Chapter 4: Individual and Market Demand

Overview:

Chapter 4 + 5.1-5.3: Implications of optimal choice

What happens if _____ changes?
What happens to individual demand if a price changes?

- ►Individual demand function
- ►From individual demand to market demand
- ►Market demand and changes in prices or income
- ►The impact importance of a market for consumers
- ►Consumer surplus: Willingness to pay versus actual pay

The Environment: _____ markets

Price taking assumption: There is one (per-unit) price that everybody takes as given.

- Impersonal market
- No haggling, bluffing, or other forms of strategic behaviour to influence prices.

The Price Elasticity of Demand and Supply

- Price Elasticity is a _____ measurement of the **sensitivity** of the quantity demanded or supplied to a change in the price.

- This sensitivity measures how much the firm's total revenue will change in response to a price change.

- Total revenue increases or decreases depending on how large the percentage change in the quantity demanded is relative to the percentage change in the price.

Hence, the price elasticity of demand determines whether revenue will rise or fall.

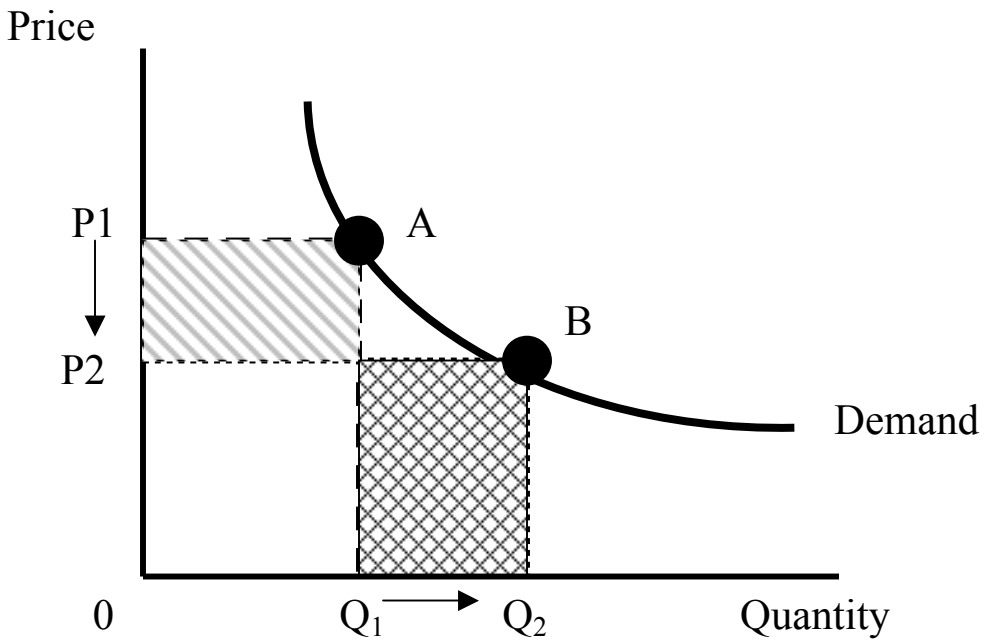
Price Elasticity of Demand

"The price elasticity of demand measures the percentage change in the _____ demanded relative to the percentage change in price."

If the percentage change in the quantity demanded is larger than the percentage change in price, total revenue will change in the opposite direction to the price change.

Let R=PQ (Total Revenue)

i.e. P increases $\rightarrow$Q decreases$\rightarrow$If Q is > P$\rightarrow$TR decreases
The change in TR is negative.



At the lower price, the firm can sell **more** units and TR increases.

At price P1, the quantity demanded is Q1.
Total revenue= P1*Q1.

Suppose price falls: At the new lower price of P2, the quantity demanded is Q2. → Total revenue is P2*Q2.

In this case, total revenue _____, but this is not always the case.

It depends on how ***sensitive*** a change in quantity demanded is to a change in _____.

The response of revenue to a change in price will result in demand being:

(1) **price elastic** if total revenue increases (decreases) when the change in price decreases (increases).

(2) **unitary elastic** if total revenue does not change when the price changes.

(3) **price inelastic** if the total revenue changes in the same direction that the price changes.

(I) Point Price Elasticity of Demand (small price changes)

The point price elasticity of demand measures the sensitivity of the quantity demanded to a change in price starting at a point on the demand curve.

The ____ of this elasticity is negative. Hence, it is customary to report the absolute value of the elasticity of demand.

If something is price elasticity| η_p |>1.

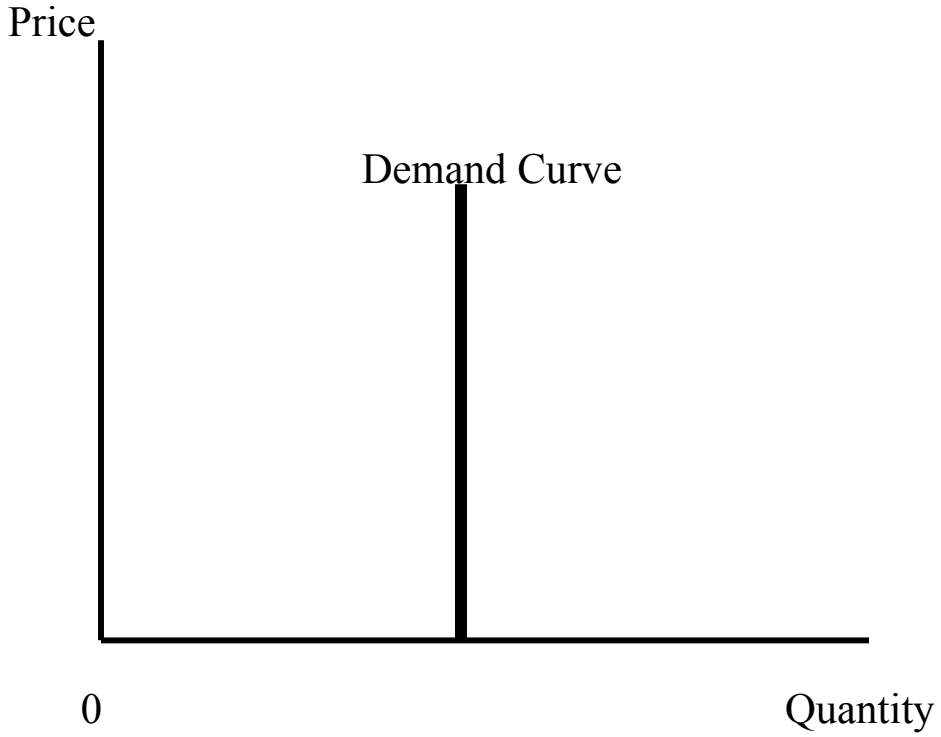
If something is price inelastic, | η_p |<1.

$$\eta_P = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta P}{P}} = \frac{\Delta Q}{\Delta P} \bullet \frac{P}{Q} \quad \Leftarrow \text{Point Elasticity of Demand}$$

$$\eta_P = \frac{\partial Q}{\partial P} \times \frac{P}{Q}$$

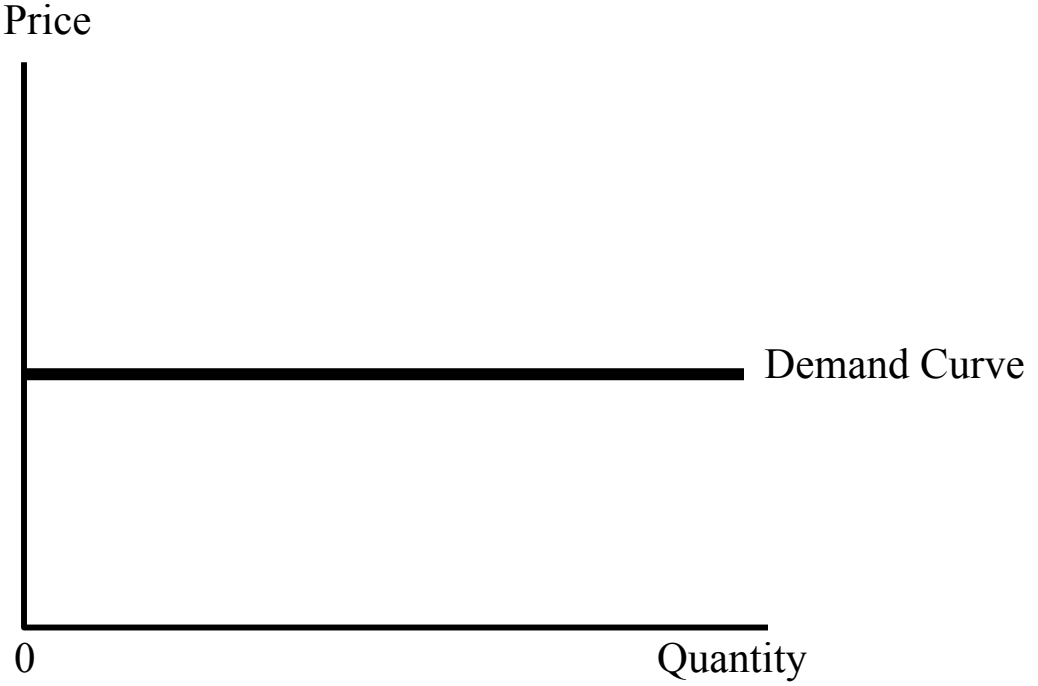
*Note: With straight-line demand functions, the numerical value of the price elasticity is different at different points along the demand function because $\Delta Q / \Delta P$ and/or P/Q will change. Only in some 'special' cases this does not hold.

