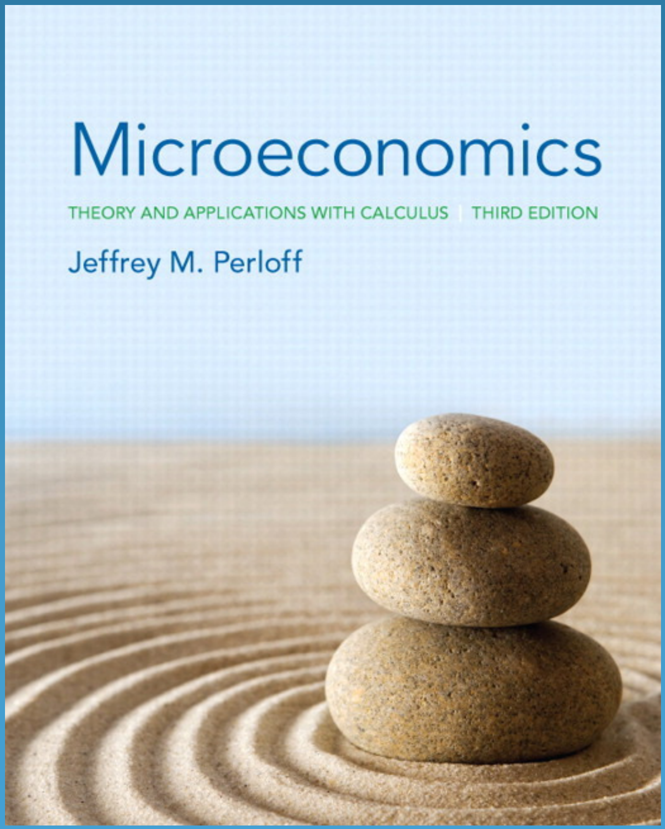
ECO2144C
MICROECONOMIC THEORY I
Consumer Welfare & Policy Analysis (Ch. 5)
Professor Lenjosek



Chapter Focus: Consumer Welfare & Policy Analysis

- Willingness to pay and consumers surplus
- Compensating variation (CV) and equivalent variation (EV)
  - In commodity space
  - In price-commodity space
  - Calculated using expenditure functions
- Comparing CV, EV and ΔCS
  - Reference to the Slutsky equation
- Effects of government policies
  - Quotas
  - Food stamps
  - Child care price subsidy versus lump-sum subsidy
- Labour supply
  - Labour-leisure choice
  - Income and substitution effects
  - Shape of the labour supply curve
  - Income taxes

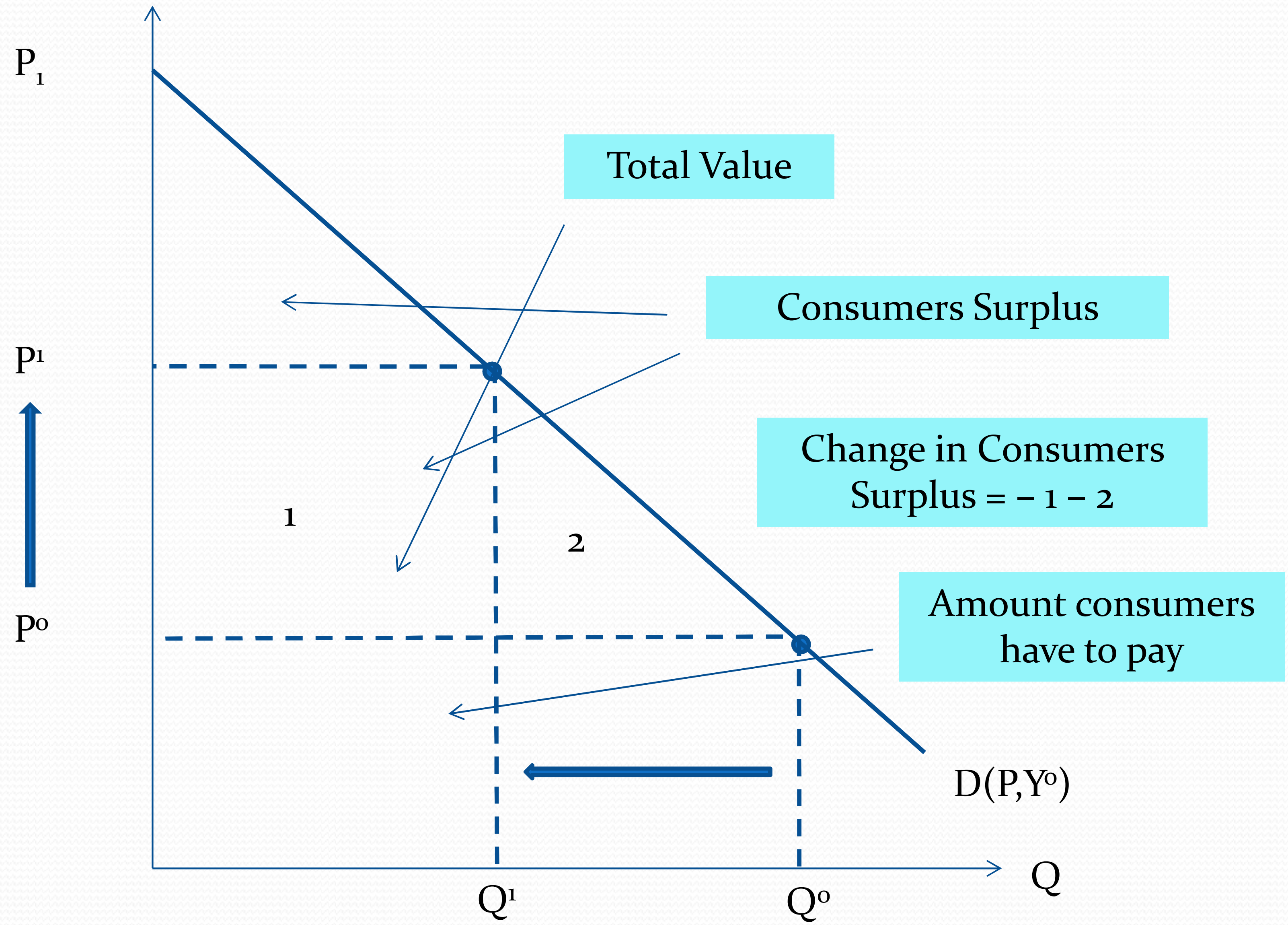
Measures of Consumer Welfare

- How much benefit do consumers derive from an equilibrium?
- How much are consumers helped or harmed when shocks affect equilibrium?
- We cannot use utility to answer these questions
  - Rarely known
  - Ordinal (can't measure gaps between indifference curves)
  - Can't compare/ combine the utilities of different individuals
- But we can use money ($) to address these questions
  - We do so in three ways
    - Using consumers surplus
    - Using compensating variation
    - Using equivalent variation

Consumers Surplus (CS)

