

BASIC MICROECONOMIC FOUNDATIONS OF COST-BENEFIT ANALYSIS

EE465/EE463 Project Evaluation

Semester 2/2015

Topics

- Demand Curves
- Supply Curves
- Social Surplus and Allocative Efficiency
- Government Surplus and Allocative Efficiency
- Measuring Changes in Welfare

Assumption: Perfectly Competitive Market

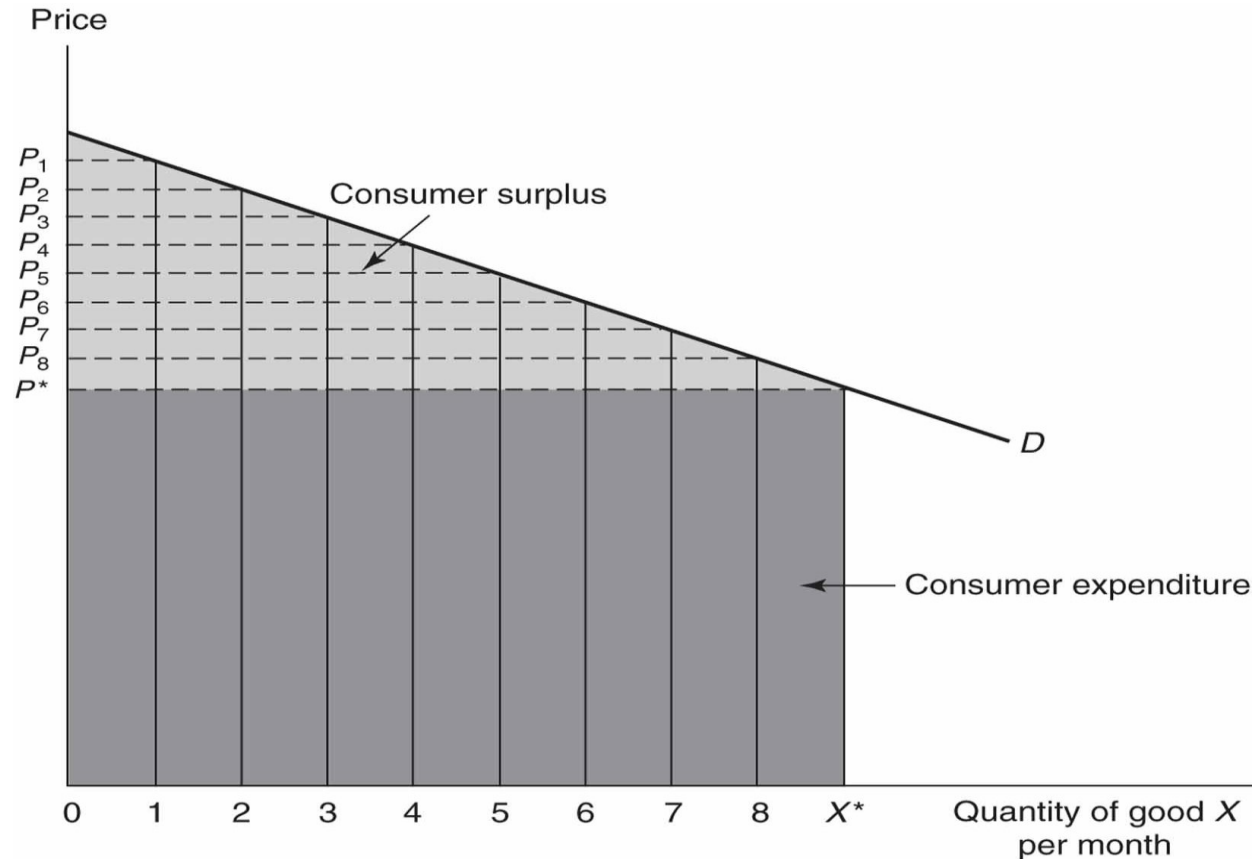
- There are many buyers and sellers in the market.
- Buyers and sellers can easily enter and exit the market.
- The goods sold are homogenous.
- There is no transaction costs.
- Information is perfect.
- Private costs and benefits are identical to social costs and benefits.

DEMAND CURVES

Demand Curves

- Ordinary demand curve vs. **Inverse demand curve**
- Individual demand curves slope downward. Why?
→
- The *inverse market demand curve* can be interpreted as a *societal **marginal benefits (MB)*** curve.
 - It indicates the *maximum* amount someone is willing to pay for an additional unit of a good.
 - The sum of all the willingness to pay amounts equals the total WTP for the good by all the members of society.
- Thus, **WTP is an appropriate measure of the benefit** of a good or service.

