER

- Assuming competitive market: consumers and suppliers of water face the same market price
- Efficiency in water allocation is obtained at the point of equilibrium (point b in the figure).
- At equilibrium: price $=P^*$ and quantity $= Q^*$
- Consumers Total willingness to pay (TB=TWTP): Area A+B+C
- Total cost (TC): Area C
- Net benefit (NB) = TB – TC = Area A+B
- Consumer Surplus = (A + B + C) - (B + C) = Area A
- Producer Surplus = (B + C) - (C) = Area B



SHADOW VALUE OF WATER

- What is the value of water in production?
- Consider a farmer that produces a crop using three inputs: labor (L), water (W) and capital (K)
  - Output depends on in input ue: $Q = Q(L, W, K)$
  - Inputs are available in limited supply: $L = L^0$, $W = W^0$ and $K = K^0$
- The farmer wants to maximize output subject to the available inputs
  - Max $Q(L, W, K)$ subject to $L = L^0$, $W = W^0$ and $K = K^0$
- The Lagrange function

$$L = Q(L, W, K) + \gamma[L^0 - L] + \lambda[W^0 - W] + \delta[K^0 - K]$$

SHADOW VALUE OF WATER

- To maximize profit, we look at the First order conditions (FOCs):
  - $\frac{\partial L}{\partial L} = \frac{\partial Q}{\partial L} - \gamma = 0 \quad \rightarrow \frac{\partial Q}{\partial L} = \gamma \rightarrow MP_L = \gamma$
  - $\frac{\partial \pi}{\partial W} = \frac{\partial Q}{\partial W} - \lambda = 0 \rightarrow \frac{\partial Q}{\partial W} = \lambda \rightarrow MP_W = \lambda$
  - $\frac{\partial \pi}{\partial K} = \frac{\partial Q}{\partial K} - \delta = 0 \quad \rightarrow \frac{\partial Q}{\partial K} = \delta \rightarrow MP_K = \delta$
- The FOCs show that the marginal products of the resources are equal to their respective Lagrange multiplier
- For water, we have $MP_W = \lambda$, and λ is the shadow value of water
- **Shadow value** of water measures the value to production of having one more unit water
- The shadow value, i.e. the value of having the water constraint relaxed is equal to the marginal product of water.

Thank you