- The ***height of a demand curve*** equals the ***MRS*** since, in equilibrium, $MRS = p_1/p_2$
  - The *MRS* is the maximum amount a consumer would be ***WTP*** for an additional unit of the good (its marginal value to the consumer)
  - The MRS of a good declines, the more of the good one possesses
    - This is why demand curves slope downwards
- Adding up the marginal value of each unit of a good yields the ***total value*** a consumer places on a good
  - The maximum amount the consumer is WTP for a given number of units of the good
  - Total value equals the ***area under the demand curve***
  - Total value increases, as does the equilibrium level of utility (or the subjective value a person places on a good), the more of the good possessed
- ***Consumers surplus*** is the difference between the total value a consumer places on a given number of units of a good and the cost to the consumer of purchasing those units in the market
  - Changes in price result in ***changes in consumer's surplus***

CS: Before and After a Price Increase

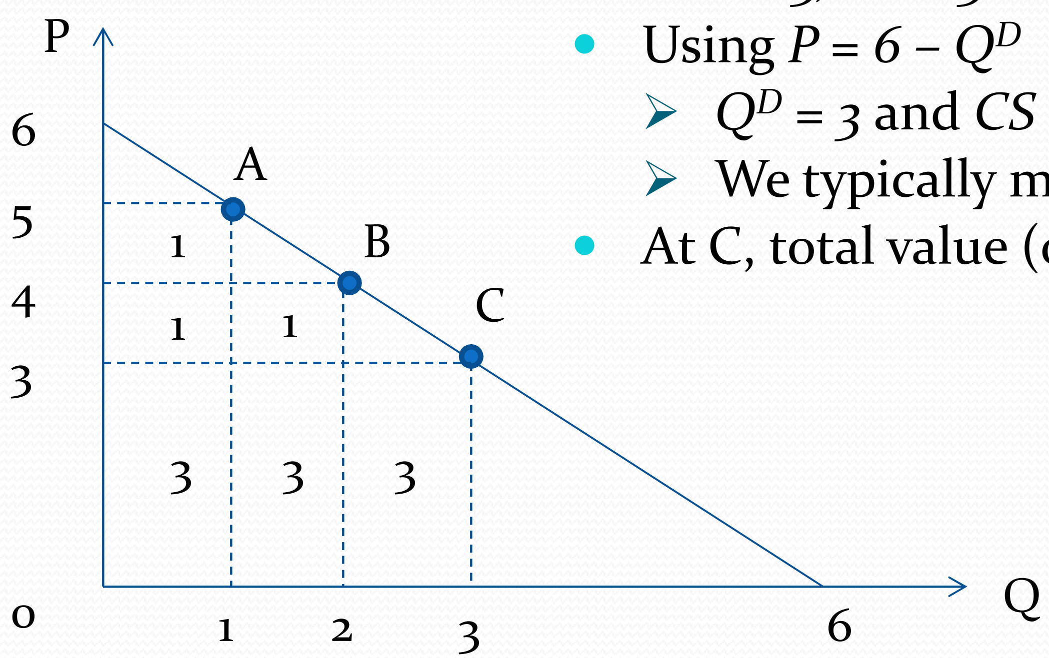


Pros and Cons of Using CS

- Relatively easy to calculate
  - Practical/ convenient
  - Based on the uncompensated demand curve
- Can compare/ combine the $ measures of different individuals
- Market consumers surplus is measured in the same way as individual consumer surplus
- Most widely used measure of consumer welfare
- It yields an approximation to true measures of consumer welfare

Calculating CS: An Example

- Let $Q^D = a - bP$ (*demand curve*)
- Then $P = a/b - Q^D/b$ (*inverse demand curve*)
  - This is what we graph
- We can find the equation of the inverse demand curve used in Fig 5.1
  - When $Q^D = 1$, $P = 5 = (a - 1)/b \Rightarrow a = 5b + 1$
  - When $Q^D = 2$, $P = 4 = (a - 2)/b \Rightarrow a = 4b + 2$
  - Setting $5b + 1 = 4b + 2$ yields $b = 1$. Thus, $a = 6$.
  - $P = 6 - Q^D$

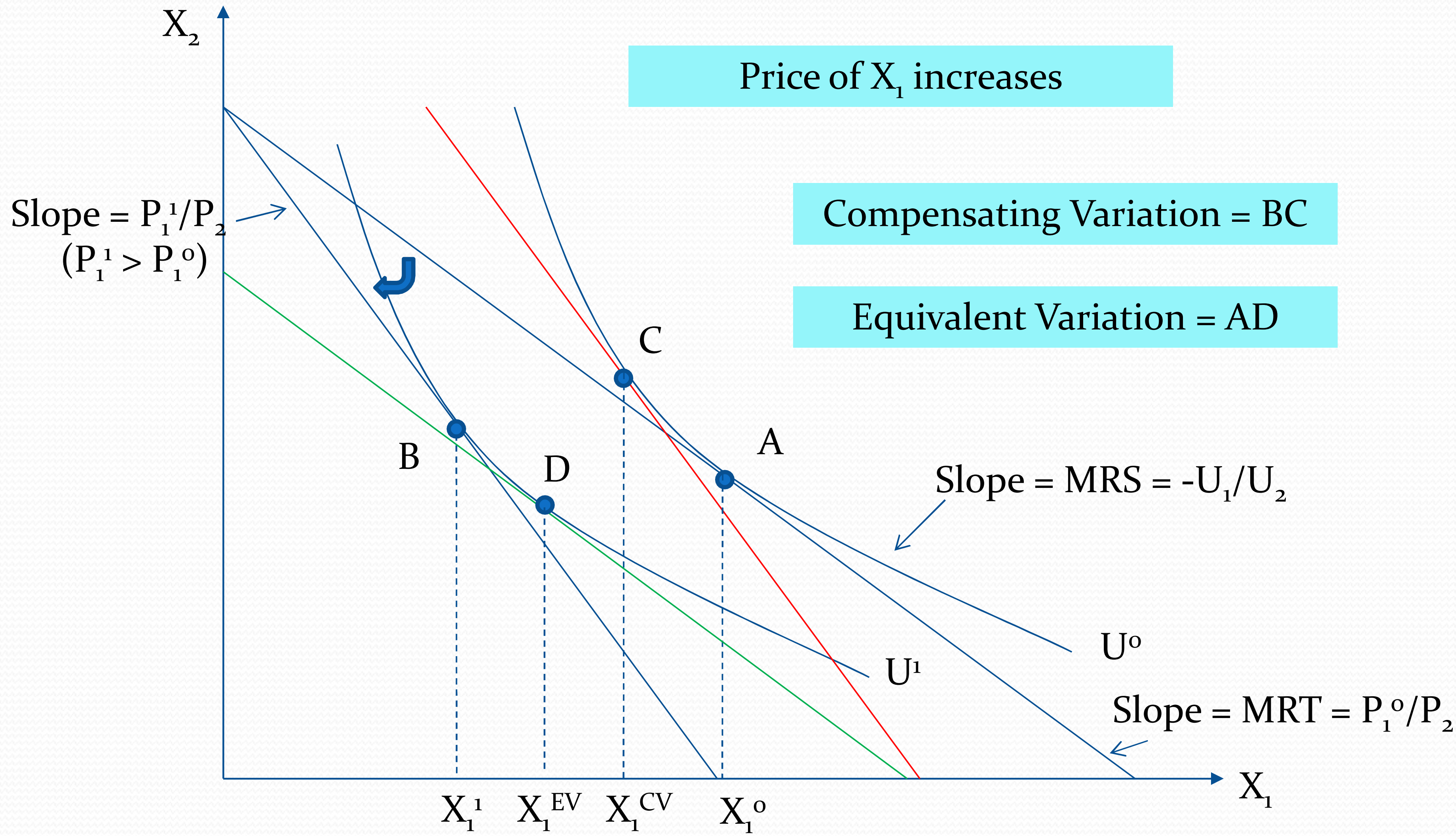


- At $P = 3$, $CS \approx 3$
- Using $P = 6 - Q^D$
  - $Q^D = 3$ and $CS = 4.5 - 1 = 3.5$
  - We typically measure it as ½(base)(height)
- At C, total value (or total *WTP*) = 13.5 $(4.5 + 9)$