Consumer's Total Benefits & Consumer Surplus



Copyright © 2011 Pearson Education, Inc. publishing as Prentice Hall

Total benefits (B) = consumer surplus + consumer expenditure
(i.e. the area under the demand curve)

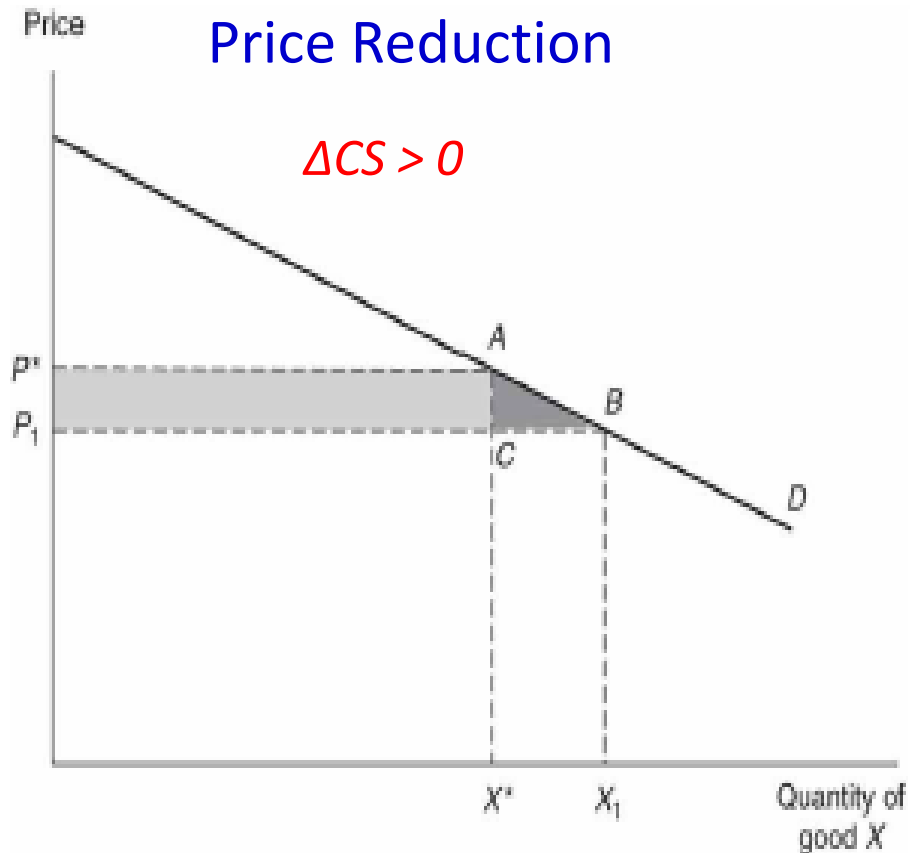
Consumer Surplus & Changes in Consumers' Surplus

- **Consumer surplus** is the **net benefit** to consumers, which is equal to **the total benefits less consumers' actual expenditures**:

$$CS = B - P^*X^*$$

- In CBA, changes in CS can be viewed as **close approximations of the WTP for (the benefits of) a policy change**.
 - A policy that *reduces* the price of the good would result in a *benefit* to consumers (_____).
 - A policy that increases the price of the good would impose a “cost” on consumers (_____).

Changes in Consumers' Surplus



For linear demand curves, $\Delta CS =$

Changes in CS for Unknown Demand Curve

- Suppose the demand curve is unknown, but we know the price elasticity of demand (E_d):

$$E_d = \frac{P}{X} \frac{dX}{dP}$$

- Given the initial prices (P^*) and quantity (Q^*):

$$E_d = \frac{P^*}{X^*} \frac{dX}{dP}$$

- Hence, one can derive the **change in consumer surplus** as:

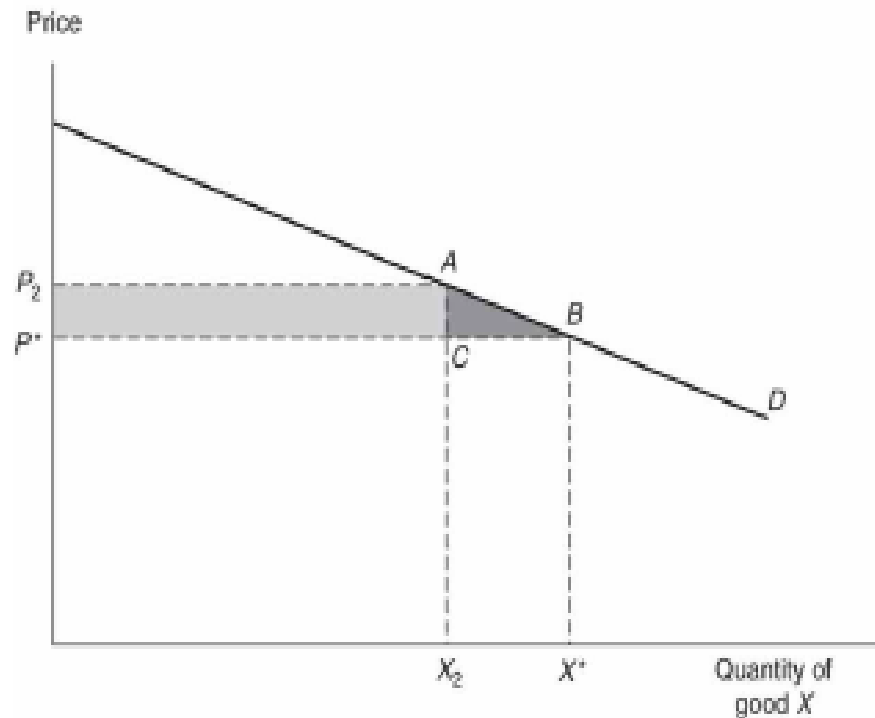
$$\Delta CS = -X^* \Delta P - \frac{1}{2} \Delta X \Delta P$$

→ $\Delta CS =$

Taxes

- Taxes are important in CBA because governments often raise funds for government projects through taxes.
- Suppose the price increase results from a government-imposed **excise tax**.
- The *tax revenue collected* can be viewed as a **transfer** from consumers of X to the government.
- The tax incurs a cost – **lost consumer surplus for which there is no offsetting benefit accruing to some other part of society**.
 - This is **deadweight loss of taxation**.
 - It results from a distortion in economic behaviour from the competitive equilibrium.

Illustration of DWL from Taxation



$$\Delta DWL =$$

$$\text{If } \Delta P = t, \text{ then } \Delta DWL =$$

DWL and Leakage

- *Leakage* is the ratio of the deadweight loss to the total tax revenue raised:

$$Leakage = \frac{DWL}{Tax\ Revenue}$$

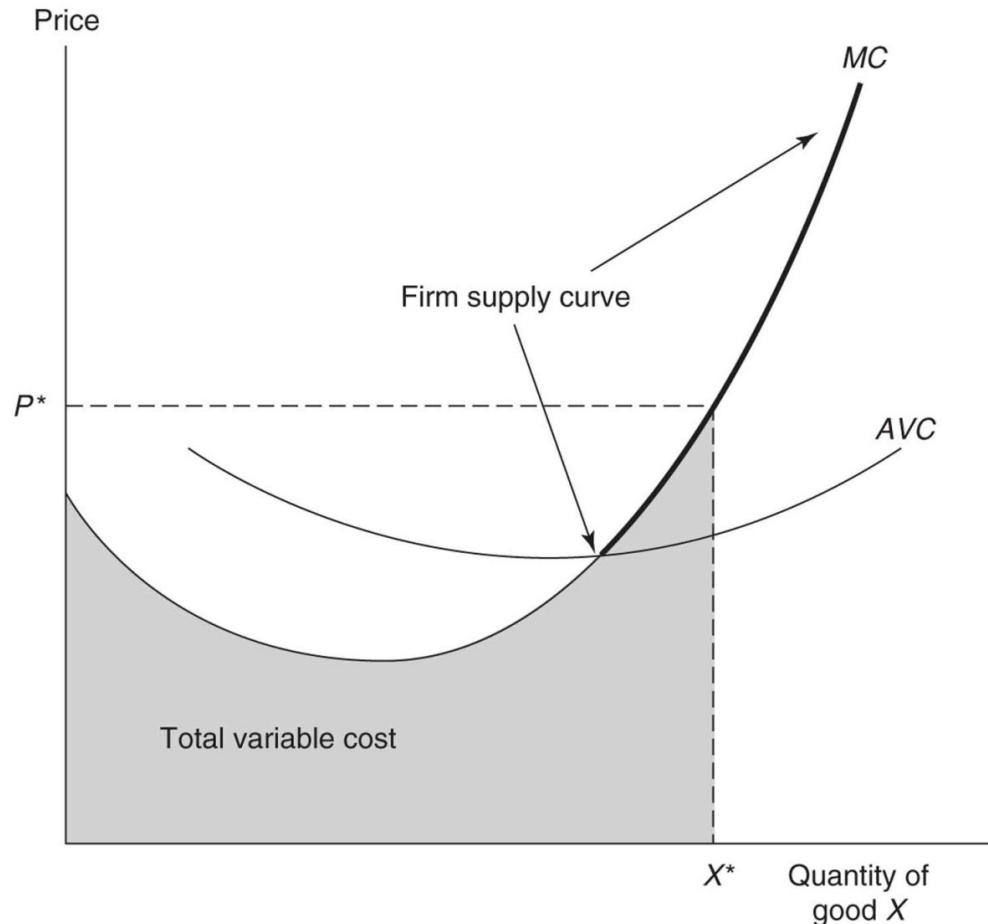
→ $Leakage =$

- If the change in output is relatively small, then a very slight over-estimate of the leakage is:

$$Leakage =$$

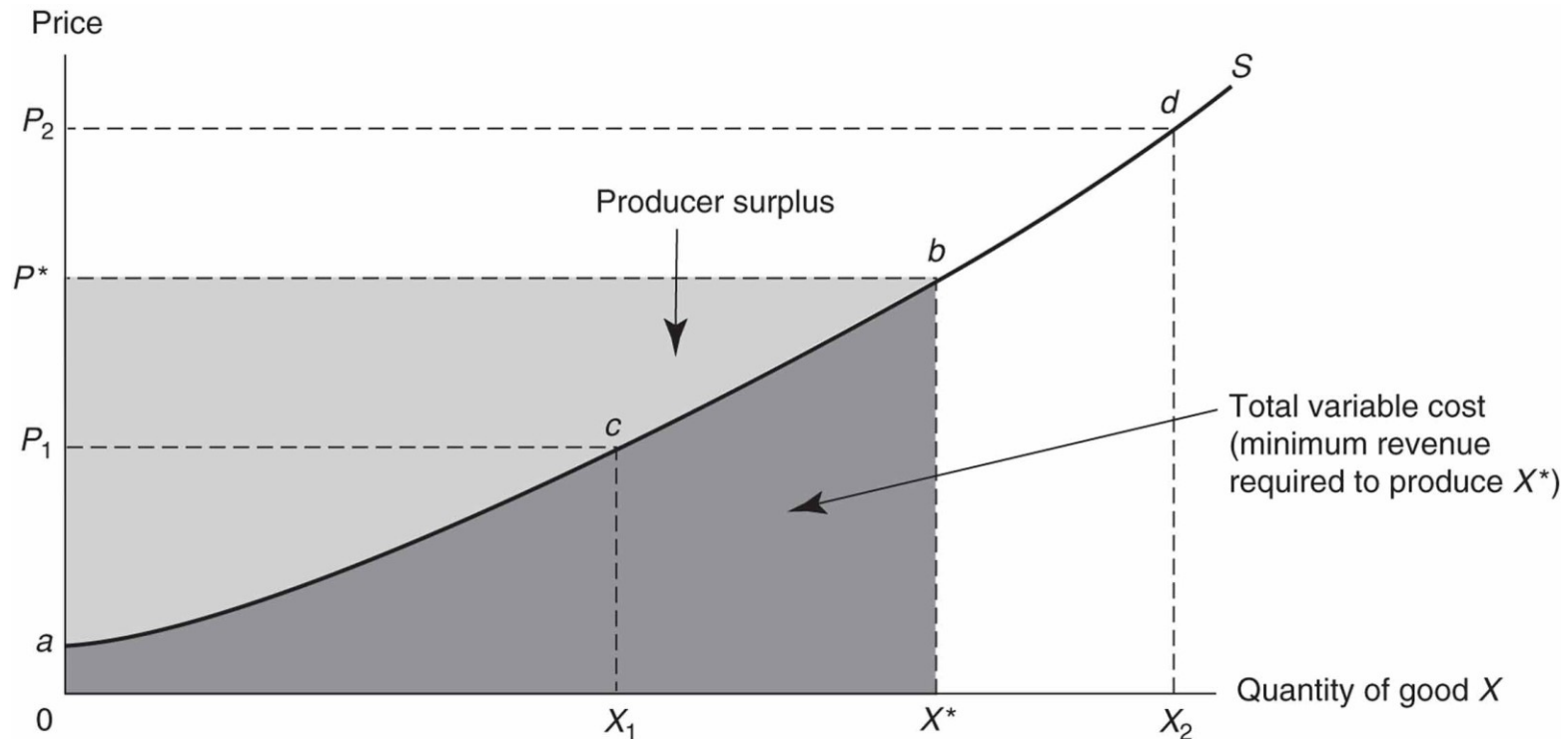
SUPPLY CURVES

Short-Run Individual Firm's Supply Curve



- Supply curve is the upward sloping segment of a firm's marginal cost (MC) curve above its AVC curve.
 - Why does it slope upward?
- Supply curve indicates the MC of each additional unit produced.
 - Area under MC is TVC.
- The cost curve reflects the opportunity costs of the resources used in the production (including a normal return).