Figure 1:
Demand Curve With ____ Price Elasticity of Demand



Demand curve has a price elasticity of zero: $\eta_p = 0$.
Quantity demanded is unaffected by price.
Example: Insulin

Figure 2:
Demand Curve with _____ Price Elasticity of Demand



Nothing can be sold if the price if the price is increased slightly.

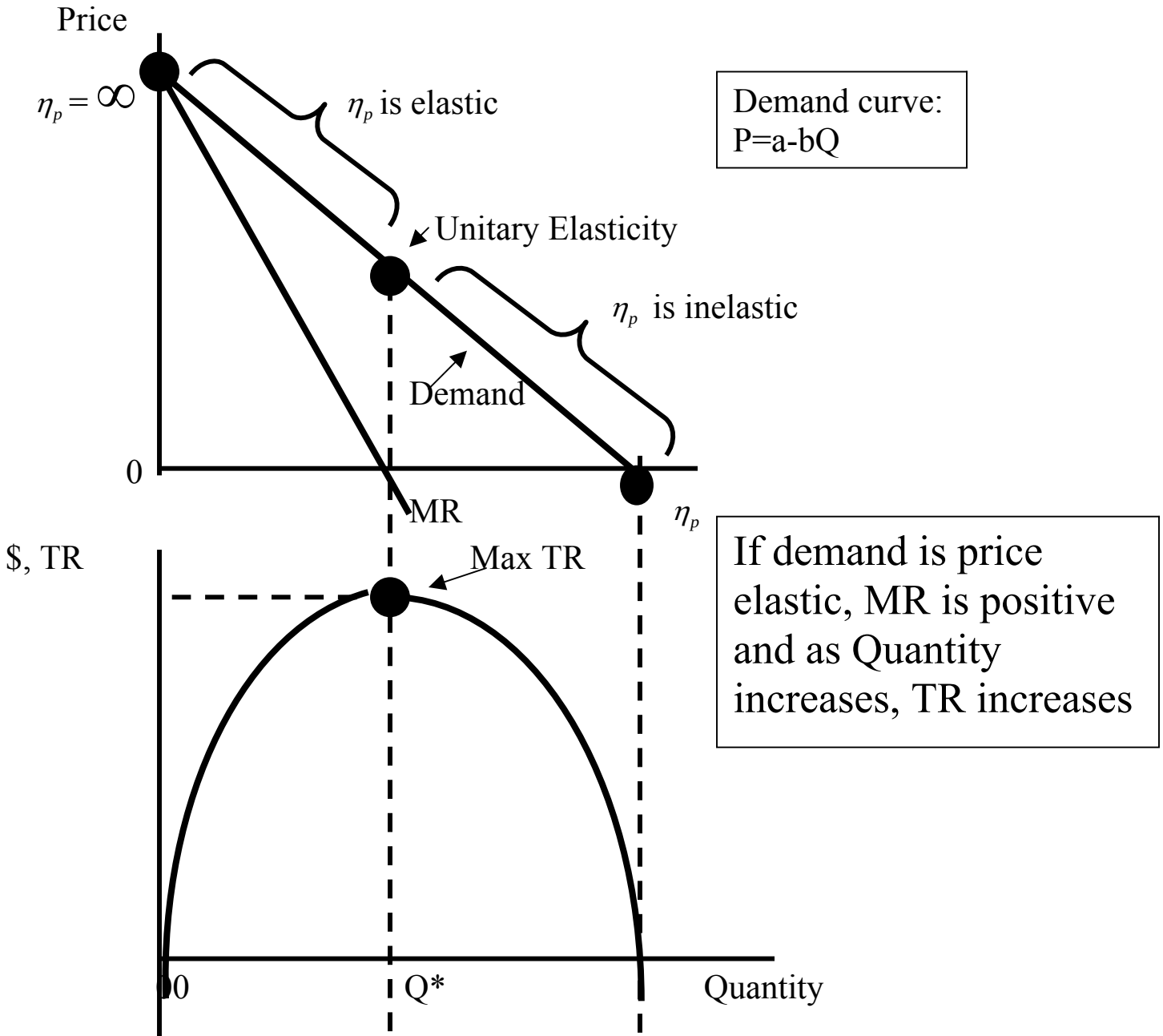
Demand curve price elasticity equals infinity: $\eta_p = \infty$.

→Unlimited amount can be sold at a particular price.

Example: interest rates on GICs.

Figure 3:

Values of the Price Elasticities Of Demand Along a Linear Demand Curve



Demand curve:
P=a-bQ

If demand is price elastic, MR is positive and as Quantity increases, TR increases

(II) Arc Price Elasticity of Demand (large price changes)

Also measures the percentage change in quantity relative to the percentage change in price.

Arc Price Elasticity: equals the change in quantity relative to the average quantity demanded divided by the change in price relative to the average price.

$$\eta_p = \frac{\dfrac{\Delta Q}{(Q_1 + Q_2)/2}}{\dfrac{\Delta P}{(P_1 + P_2)/2}} = \frac{\Delta Q}{\Delta P} \bullet \frac{P_1 + P_2}{Q_1 + Q_2}$$

Things to Note: The arc elasticity is:

(i) always _____ because $\Delta Q/\Delta P$ is negative. I.e. the price and quantity demanded will change in the opposite direction.

(ii) not equal to the slope of the demand function.

The value of the arc price elasticity dictates whether revenue increases, decreases or remains the same when price changes.

Just like the point elasticity of demand, the arc elasticity of demand has **three** possible outcomes:

1) If arc price elasticity is less than -1, demand is considered price **elastic**.

- Total revenue will change in the opposite direction to the price change.
- An increase in price leads to a decrease in total revenue.

2) If arc price elasticity is equal to -1, demand has **unitary** elasticity.

- A change in price does not change total revenue.

3) If arc price elasticity is between -1 and 0, demand is price-**inelastic**.

- Total revenue will change in the _____direction as the price change.

- An increase in price leads to an increase in revenue.

Factors That Determine the Size of Price Elasticity of Demand

1. The higher the percentage of a consumer's total income spent on a good, the _____ price-elastic is the demand for that good.

Expensive items are very price sensitive. Small changes in price, may lead to large changes in quantity demanded.

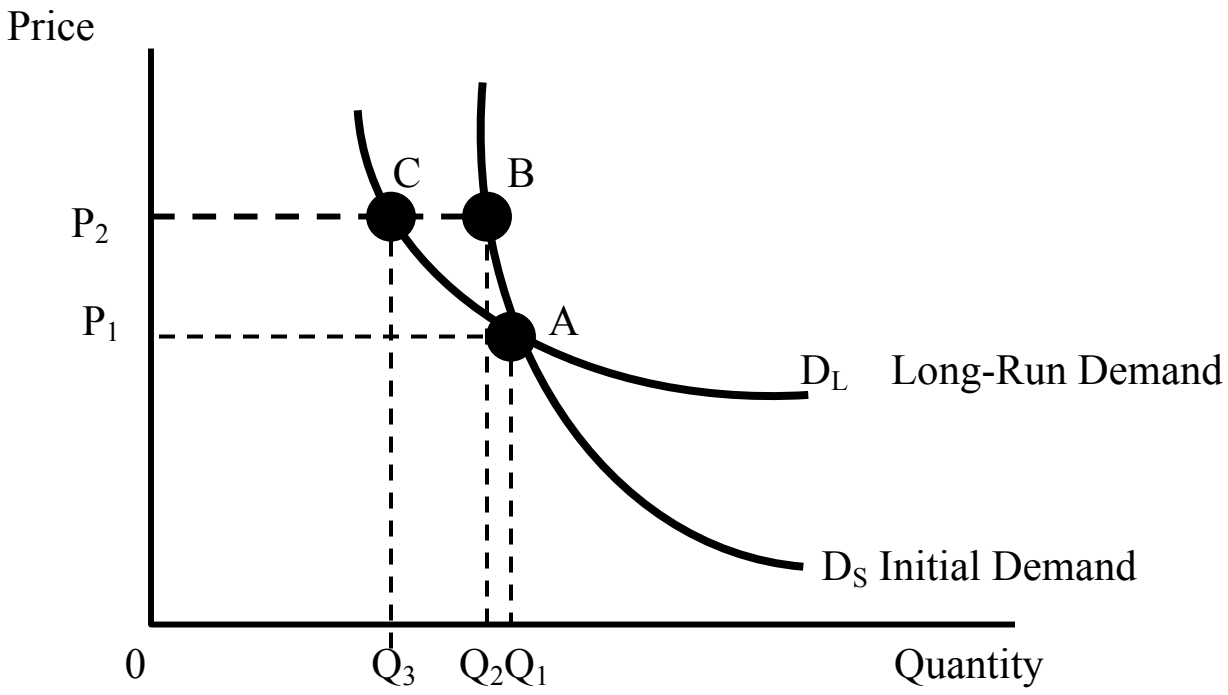
2. The more substitute products, the more demand will be price-elastic.