Calculating ΔCS: An Example

- Jackie's utility function (from solved problem 5.1)
- $U = q_1^{0.4} q_2^{0.6}$
- $U_1 = 0.4U/q_1$ and $U_2 = 0.6U/q_2$
  - Thus, $U_1/U_2 = 2q_2/3q_1 = p_1/p_2$ or $p_2q_2 = 3p_1q_1/2$
- $Y = p_1q_1 + p_2q_2 = p_1q_1(1 + 3/2) = 5p_1q_1/2$
  - Thus, $q_1 = 0.4Y/p_1$ (and $q_2 = 0.6Y/p_2$)
- $\Delta CS = -\int q_1 dp_1 = -0.4Y\int dp_1/p_1 = -0.4Y \ln p_1$
- If $Y = 30$, $p_1^1 = 0.5$ and $p_1^2 = 1$, then
  - $\Delta CS = -0.4(30)[\ln 1 - \ln 0.5] = -8.32$

Consumer Equilibrium & Price Increase: Normal Good



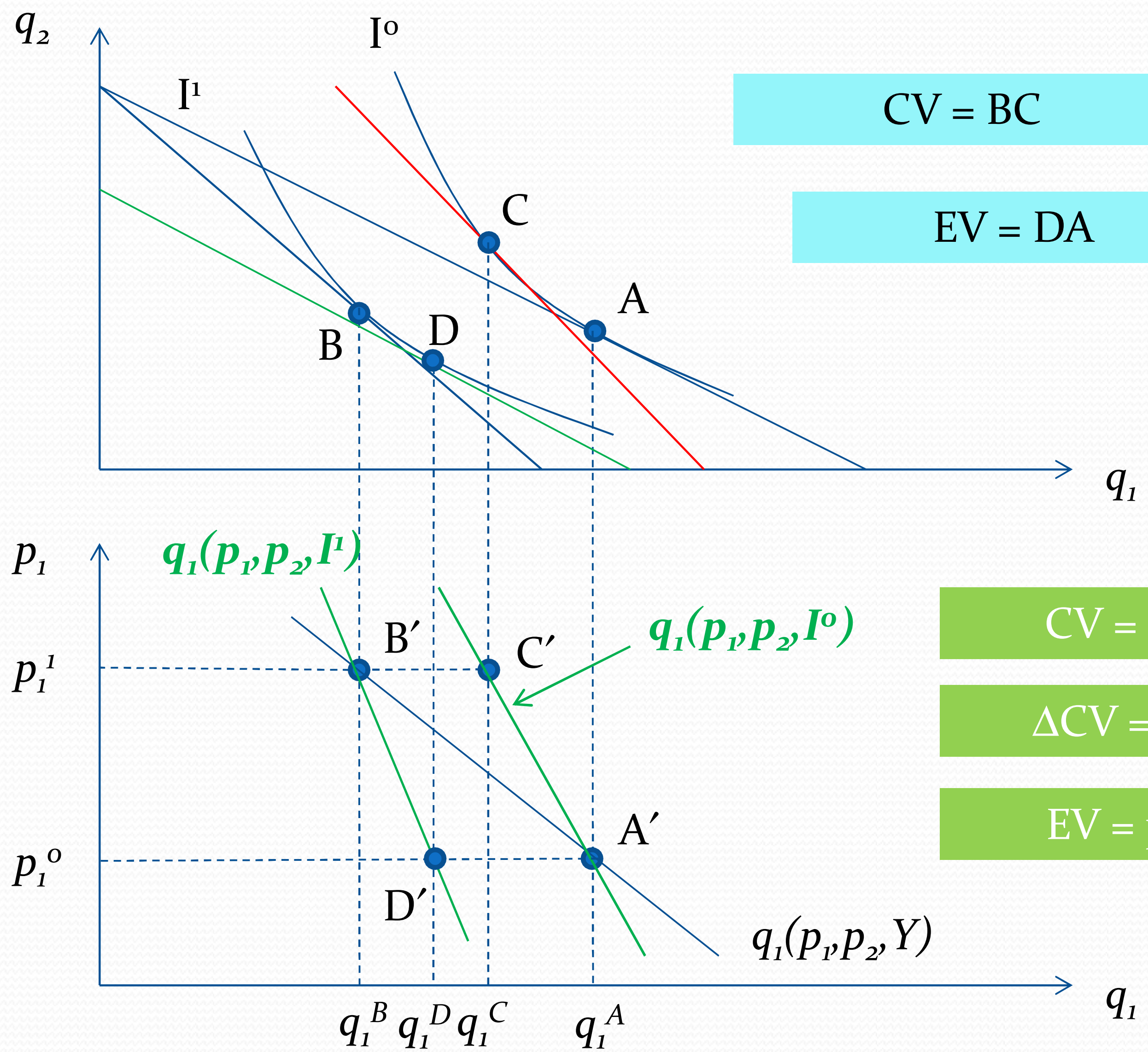
Calculating CV and EV: An Example

- $CV = e(p^1, U^1) - e(p^1, U^0)$
- $EV = e(p^0, U^1) - e(p^0, U^0)$
  - Note: $e(p^1, U^1) = e(p^0, U^0) = Y$
- Now back to Jackie
  - $U = q_1^{0.4} q_2^{0.6} = (0.4Y/p_1)^{0.4}(0.6Y/p_2)^{0.6} = 0.51Y/(p_1)^{0.4}(p_2)^{0.6}$
    - Let $p_2 = 1$ (need this additional information)
    - At A, $U^0 = 20.195$ and at B, $U^1 = 15.305$
  - $e(p, U) = U(p_1)^{0.4}(p_2)^{0.6}/0.51$
    - $e(p^1, U^0) = U^0/0.51 = 39.59$
    - $e(p^0, U^1) = U^1(p_1)^{0.4}/0.51 = 22.74$
  - Thus, $CV = e(p^1, U^1) - e(p^1, U^0) = 30 - 39.59 = -9.59$
  - And $EV = e(p^0, U^1) - e(p^0, U^0) = 22.74 - 30 = -7.26$
  - Remember: $\Delta CS = -8.32$
  - So, *for a normal good*, $|CV| > |\Delta CS| > |EV|$

Calculating CV & EV using Compensated D Curve

- For a normal good, $|CV| > |\Delta CS| > |EV|$
- For an inferior good, $|CV| < |\Delta CS| < |EV|$
- This can be seen from the following diagrams