Market Supply Curve & Producer Surplus

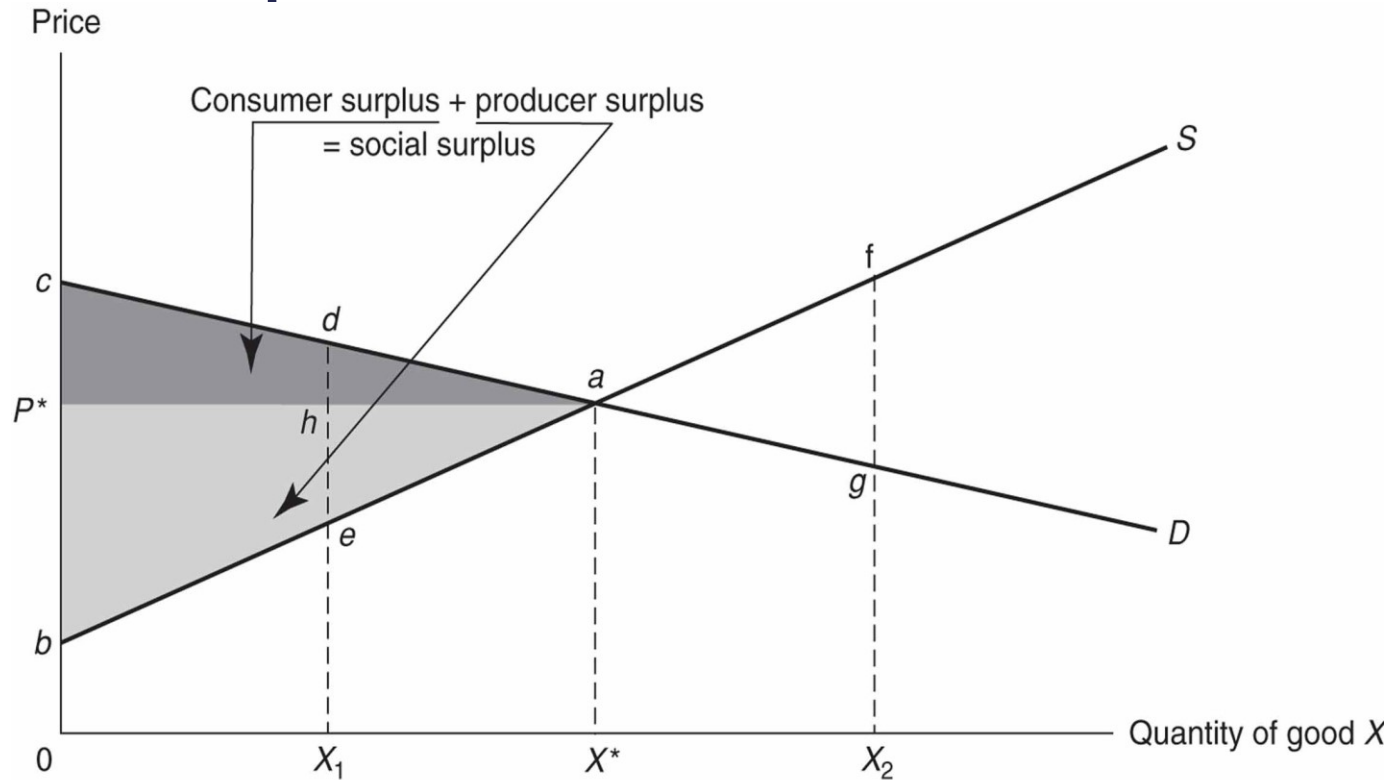


- $PS = \text{Total Revenue} - \text{TVC} = P^*X^* - \text{TVC}$
- If P decreases from P^* to P_1 , $\Delta PS = \text{Area}$
- If P increases from P^* to P_2 , $\Delta PS = \text{Area}$

Social Surplus and Allocative Efficiency (1)

- **Social surplus (SS)**, a.k.a. total surplus, is the sum of consumer surplus and producer surplus: $SS = CS + PS$.
- **Net social benefits (NSB)** equals the difference between **total consumer benefits** (D curve) and **total producer costs** (S curve).
 - Thus, $NSB = SS$.
- Since demand reflects MB and supply reflects MC, net social benefits (social surplus) is maximized where the supply and demand curves intersect.
 - In a perfectly competitive market, NSB and SS are maximized.
 - This outcome is *Pareto efficient* and *allocatively efficient* (or economically efficient).
 - **First Welfare Theorem** (_____)

Social Surplus



At (X^*, P^*) , $D = S$ and $P = MC$.