If the price of one type of cel-phone increases by a small amount, the demand for that phone may dramatically drop. This is because there are many substitute phones that offer the same quality of service.

3. As income rises and consumers continue to spend an increasing proportion of their increasing income on a good, these goods also have more _____ demand functions, other things remaining the same.

Examples: Houses, cars, vacations, etc..

4. **Time**: the more time for consumers to gather information about substitute products, the more price elastic is the demand for the good. In the short-run, a price change may have very little affect on the quantity of the good demanded. But, in the long-run, as consumers become more informed about substitute products, this price change may have a more dramatic affect on the quantity demanded. Hence, price increases may be a big mistake in the long-run.



As time goes by, consumers become more aware of alternative products.

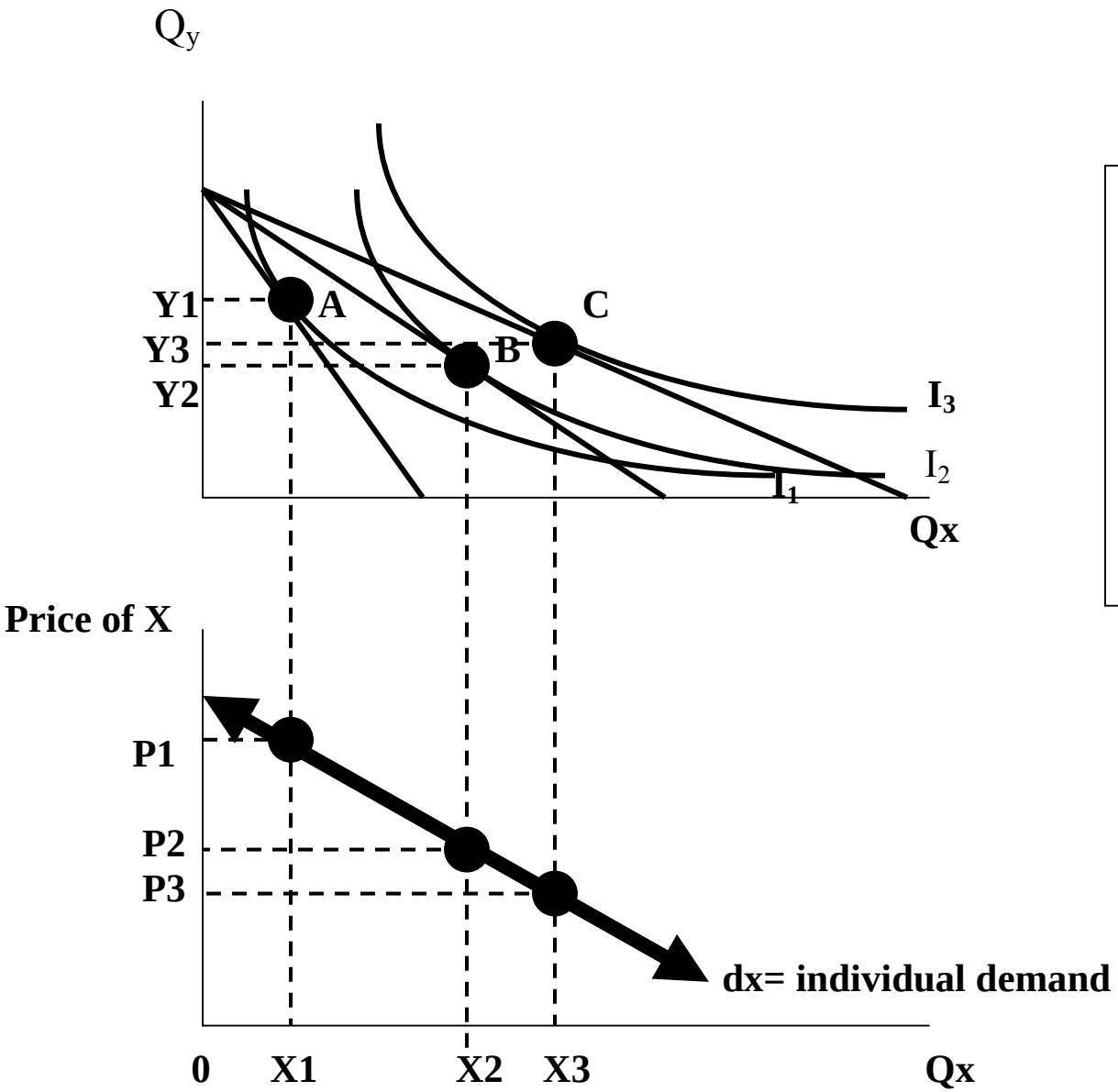
The demand function becomes more elastic in the long-run.

The Market Demand Function

To derive the market demand function, we will use the _____ maximization model of consumer behaviour to determine each consumer's demand function for a good.

The Consumer's Demand Function

Assume: the consumer's income is fixed
two goods, X and Y
price of Y is fixed



- As the price of X decreases, the budget constraint rotates.
- The consumer purchases different baskets to maximize utility.
- The demand curve for good X is **derived** as the price of X changes.

The Market Demand Function

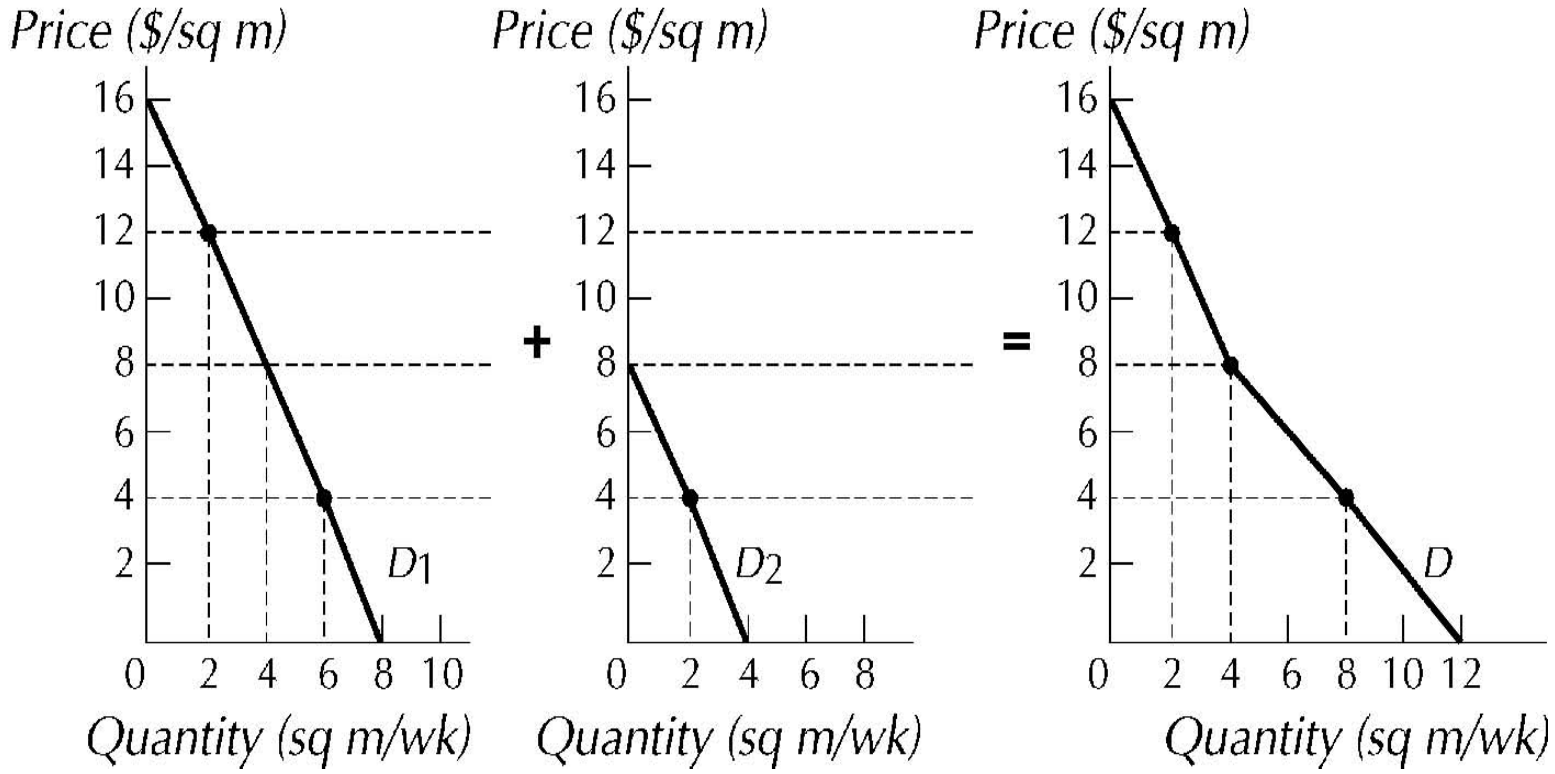
The market demand function represents the **total quantity** of a good demanded by **all** individuals at each price.

It is derived by summing up horizontally the demand curve of each consumer.

For each price, the quantity demanded by each consumer is added up horizontally to derive the total quantity demanded in the market.