CV & EV: Compensated Demand, Normal Good, Price ↑



$CV = BC$

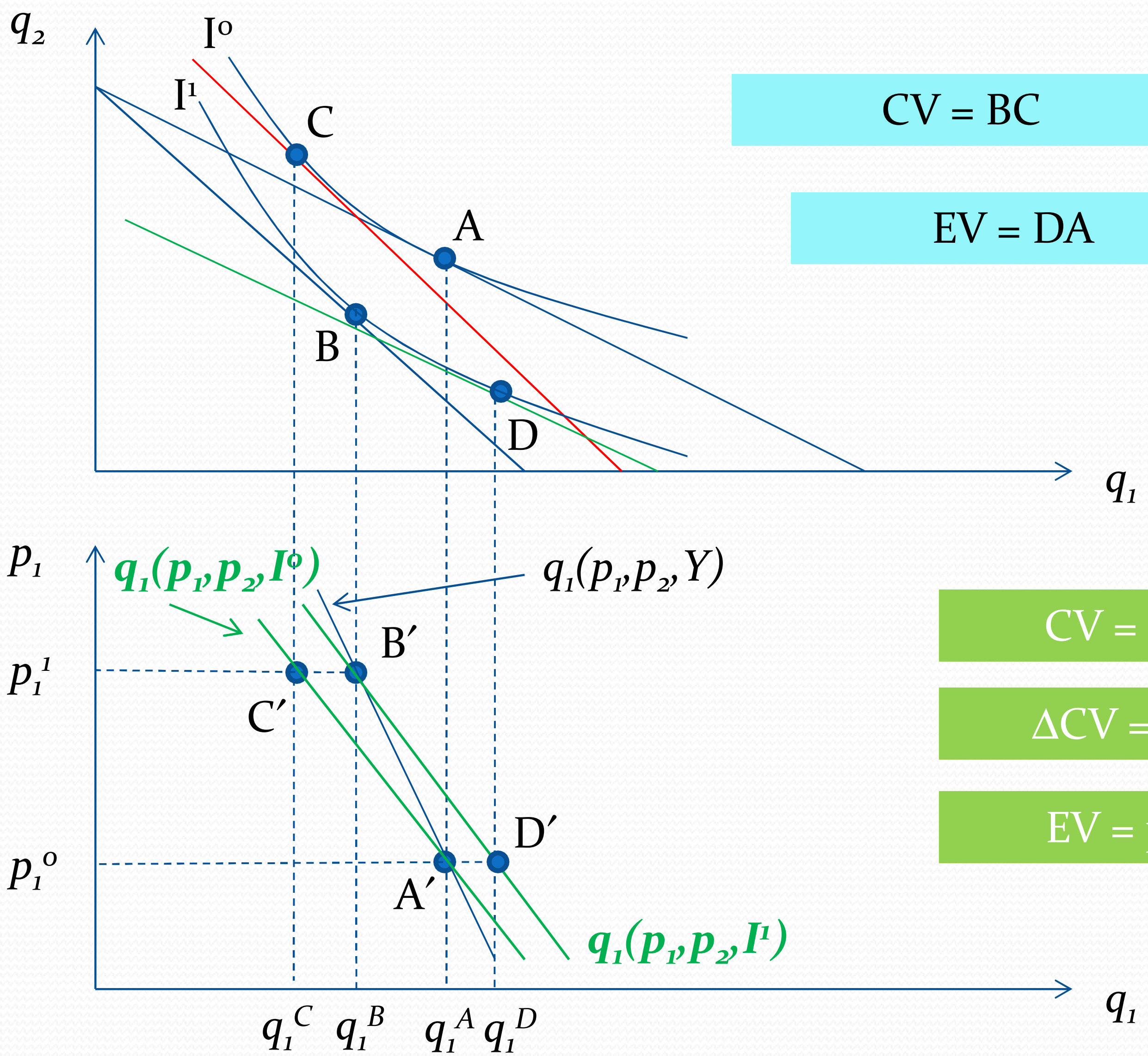
$EV = DA$

$CV = p_1^1 C' A' p_1^o$

$\Delta CV = p_1^1 B' A' p_1^o$

$EV = p_1^1 B' D' p_1^o$

CV & EV: Compensated Demand, Inferior Good, Price ↑



CV = BC

EV = DA

CV = $p_1^1 C' A' p_1^o$

ΔCV = $p_1^1 B' A' p_1^o$

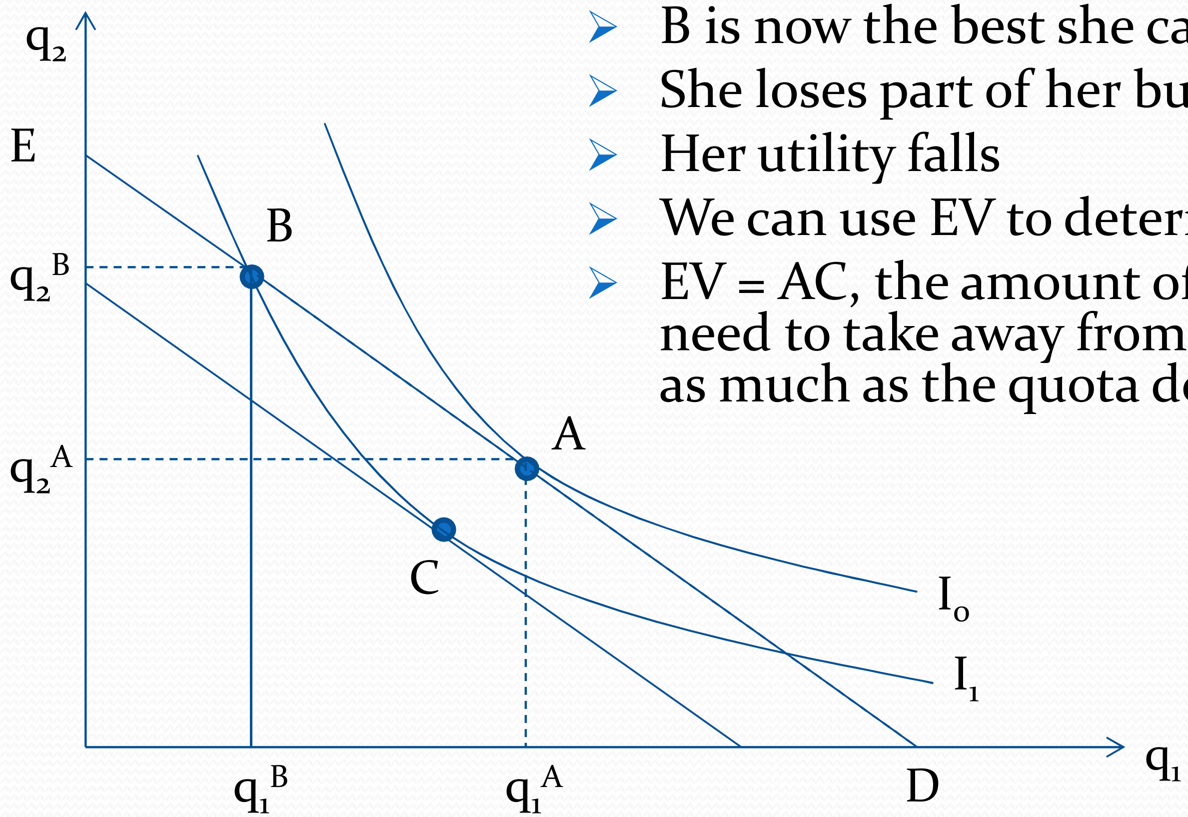
EV = $p_1^1 B' D' p_1^o$

When the 3 Welfare Measures are the Same

- Remember the Slutsky equation: $\varepsilon_1^T = \varepsilon_1^S - \theta_1 \xi_1$
- When the expenditure share is small, $\varepsilon_1^T \approx \varepsilon_1^S$ so that
  - $CV \approx EV$
  - Since ΔCS lies between CV and EV, it must also be the case that $CV \approx \Delta CS \approx EV$
- Furthermore, when the income elasticity is small
  - $CV \approx \Delta CS \approx EV$
- Willig (1976) showed that, when the price change is small, $CV \approx \Delta CS \approx EV$
  - Price changes are typically small
  - As a result, economists, frequently use ΔCS