- This point is **allocatively efficient** because NSB is maximized.
- It is also **Pareto efficient** because no one can be made better off without hurting anyone else

Profit and Factor Surplus

- In practice, CBA projects often involve changes in **fixed costs** which should be taken into account.
- Also, regardless of including fixed costs or not, it is easier for most people to think of *profits* than producer surplus.
- One way to deal with these two issues is to recognise that:

$$PS = \pi + FS,$$

where π = economic profits, and FS is *factor surplus*, which are a form of *Ricardian rents*.

- Example of Ricardian rent: the return going to a particular productive plot of land in a competitive agricultural market.
- Hence,

$$SS = \quad \text{and} \quad \Delta SS =$$

GOVERNMENT SURPLUS AND ALLOCATIVE EFFICIENCY

Government Surplus (1)

- **Government surplus (GS)** is the net budget impacts on government.
 - Financial inflows: taxes
 - Financial outflows: expenditures
- When GS is non-zero, social surplus and changes in social surplus are given by:

$$SS = CS + PS + GS$$

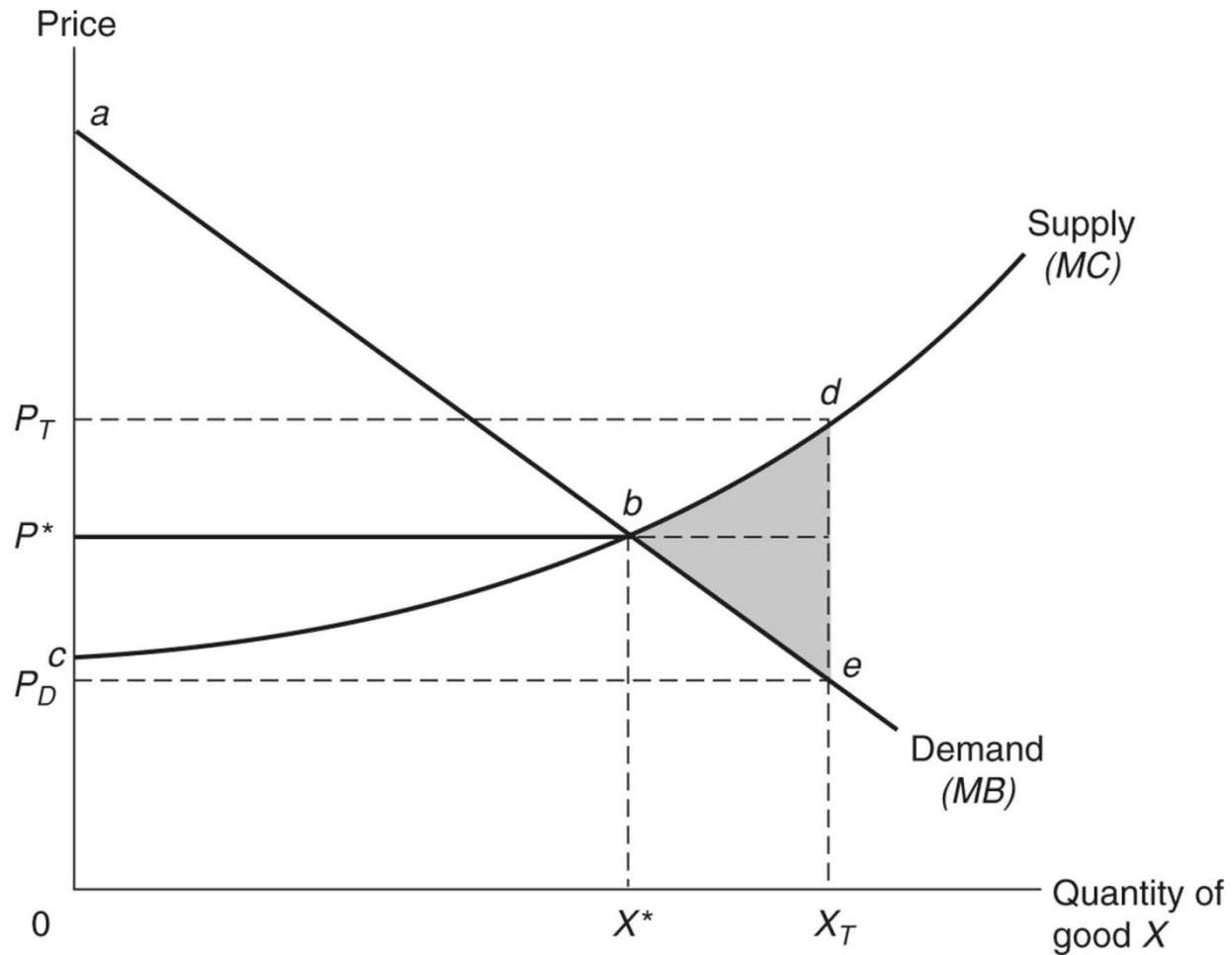
and $\Delta SS = \Delta CS + \Delta PS + \Delta GS$