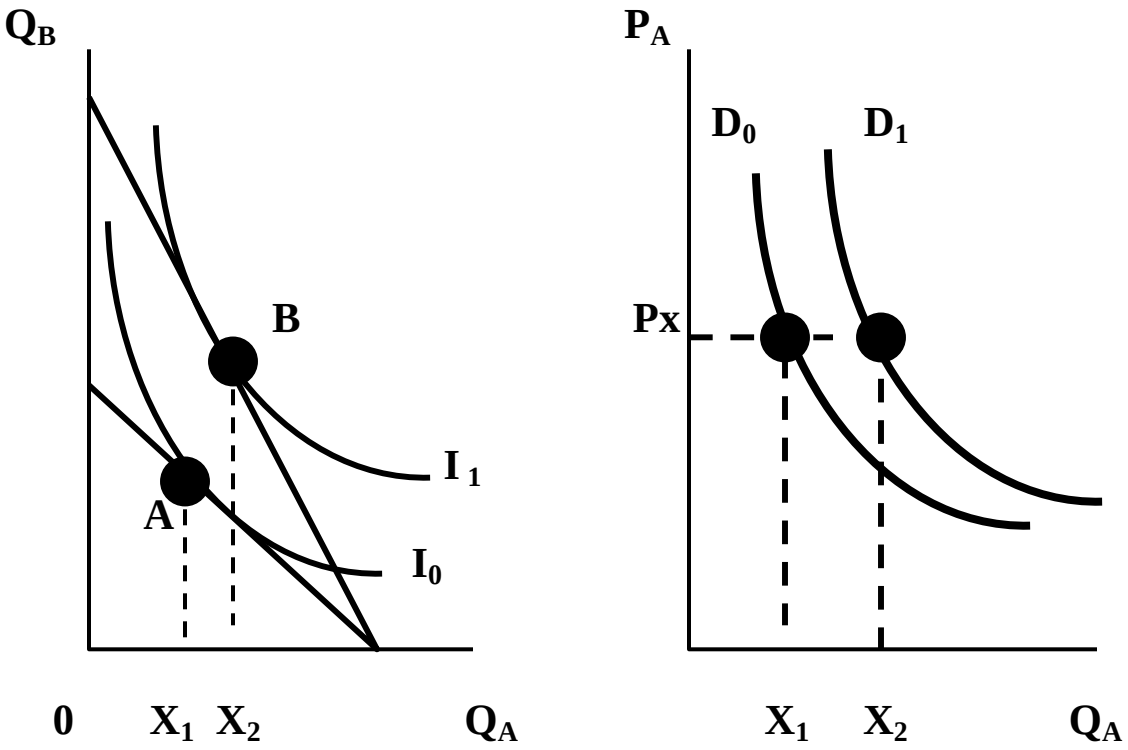
Individual demand curves differ because income and _____ differ across consumers.

Deriving the market demand curve (aggregated demand curve) from individual demand curves:



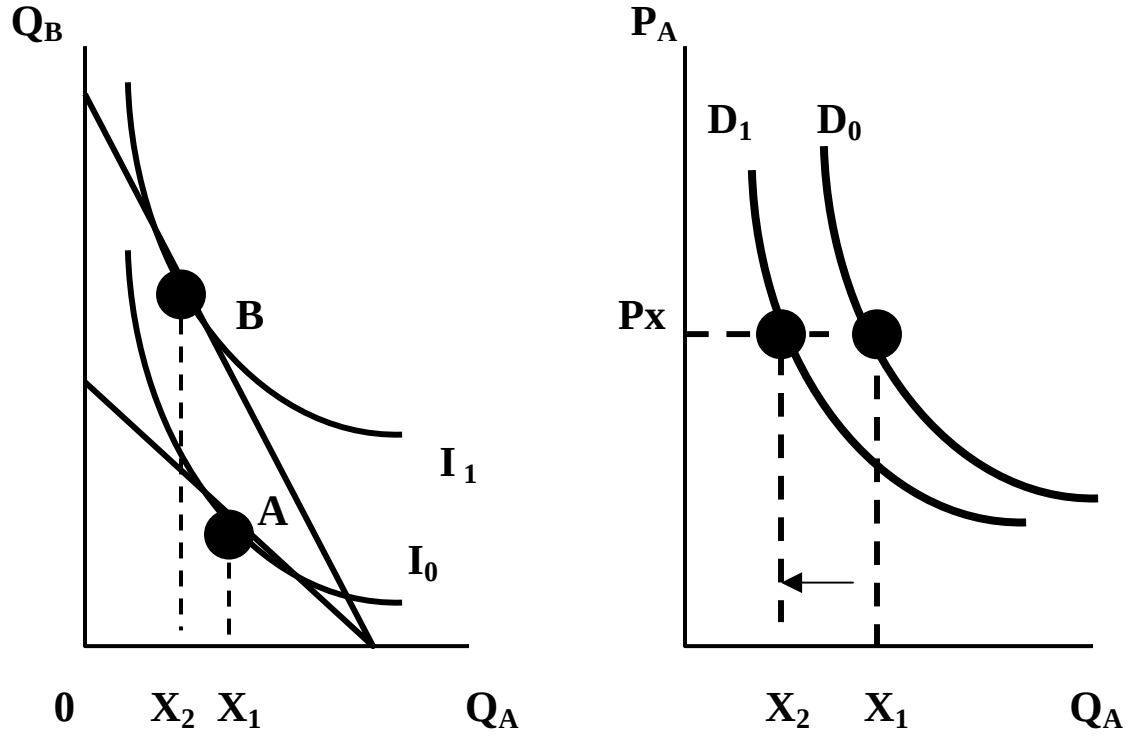
Substitutes and Complements

When the price of a good changes and the quantity demanded of another good changes in the opposite direction, with the price of the other good held constant, the two goods are referred as **complement goods**.



Demand for good A increases due to a decrease in the price of B.

When the price of a good changes and the quantity demanded of another good changes in the ____ direction, with the price of the other good held constant, the two goods are referred as **substitute goods.**



Examples:

IBM computers and Dell computers

We can determine whether two goods are substitutes or complements by the sign of the **arc cross-price elasticity of _____**.

The arc cross-price elasticity of demand measures the average percentage change in the quantity of one good relative to the average percentage change in the price of another.

If we have two goods A and B, the arc cross-price elasticity of demand is:

$$E_{BP_A} = \frac{\Delta B}{\Delta P_A} \bullet \frac{P_A^1 + P_A^2}{B_1 + B_2}$$

The only difference with this equation with the arc price elasticity of demand is that the change in the quantity of A has been replaced by the change in the quantity of B, and the sum of the units of A by the sum of the units of B.

The arc cross-price elasticity of demand measures the response of B to a change in the price of A.

If A and B are complements, then $\frac{\Delta B}{\Delta P_A}$ is _____ and the arc cross price elasticity of demand is **negative**.

If A and B are substitutes, then $\frac{\Delta B}{\Delta P_A}$ is positive and the arc cross price elasticity of demand is **positive**.

Extending the Theory of Consumer Behaviour

1) **The Shape of the Consumer's Demand Function**
   - Income Effect
   - Substitution Effect
   - Slope of the Demand Function

2) **Consumer Surplus**
   - Marginal Value

The Shape of the Consumer's Demand Function

Recall, consumers have different individual demand functions and indifference curves for goods.

If the price of a good is _____, some consumers will reduce their consumption of the good by a large amount, while other consumers will reduce their consumption by a modest amount.

This is because consumers have different preferences and income levels.

In order to examine the factors that explain the different responses these differences create, we will decompose the effects into what is referred to as the _____ **effect** and the **substitution effect**.

►Suppose the price a good 'X' decreases.

How does the consumer respond?

A price decrease in X can be viewed as a release in income formerly used to purchase units of X. These '$'s' represent an increase in disposable income that can be used to purchase more of good X or more of other goods.

This increase in disposable income can be graphically illustrated as a shift outward of the budget constraint.

As a result of the shifting budget constraint, the consumer can select a new market basket on a higher indifference curve.

So:

"The change in quantity demanded of good X due to the change in money income is the _____ effect.

But, a price cut also has a **substitution effect** that must be considered.

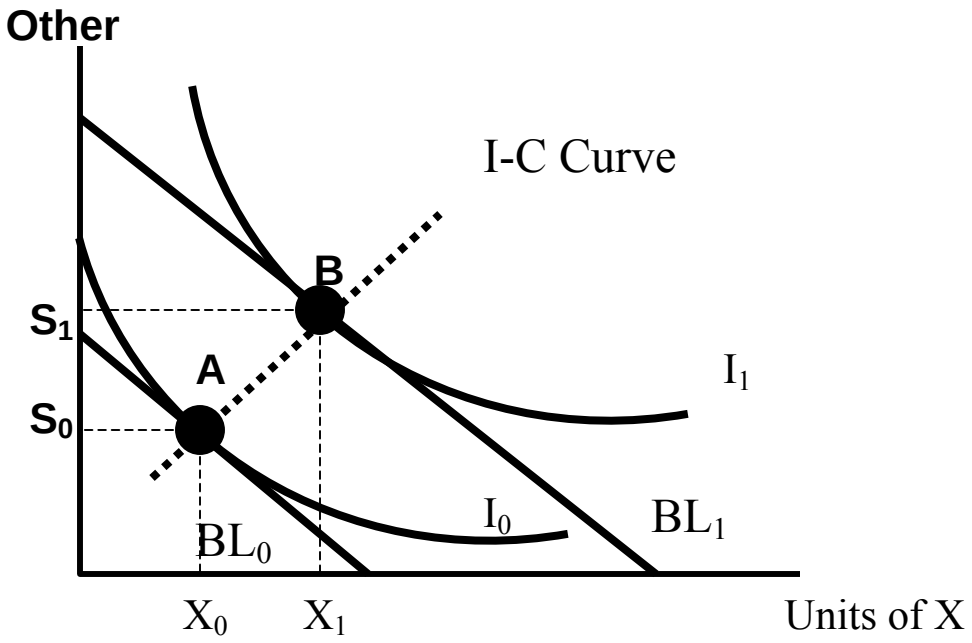
With a price cut, good X is now cheaper relative to other goods than before.