Quotas

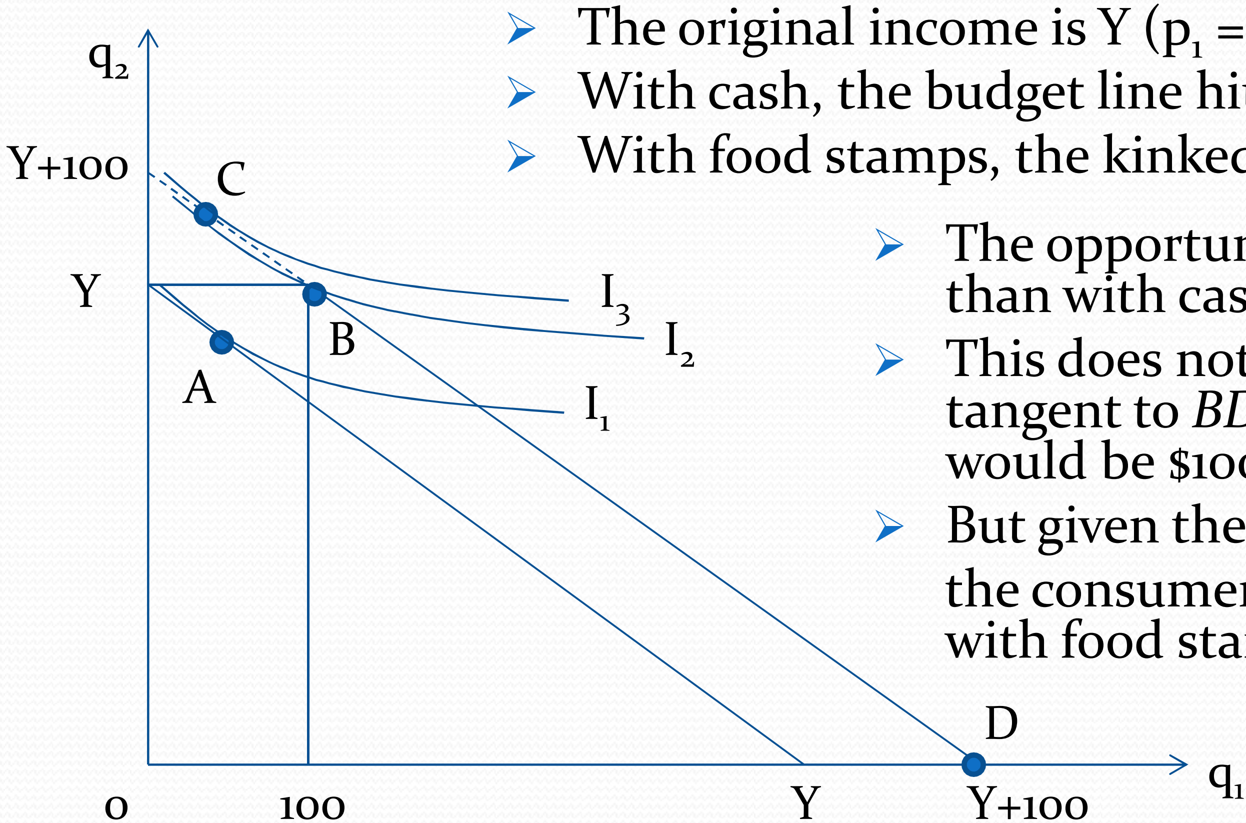
- A quota reduces the number of units of a good a consumer can buy and creates a kink in the budget constraint
- Consumer welfare is reduced if the consumer cannot buy as many units as he/she wants
- <u>Examples</u>: Water quotas, energy use, Jackie's music buys
  - Her budget line becomes EBq_1^B; kinked



- B is now the best she can do
- She loses part of her budget set (BDq_1^B)
- Her utility falls
- We can use EV to determine by how much
- EV = AC, the amount of money we would need to take away from Jackie to harm her as much as the quota does

Food Stamps

- Are poor people better off receiving food or a comparable amount of cash?
  - There has been much debate about this over the years
- Only food can be obtained from food stamps, unlike cash
  - This limits choices
  - Food stamps do not increase the opportunity set by as much as cash