- *In a competitive market, the net social benefit of a project equals the change in consumer surplus plus the change in producer surplus, plus the net change in government revenue.*

Government Surplus (2)

- Example 1: Suppose government incurs all the costs of a project and enjoy none of financial benefits (e.g. build a rent-free shelter). Assume that $\Delta PS = 0$.
 - $\Delta SS = NSB = B - C$ where $B = \Delta CS$ and $C = \Delta GS$
- Example 2: Suppose now the government charges a market rent. Would the NSB be the same?
 - *Method 1* - Consider the rent paid as a transfer – a cost to consumers but a benefit to government.
 - The net effect of a transfer is zero.
 - *Method 2* - Consider *gross benefits* to consumers (B) and total cost:
 - $B = \Delta CS + \text{Rents}$
 - $C = \text{Rents (paid by consumers)} + \text{project expenditures (paid by govt)}$
 - ➔ $NSB = B - C = \Delta CS - \text{Construction costs} - \text{Operating costs}$

Example: Target Pricing



Distributional Implications of Target Pricing: Breakdown of CS Gain, PS Gain, and DWL

<i>Group</i>	<i>Incremental Benefit</i>	<i>Incremental Cost</i>	<i>Change in Surplus</i>
Consumers			
Producers			
Government			
Net (Social)			

Leakage is the proportion of each dollar given up by government that, as a result of a deadweight loss, does not accrue as transfers to any other group.

→ *Leakage* =

Marginal Excess Tax Burden & Allocative Efficiency

- The *DWL* that results specifically from a tax is called *excess tax burden*.
- The *change in DWL* resulting from raising an additional dollar of tax revenue is called the *marginal excess tax burden (METB)*.
 - The size of METB depends on the magnitude of the behavioral response to a tax change (e.g. how much consumer purchases change due to an excise tax).
- METB is an *efficiency cost*. Taking this effect into account, social surplus and the change in social surplus becomes:

$$SS = CS + PS + (1+METB)GS$$

$$\Delta SS = \Delta CS + \Delta PS + (1+METB)\Delta GS$$

Measuring Changes in Welfare

- CBA focuses on allocative efficiency. However, *welfare* concerns allocative efficiency and *equity*.
- It is possible to move from measuring social surplus to a measure of welfare by “weighting” each of the different types of surplus:

$$\Delta W = \gamma_c \Delta CS + \gamma_p \Delta \pi + \gamma_f \Delta FS + \gamma_g \Delta GS$$

where $\gamma_c, \gamma_p, \gamma_f,$ and γ_g are welfare weights for consumers, producers, factors of production and government, respectively.

- If $\gamma_c = \gamma_p = \gamma_f = 1$ and $\gamma_g = 1 + \text{METB}$, then $\Delta W = \Delta SS$.
- In practice, it is not clear what the weights should be. Some studies use the above equation to measure changes in welfare due to privatization.

APPENDIX: CONSUMER SURPLUS & WTP

Compensating Variation

- **Compensating variation (CV)** is the maximum amount of money that consumers would be willing to pay to avoid a price increase.
 - It is the amount required to return the consumers to the same utility level they enjoyed prior to the change in price. (Why?)
- Suppose that if the consumer is willing to pay all the compensation she received, then the price increase will be revoked. Will she accept or reject the offer?
 - She will be indifferent.
 - If she takes the offer, then she returns to her initial equilibrium.
 - If she rejects the offer, she will be move to a new equilibrium but on the same utility level.