The consumer will now demand more units of the cheaper good and fewer units of other goods while remaining at the same level of satisfaction (same indifference curve).

The substitution effect measures the change in the quantity demanded due to a change in the relative price of X holding utility constant.

►Hence, we assume the consumer separates the total change in the quantity demanded of X caused by a price change into these two effects.

The Income Effect: Normal Good



If the consumer's income increases to BL_1, there will be a parallel shift outward by budget line.

The consumer can now purchase market bundle B on the higher indifference curve I_1, which is tangent to the higher budget constraint.

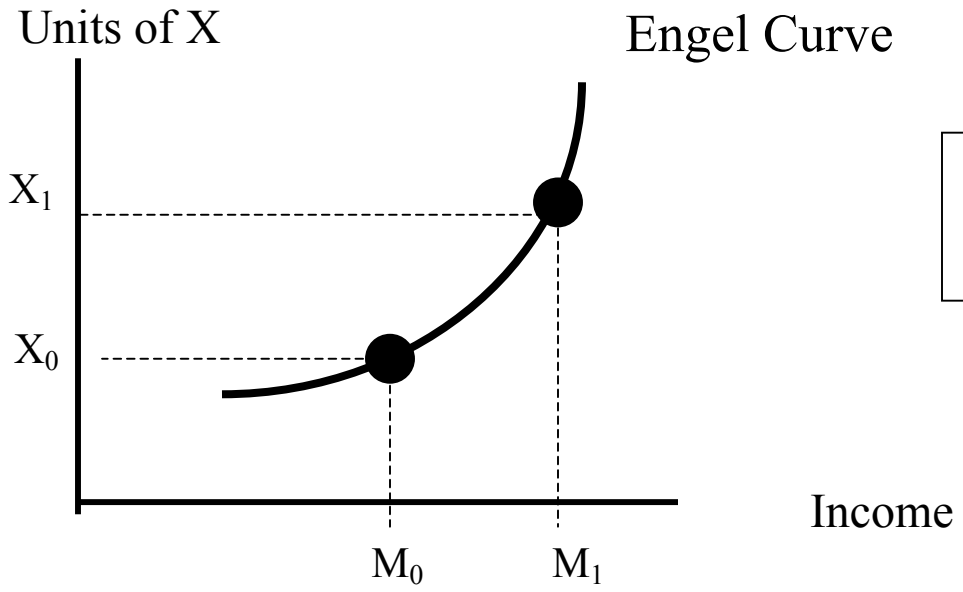
In this case, more of both goods are purchased

When the quantity demanded of a good changes in the same direction as the change in income, the good is referred to as a **good**.

Note: For every level of income there is point of tangency between the budget constraint and an indifference curve. By connecting these points, we form what is known as the **income-consumption** curve.

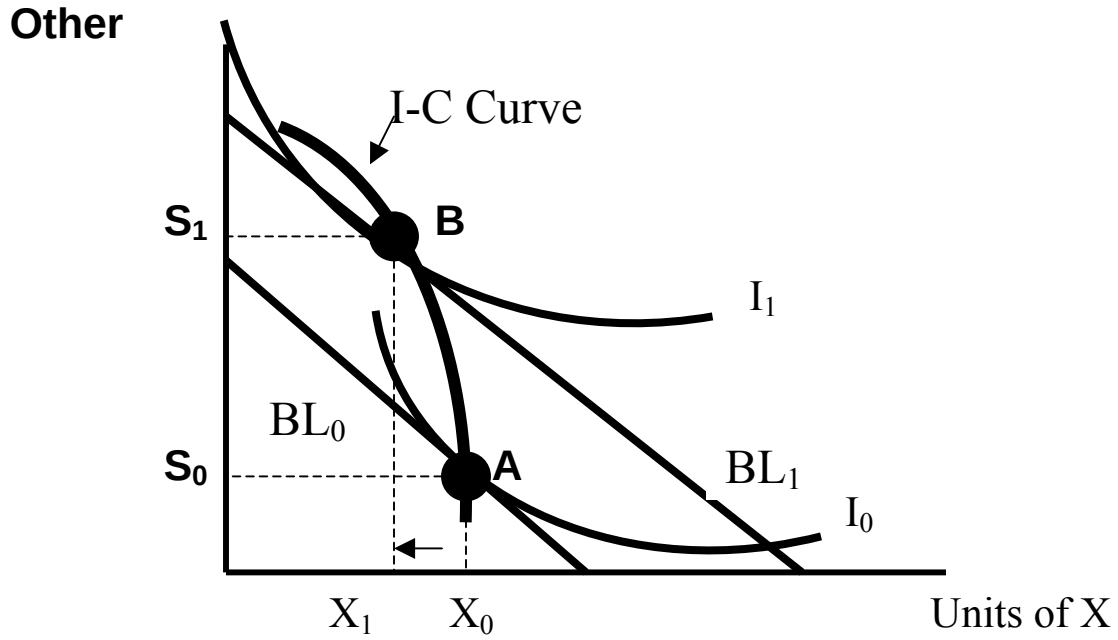
Engel curve illustrates the relationship between the quantity demanded of good X and the income of the consumer when prices are held constant.

With a normal good, the Engel curve has a _____ slope.



Examples: Fruit
Fresh meat

The Income Effect: Inferior Good



The diagram illustrates how a consumer's consumption choice changes when _____ has increased.

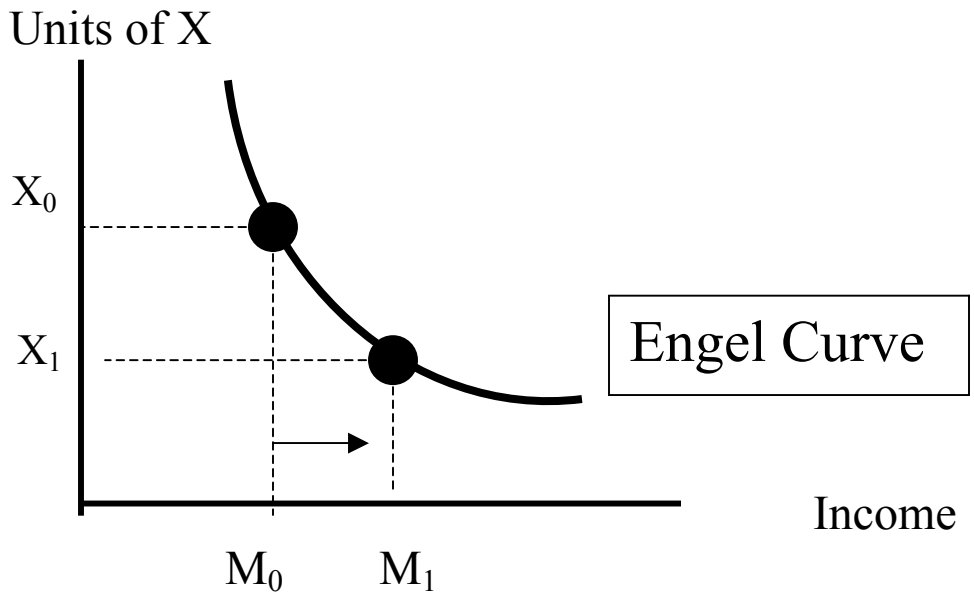
If the consumer's income increases to BL_1, there will be a parallel shift outward by the budget line.

The consumer can now purchase market bundle B on the higher indifference curve I_1, which is tangent to the higher budget constraint.

In this case, ____ of good X and more of other goods are purchased.

When the quantity demanded of a good changes in the opposite direction as the change in income, the good is referred to as an **inferior good**.

With an inferior good, the Engel curve has a negative slope.



Examples:
Hamburger
used cars
used shoes

This is because the quantity demanded decreases when income increases holding prices constant.

Note: Inferior goods are not inferior to all consumers at all income levels.

Income Elasticity of Demand

Income elasticity of demand measures the response of a percentage change in the quantity demanded due to a percentage change in income.

The point income elasticity of demand:

$$\eta_M = \frac{\frac{\Delta Q_x}{Q_X}}{\frac{\Delta Income}{M}} = \frac{\Delta Q_x}{\Delta M} \bullet \frac{M}{Q_X}$$

The point measure of income elasticity is the percentage change in quantity demanded divided by the percentage change in income.