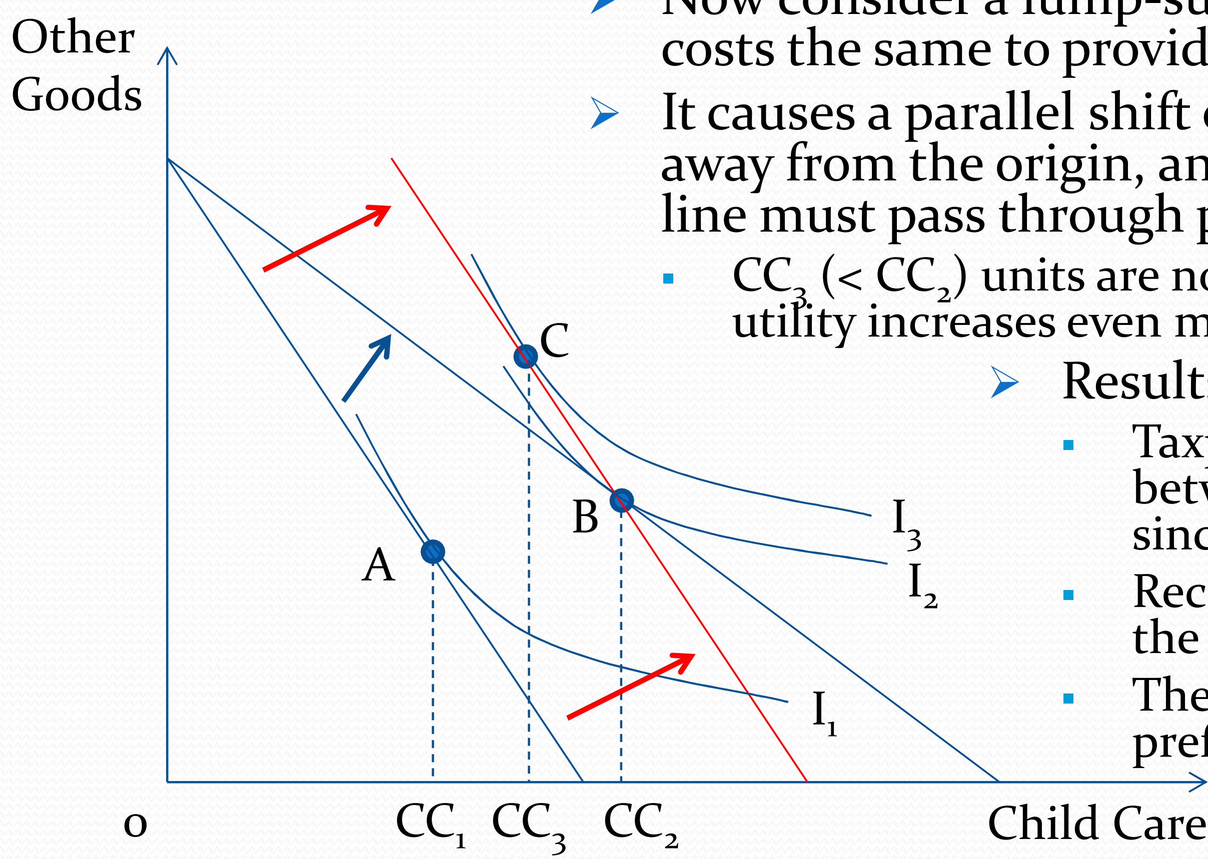


- The original income is Y ($p_1 = p_2 = 1$)
- With cash, the budget line hits both axes at Y+100
- With food stamps, the kinked budget line is *YBD*
  - The opportunity set is smaller than with cash
  - This does not matter if the IC is tangent to *BD* in which case EV would be $100
  - But given the ICs,

    the consumer would choose B with food stamps and C with cash

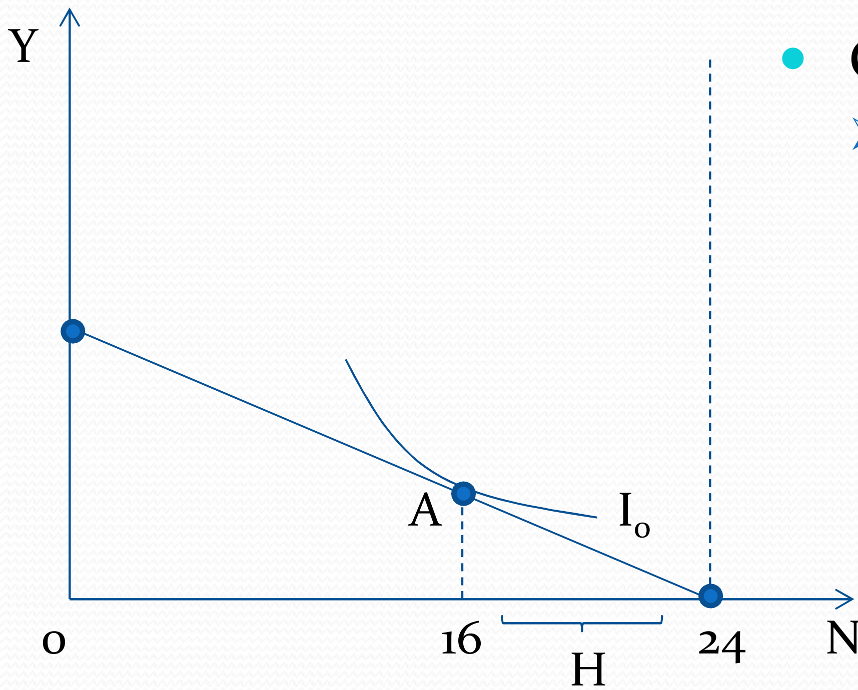
Child Care: Price Subsidy versus Lump-Sum Subsidy

- Which policy benefits recipients more?
  - Consider taxpayers, recipients and the child-care industry
  - Initially, CC_1 units of child care (a normal good) are demanded
  - A price subsidy (*PS*) reduces the price of child care and causes the budget line to rotate counterclockwise
    - CC_2 units are now demanded and utility increases
  - Now consider a lump-sum subsidy (*LSS*) that costs the same to provide as the price subsidy
  - It causes a parallel shift of the budget line away from the origin, and the new budget line must pass through point B
    - CC_3 ($< CC_2$) units are now demanded and utility increases even more
  - Results:
    - Taxpayers are indifferent between the *PS* and the *LSS* since they cost the same
    - Recipients are better off with the *LSS*
    - The child care industry prefers the *PS* since $CC_2 > CC_3$



The Labour-Leisure Choice

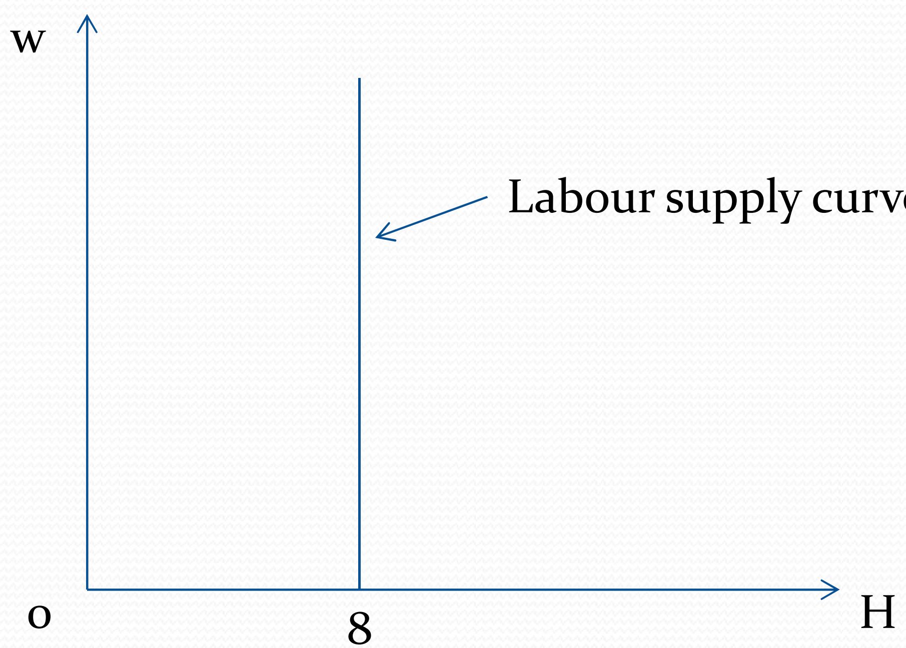
- People spend time working (H; to earn money to buy things) and not working (N; on leisure activities, chores, sleep)
- Since there are a fixed 24 hours in a day, $H = 24 – N$
- Income (Y) may be earned (wH; wage income) or unearned (Y^*; come from investments, gifts, inheritances)
  - $Y = wH + Y^*$
  - We'll let $Y^* = 0$ for the time being



- Graphical depiction
- Constrained optimization problem:
  - $Max_{Y,N}\, U = U(Y,N)$ s.t. $Y = w(24 – N)$
    - $dU = 0 = U_Y dY + U_N dN$
      $\Rightarrow MRS = dY/dN = -U_N/U_Y$
    - $dY = 0 = -wdN$
      $\Rightarrow MRT = dY/dN = -w$
    - Setting $MRS = MRT$ yields
      $U_N/U_Y = w$ or $U_N/w = U_Y$