Illustration of Compensating Variation

Income and Substitution Effects

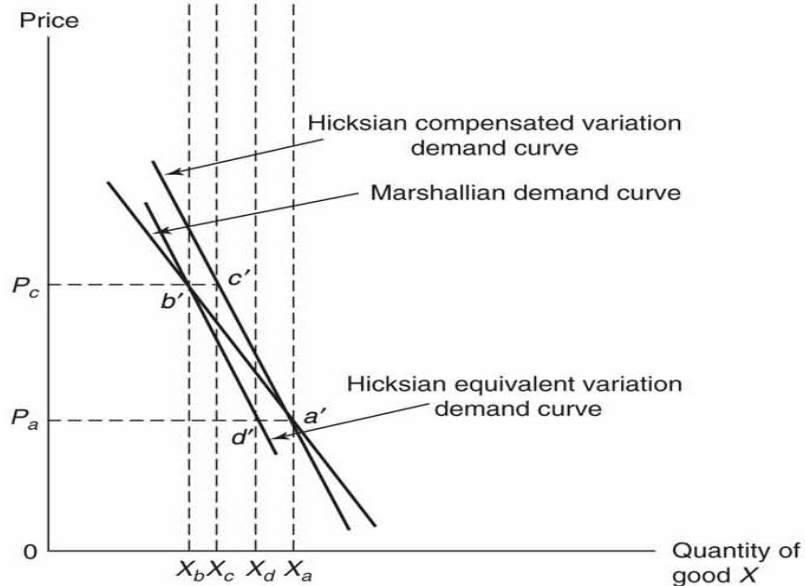
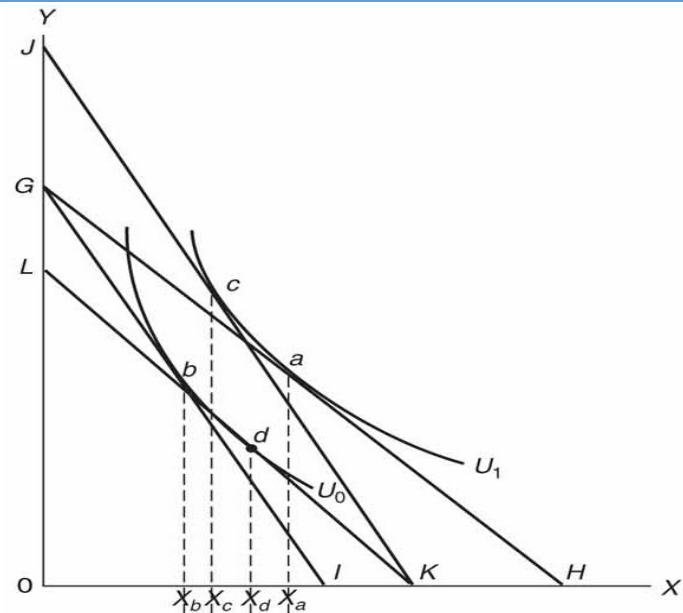
- *Compensated Substitution effect* is the change in quantity demanded as a result of price change, holding the utility constant (i.e. the consumer were exactly compensated for any losses of utility she suffers as a result of the price increase).
- *Income effect* is the change in quantity demand as a result of the price change.
 - An increase in the price of the good reduces the consumer's disposable income.
 - For normal goods, purchases of the good and disposable income are positively related.

Illustration of Substitution and Income Effects

Demand Curves

- **Marshallian demand curve**
 - Incorporates *both the substitution and income effects* associated with changes in the price of good X.
 - Possible to estimate empirically
- **Hicksian compensated variation demand curve**
 - A.k.a. **utility compensated demand curve**
 - Incorporates *only the compensated substitution effect* associated with price changes.
 - Cannot be directly estimated using statistical technique

Derivation of Marshallian and Hicksian Demand Curves



Consumer Surplus (CS) and Compensating Variation (CV)

- **Compensating Variation (CV)** can be measured graphically as the vertical distance (JG in previous slide) or as **the change in consumer surplus indicated by Hicksian compensated variation demand curve** (Area $P_a a' c' P_c$).
- Hence, using Marshallian demand curve will result in a *biased estimate of compensating variation* and of WTP.
 - **Change in CS (hence WTP) will be *smaller* if measured with Marshallian demand curve.**
- The bias from using Marshallian demand depends on the size of *income effect* associated with a price change.
 - Not a big deal for CBAs of policies that affect corn, tobacco, gasoline, etc.
 - But for consumptions goods as housing or automobiles, this bias can matter.

Equivalent Variation as an Alternative to Compensating Variation

- **Equivalent Variation (EV)** is the amount of money (distance GL) paid by the consumer that would cause her to lose just as much utility as the price increases.
- Using equivalent variation approach, the price increase result in:
 - the income effect is the change from X_a to X_d
 - the substitution effect is the change from X_d to X_b .
- The **Hicksian equivalent variation demand** can be derived from the substitution effect by holding the utility constant *after* the price changes.
- EV can be measured by the area $P_a d' b' P_c$.
- Thus, EV is smaller than the change in Marshallian CS.