The arc income elasticity of demand:

$$\eta_M = \frac{\frac{\Delta Q_x}{\left(Q_{X0} + Q_{X1}\right)/2}}{\frac{\Delta Income}{\left(M_0 + M_1\right)/2}} = \frac{\Delta Q_x}{\Delta M} \bullet \frac{\left(M_0 + M_1\right)}{\left(Q_{X0} + Q_{X1}\right)}$$

η_M is positive for a normal good (I.e. the quantity demanded increases when income increases,) and is negative for an inferior good. (I.e. quantity demanded decreases when income increases.

Of course, even if a good is classified to be normal, this does not guarantee that a consumer will continue to spend an increasing proportion of income on it as his or her income increases.

This will only occur if the income elasticity of demand is greater than 1.

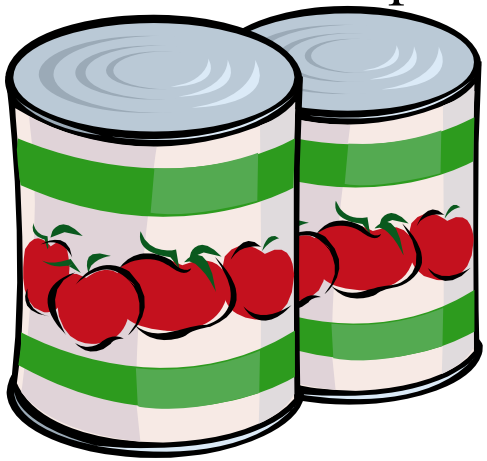
$$\eta_M > 1$$

Examples: Vacations

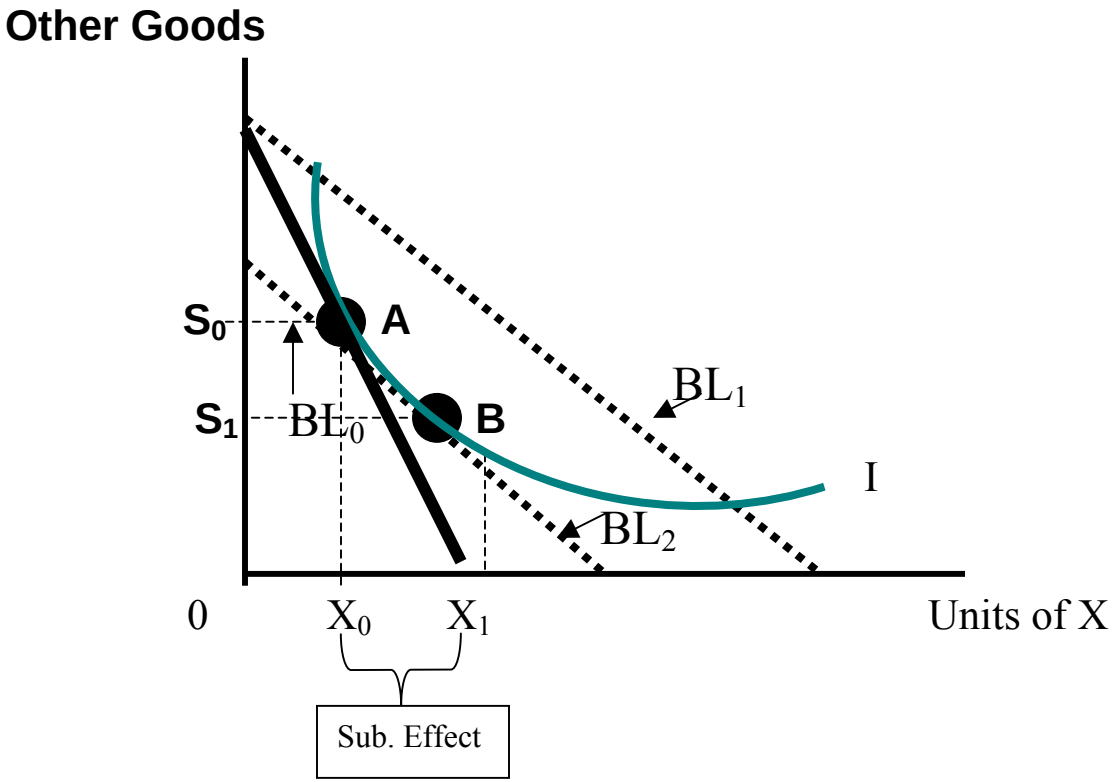
If the income elasticity of demand is between zero and 1, a good is a _____ good but the consumer spends a decreasing proportion of income on it as income rises, assuming that price has remained the same.

$0 < \eta_M < 1$

Examples: food
Clothing
Soap



Substitution Effect:



The substitution effect reflects how a consumer responds when the relative price of the good X changes such that his or her level of utility remains the same.

If the price of the good X falls, the budget constraint rotates outward.

We know that the consumer will purchase a different market basket of goods on a higher indifference curve.

Hence the utility of the consumer will _____.

But, the substitution effect measures the change in the quantity demanded when the relative prices change with ***utility held constant***.

In order to keep the consumer on the original indifference curve and maintain the original level of utility, we change money income as the price changes by just enough so that the consumer finds a new market basket on the original indifference curve where the slope of the new budget constraint equals the slope of the indifference curve.

The quantity of X demanded increases to X_1.

Since the relative price of X is lower, budget line BL_2 is flatter than BL_0.

The consumer's response to a relative price decrease in X is to purchase more units of good X and spend less on other goods.

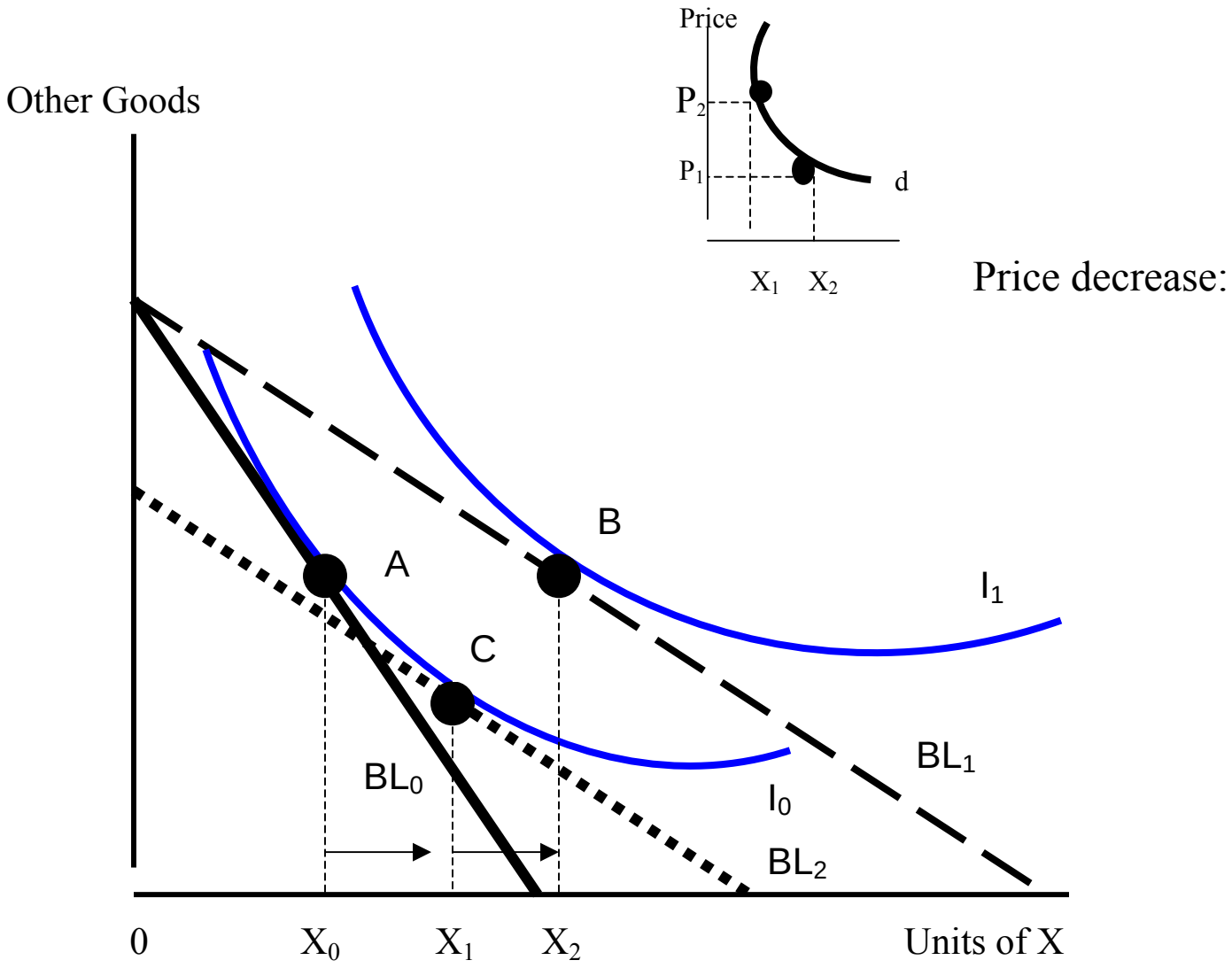
The sign of the substitution effect is _____ because a change in the relative price of X changes the quantity demanded in the opposite direction.

The Income and Substitution Effects

By combining the two effects, we can illustrate how a change in price changes the quantity demanded.