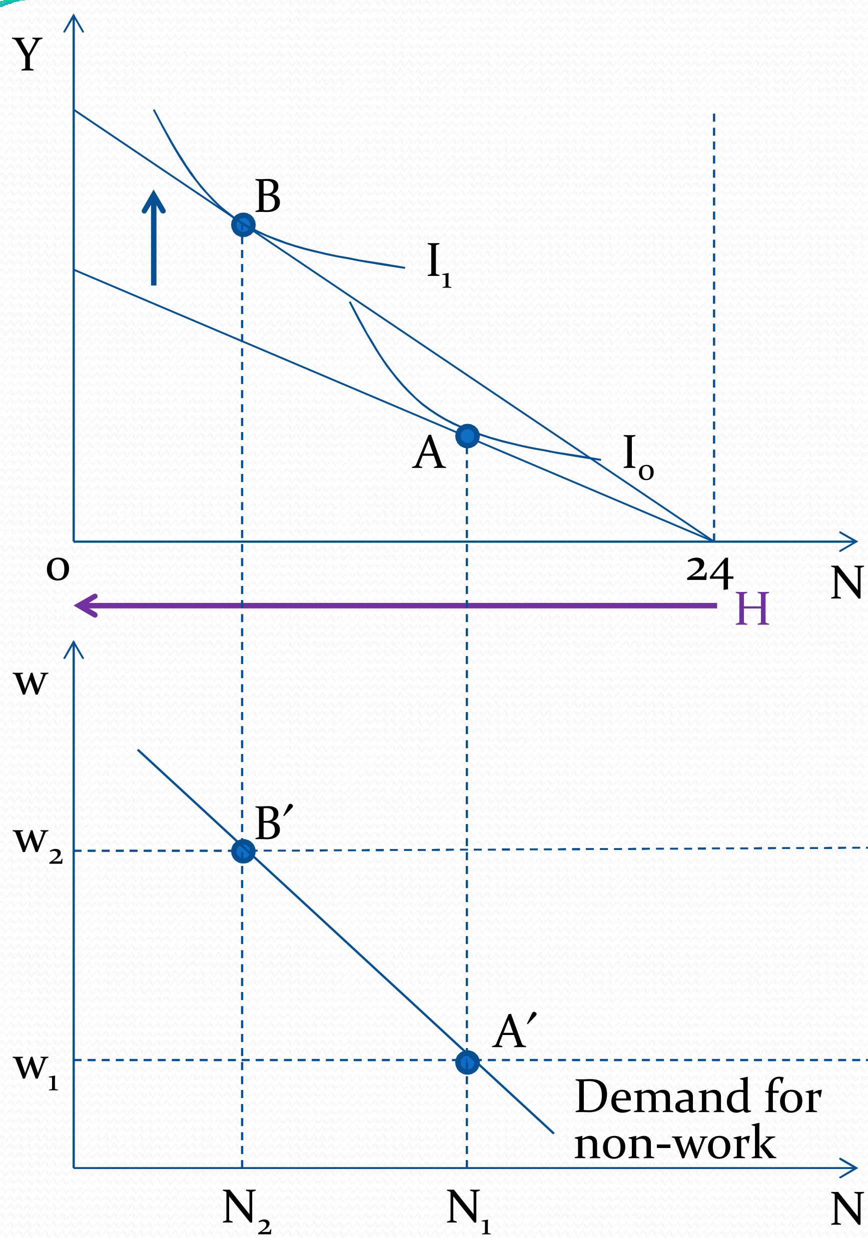
Deriving the Labour Supply Function: An Example

- Constrained maximization: $Max_{Y,N}\, U = U(Y,N)$ s.t. $Y = w(24 - N)$
- Reformulate this as an unconstrained maximization problem in terms of H, specify a functional form, and solve for H as a function of w
  - $Max_H\, U = U(wH, 24 - H) = (wH)^a(24-H)^{1-a}$ (Cobb-Douglas)
    - $U_H = 0 = aUw/wH - (1-a)U/(24-H)$
    - So, $H = 24a$
  - If $a = 1/3$, then $H = 8$
    - The individual works 8 hours per day ***regardless of*** the wage rate

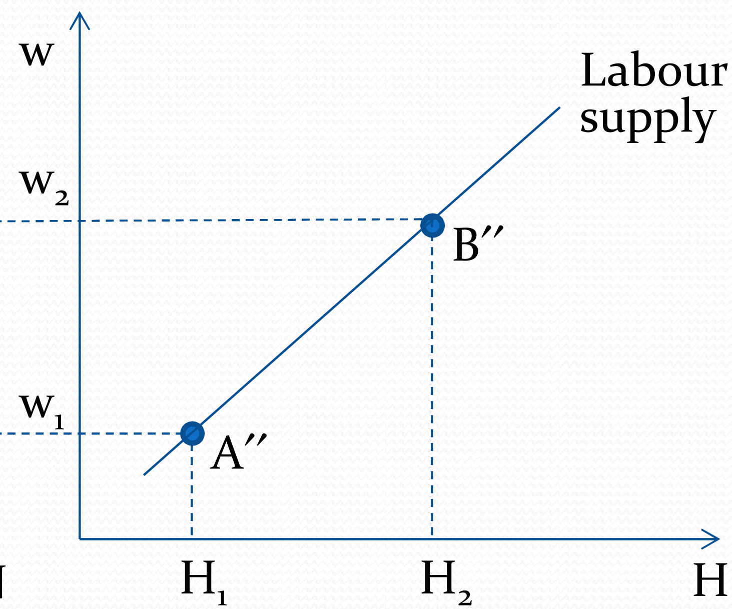


- Graphical depiction

Demand Curve for Leisure = Labour Supply Curve

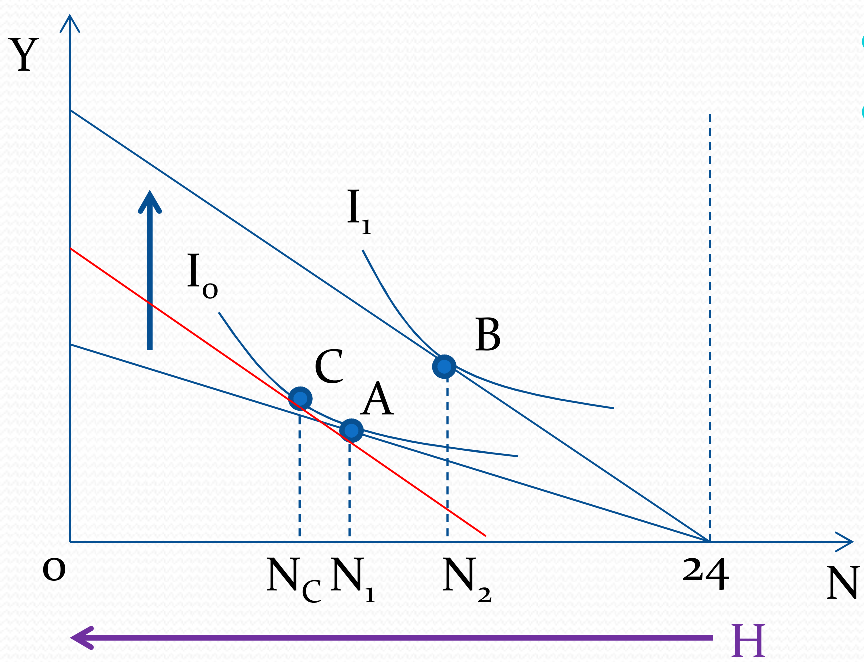


- We derive the demand curve for N in the same way as always
  - Y increases when w increases so that the budget line rotates clockwise ($dY/dw = H > 0$)
  - By increasing w, the price of N becomes more expensive
  - Since N is shown as an inferior good ($dN/dY < 0$), the demand for N is downward sloping
  - Thus, labour supply slopes up



Substitution and Income Effects

- As with all price increases, the change in equilibrium caused by a rise in *w* can be decomposed into income and substitution effects
- Assume *N* is a normal good this time ($dN/dY > 0$)
- The rise in *w* causes the budget line to rotate clockwise
  - Equilibrium moves from A to B (the total effect of the w increase)
- Income would need to be taken away to restore the initial level of utility
  - Move from B to C



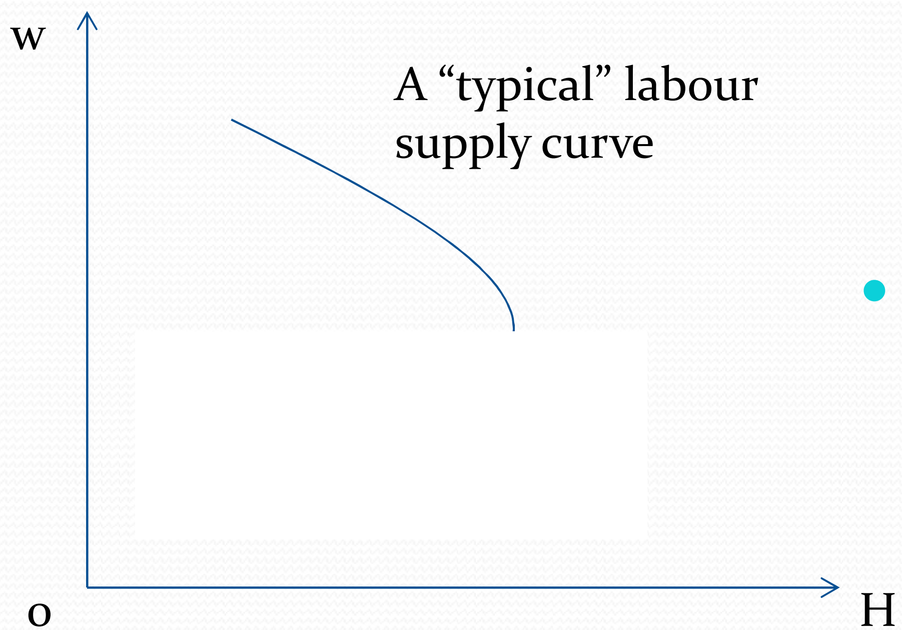
- BC = Income effect (*IE*)
- AC = Substitution effect (*SE*)
- ***Using calculus***, the total effect equals the sum of the *SE* and *IE*:

  $dN/dw = dN/dw|_{Io} + (dN/dY)(dY/dw)$

  Or $dN/dw = dN/dw|_{Io} + (dN/dY)H$
  - $dN/dY > 0$ for a normal good
  - $dN/dY < 0$ for an inferior good
  - The *SE* ($dN/dw|_{Io}$) is always negative

The Shape of the Labour Supply Curve

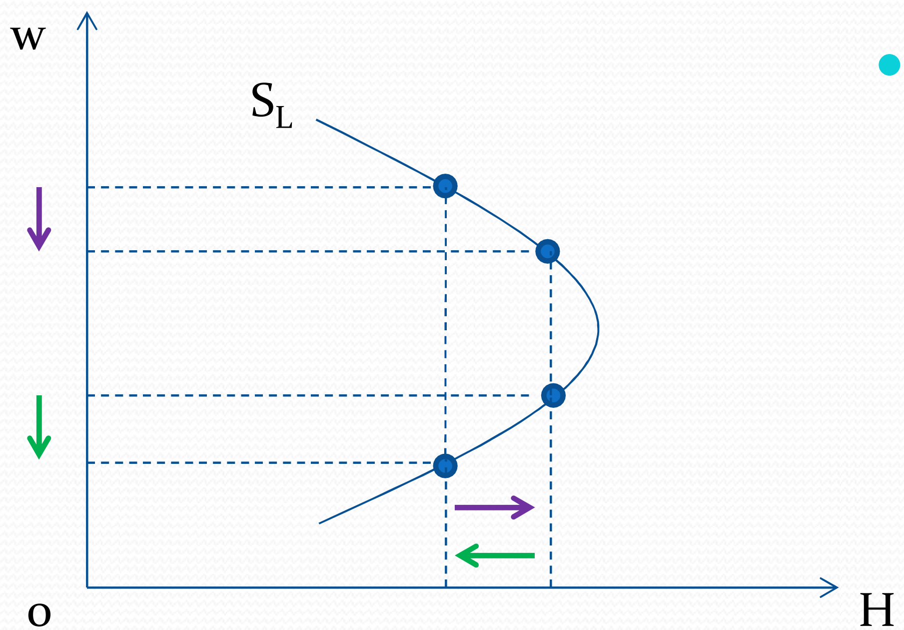
- The shape of the labour supply (S_L) curve depends on whether N is a normal or inferior good
- ***If N is normal*** ($dN/dY > 0$), then:
  - $IE = (dN/dY)(dY/dw) = (dN/dY)H > 0$
  - IE offsets the substitution effect ($SE < 0$)
  - ***If IE > SE (as on slide 21), the labour supply curve slopes down***
  - ***Otherwise***, the labour supply curve slopes ***upwards***
- ***If N is inferior*** ($dN/dY < 0$), then:
  - $IE = (dN/dY)(dY/dw) = (dN/dY)H < 0$



  - IE reinforces the substitution effect ($SE < 0$)
  - ***The labour supply curve slopes up (always)***
- It is likely that N is:
  - Inferior at low w (S_L slopes upwards)
  - Normal at high w (S_L may slope downwards)

Importance of the Shape of the Labour Supply Curve

- One reason is that governments want to know if increasing income taxes will increase or decrease:
  - Hours worked (H)
  - Tax revenues, $T = \alpha wH[(1-\alpha)w]$
- ***Read page 164***
- If the income tax rate (α) increases, after-tax wages fall which causes ***hours worked and tax revenues*** to:
  - ***Fall if S_L is upward sloping***
  - ***Rise if S_L is downward sloping***



- Using calculus:
  - $T = \alpha wH[(1-\alpha)w]$
  - $dT/d\alpha = wH - \alpha w^2 dH/dw$
- Note that:
  - $wH > 0$ (always)
  - $\boldsymbol{dH/dw > 0}$ if S_L is upward sloping so that a tax increase reduces the after-tax wage, hours worked and tax revenue
  - $\boldsymbol{dH/dw < 0}$ if S_L is downward sloping so that a tax increase reduces the after-tax wage, but increases both hours worked and tax revenue