The change in the quantity demanded is the sum of the two effects:

$$\begin{bmatrix}\text{Change in}\\ \text{quantity}\\ \text{demanded}\end{bmatrix} = \begin{bmatrix}\text{Change in quantity}\\ \text{demanded due to}\\ \text{the substitution effect}\end{bmatrix} + \begin{bmatrix}\text{Change in quantity}\\ \text{demanded due to}\\ \text{the income effect}\end{bmatrix}$$


Price
P2
P1
d
X1
X2
Price decrease:
Other Goods
A
B
C
I1
I0
BL0
BL1
BL2
0
X0
X1
X2
Units of X

The **substitution effect** is the increase in the quantity demanded from X_0 to X_1 units.

The **income effect** shifts the budget line outward in a parallel fashion from BL_2 to BL_1. This is because the price reduction frees up additional income to spend.

The consumer moves from market basket C to market basket B. The income effect increases the quantity demanded by X_2-X_1.

Together, the two effects explain why the quantity demanded increases from X_0 to X_2.

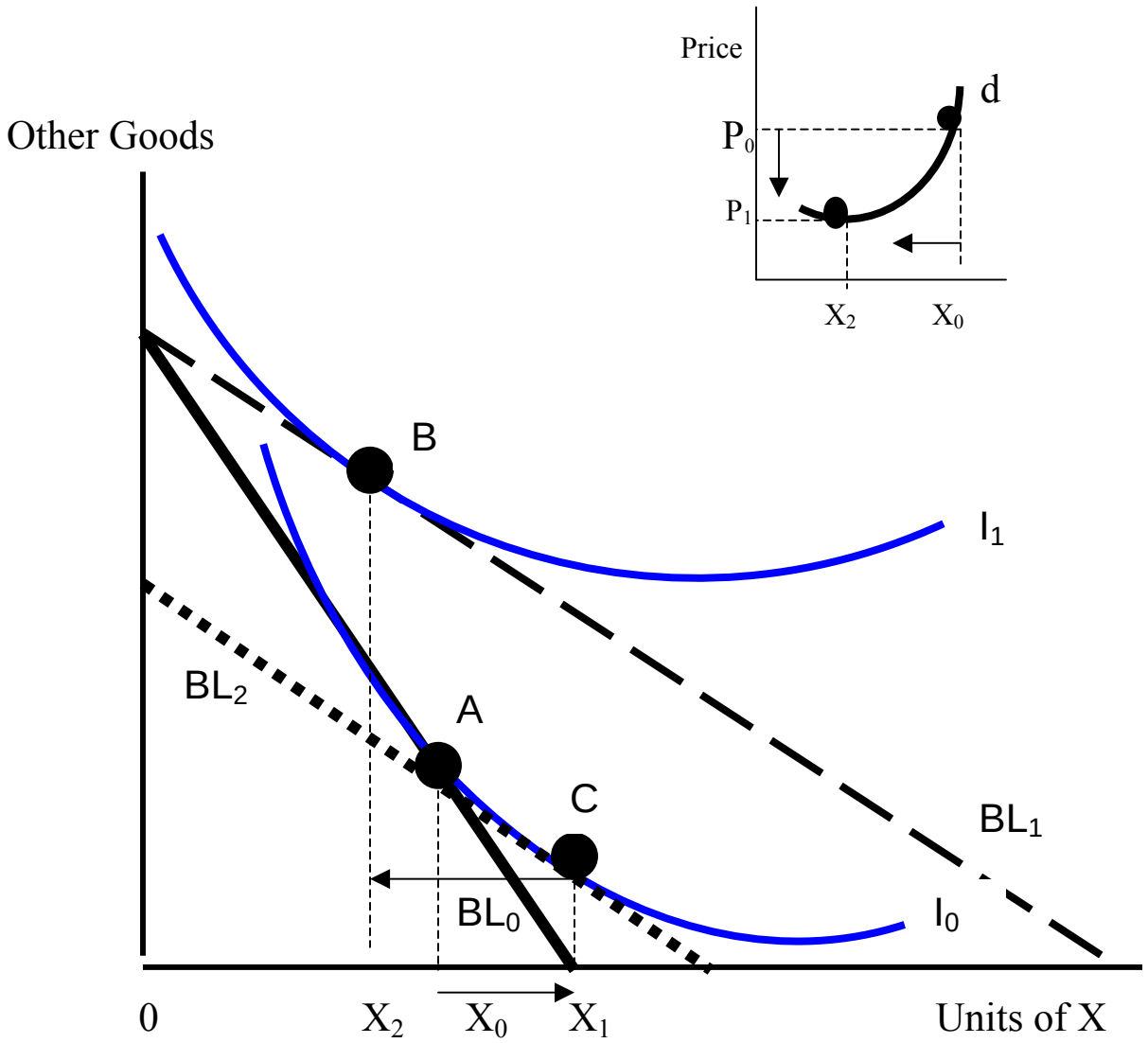
When the good is a normal good, the income effect reinforces the substitution effect: when the price falls, the quantity demanded must increase.

If the good is a normal good, a consumer demands more units at a lower price and so the demand function of the consumer has a negative slope.

What would the demand function look like for an inferior good?

There are two possibilities:

1) **The Income effect overwhelms the Substitution Effect**



The price of X falls and the budget constraint rotates out to BL_1

The total change from the decrease in the price of good X can be separated into two components:

The **substitution effect** is $X_1 - X_0$. (Opposite direction to the price change.)

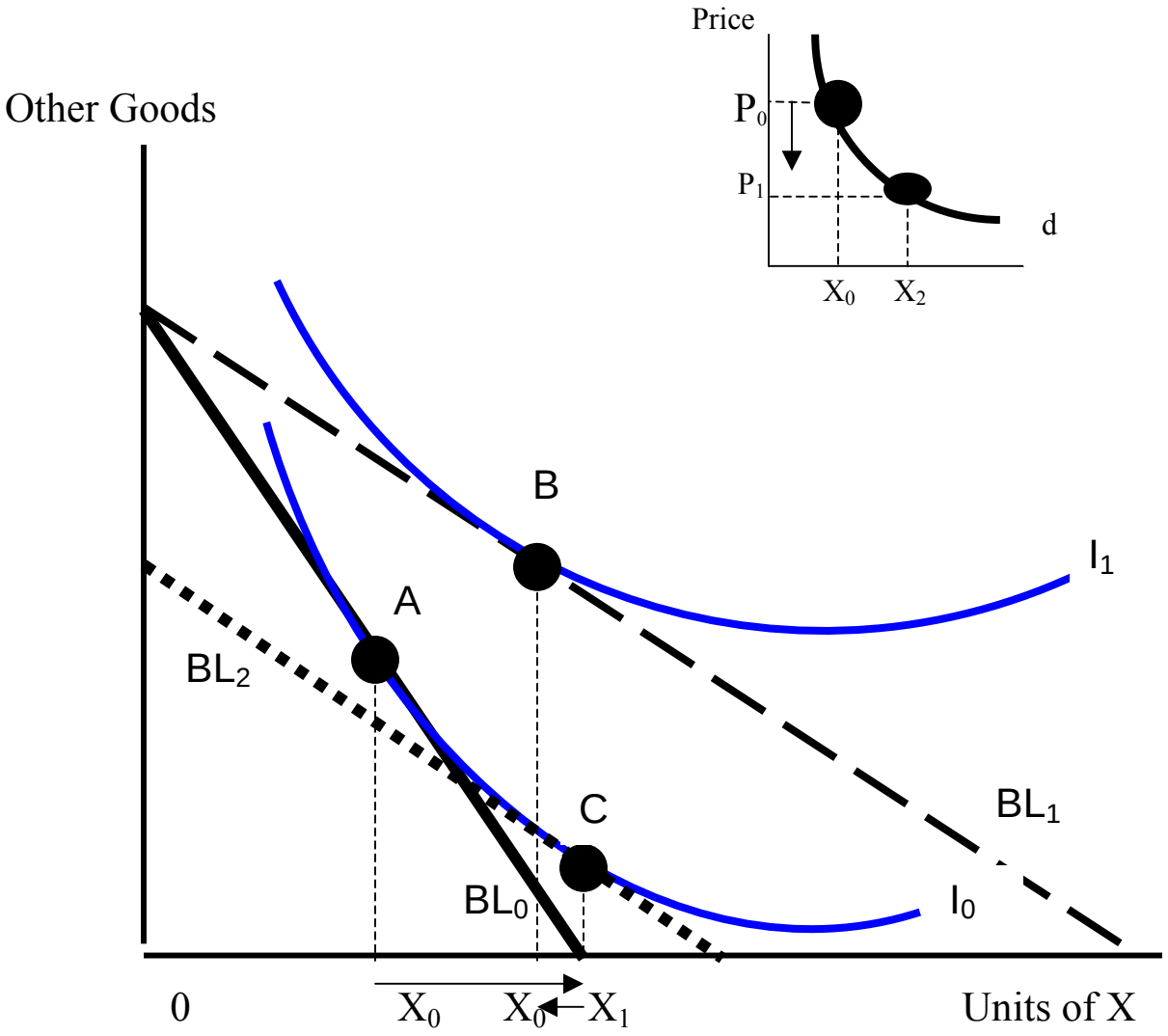
The **income effect** is X_1-X_2. (Same direction as the price change.)

The net effect is a _____in the quantity demanded due to a fall in price.

The consumer's demand function has a **positive** slope. This is because the income effect overwhelms the substitution effect.

When this occurs, we refer to this good as a **Giffen good**.

2) The Substitution Effect Overwhelms the Income Effect



In this case, the demand curve will have a negative slope:

The price of X decreases.
The substitution effect equals X_1-X_0.
The income effect equals X_2-X_1.

Hence, with a decrease in the price of X, the quantity of X demanded increases because the substitution effect overwhelms the income effect.

The Slope of the Demand Function

The consumer's demand function represents the relationship between the quantity demanded and the price of the good with income and other prices held constant;
X=d(P) (Individual Demand Function)

The slope of the demand function is $\frac{\Delta X}{\Delta P}$ and depends on the size of the substitution and income effects.

So, in order to determine whether a price change will result in a large or small change in the quantity demanded, we need to determine the size of the income or substitution effect.

Recall, the substitution effect measures the change in the quantity demanded due to a price change holding utility constant.

This can be expressed as: $\frac{\Delta X}{\Delta P}\Big|_{U=C}$.

$\frac{\Delta X}{\Delta P}$ can be determined by measuring how the quantity demanded changes along an indifference curve as the relative price of the good X changes.

This quantity will always be **negative** since the consumer demands more units of a good when its price decreases.

The slope of the demand curve also depends on the income effect.

So, when will this effect be large?

It depends on two factors:

1) The amount of income that is freed up when the price of the good falls.

2) The number of units the consumer ***now*** demands since income has increased.

The income that becomes available per dollar change in price depends on the number of units the consumer is presently consuming.

When the price of the good falls, the amount of income available to spend on goods is equal to:

$$\Delta M = -(\Delta P)\, X$$

Looking at this expression, the greater is the change in income the larger is the amount of X the consumer is currently consuming.

The change in income per dollar decrease in price equals:

$\left(\frac{\Delta M}{\Delta P}\right) = -X$.

$\left(\frac{\Delta X}{\Delta M}\right)$ equals the increase in the quantity demanded of X per dollar increase in income.

Thus, the change in the quantity demanded due to the income effect is $-X \bullet \left(\frac{\Delta X}{\Delta M}\right)$

Recall, the change in the quantity demanded due to a price change is the sum of the changes caused by the substitution effect and the income effect.

The slope of the consumer's demand function can be expressed as:

$$\left(\frac{\Delta X}{\Delta P}\right) = \left.\frac{\Delta X}{\Delta P}\right|_{U=c} - X\left(\frac{\Delta X}{\Delta M}\right)$$

Slutsky Equation

Slutsky Equation: the slope of the demand function equals the sum of the substitution and income effects. The sign of the substitution effect is always negative.

When the income effect is negative, the slope of the demand curve is negative due to the fact that the substitution effect is always negative.

If the good is a normal good, the income effect is also negative.

►The demand function will have a negative slope.

☺ If the good is an inferior good, the income effect will be positive and the slope of the demand curve can be either positive or negative.

Consumer Surplus

Objective: to demonstrate how consumer surplus is derived from the consumer's demand function.

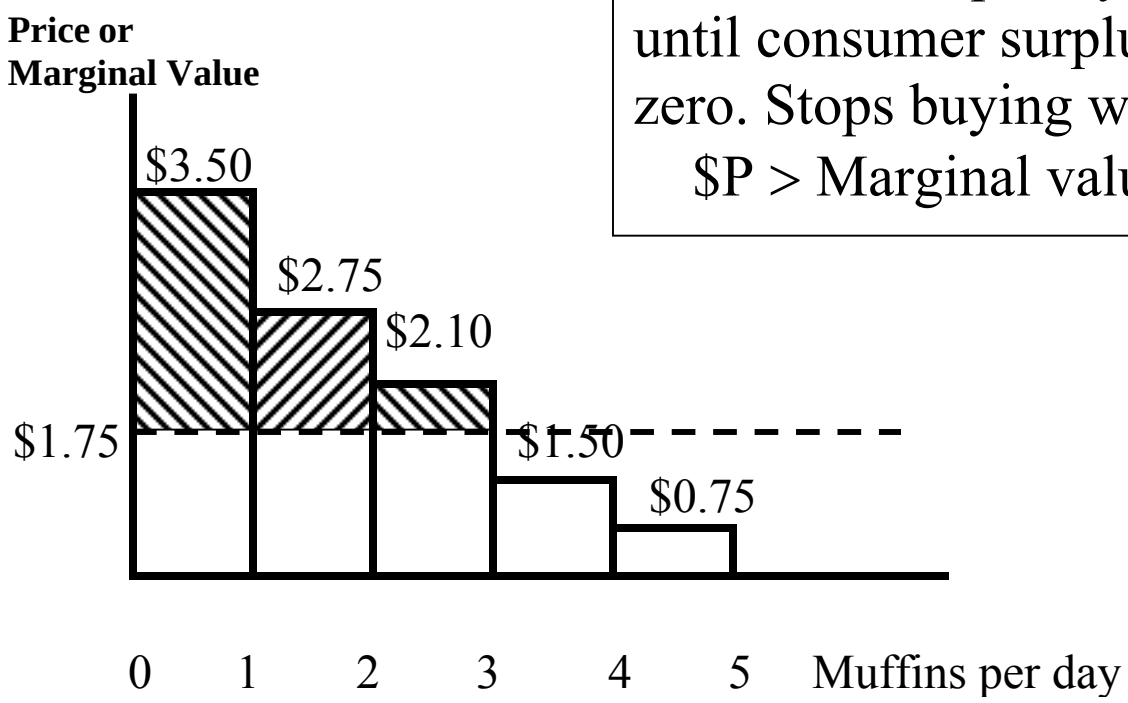
❖Consumer surplus is the difference between the _____ amount the purchaser would pay to consume a given quantity of a good and the actual amount paid.

It is assumed that the consumer receives a surplus by consuming the good and is willing to pay even more than go without the good.

Marginal Value: is the most that a consumer is willing to pay for each additional unit of a good.

A consumer that maximizes consumer surplus will determine the quantity to buy such that marginal value equals price.

Example: Muffins

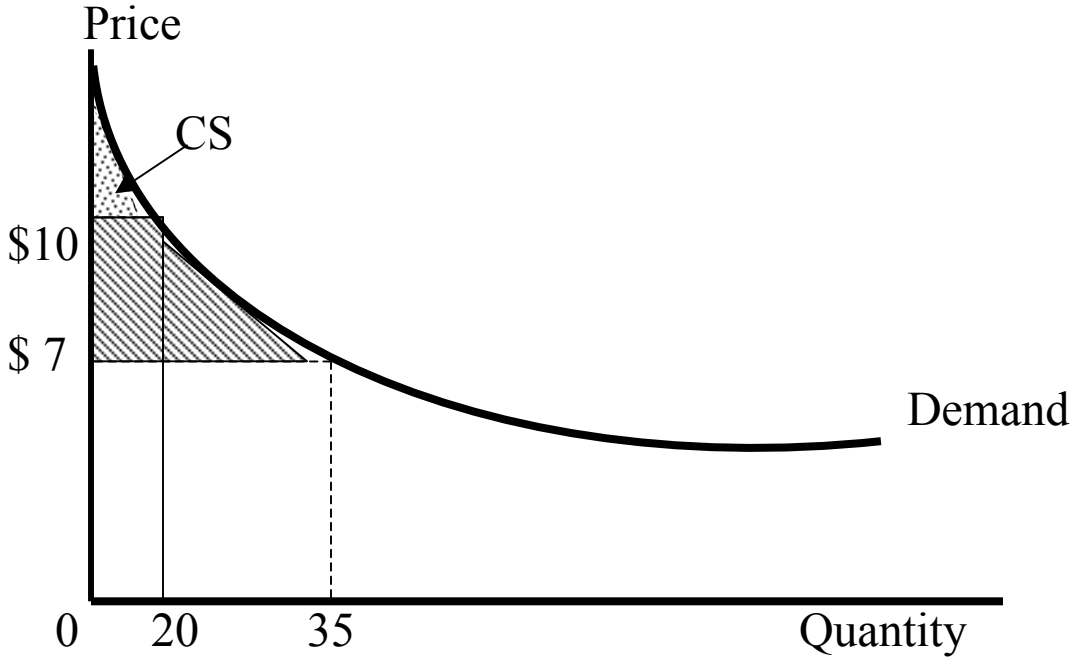


Consumer keeps buying a unit until consumer surplus equals zero. Stops buying when:

$P > Marginal value

Using Consumer Surplus To Increase Total Revenue

If the owner of a business is aware of the typical demand function of its product, he or she can attempt to capture some of the consumer surplus by charging different prices for each unit of the good sold:



The consumer will buy 35 units at $7.
Charge the consumer more than $10 for units less than 20.

Discriminatory pricing!

Transfer of _____ from consumer to producer!

☺☺☺☺☺☺☺

What About Pricing Policies that generate a loss of consumer surplus?

Some policies are designed to protect the producer, but at the expense of the consumer.

By increasing price and restricting output, these policies harm the consumer and generate a loss known as a dead-weight-loss.

Dead-weight-loss: represents the decrease in consumer surplus that is not transferred to some other group.