Chapter 3

Individual Demand Curves

Individual Demand Curves

- This chapter studies how people change their choices when conditions such as income or changes in the prices of goods affect the amount that people choose to consume.

- This chapter then compares the new choices with those that were made before conditions changed

- The main result of this approach is to construct an individual's demand curve

Demand Functions

- If we knew a person's preferences and all the economic forces that affect his or her choices, we could predict how much of each good would be chosen.

- This summarizes this information in a **demand function**: a representation of how quantity demanded depends on prices, income, and preferences.

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Demand Function

$$\text{Quantity of X demanded} = d_x(P_X, P_Y, I; preferences)$$

- The three elements that determine the quantity demanded are the prices of X and Y, the person's income (I), and the person's preferences for X and Y.

- Preferences appear to the right of the semicolon because we assume that preferences do not change during the analysis.

Homogeneous Demand Function

- Individual demand functions are homogeneous since quantity demanded does not change when prices and income increase in the same proportion.

- The budget constraint $P_XX + P_YY = I$ is identical to the budget constraint $2P_XX + 2P_YY = 2I$.

- Graphically the lines are the same.

Changes in Income

- When a person's income increase, while prices remain the same, the quantity purchased of each good might increase.

- This situation is shown in Figure 3.1 where the increase in income is shown as the budget line shifts out from I_1 to I_2 to I_3.

- The slope of the budget lines are the same since the prices have not changed .

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FIGURE 3.1: Effect of Increasing Income on Quantities of X and Y Chosen

Quantity of Y per week

Y_1
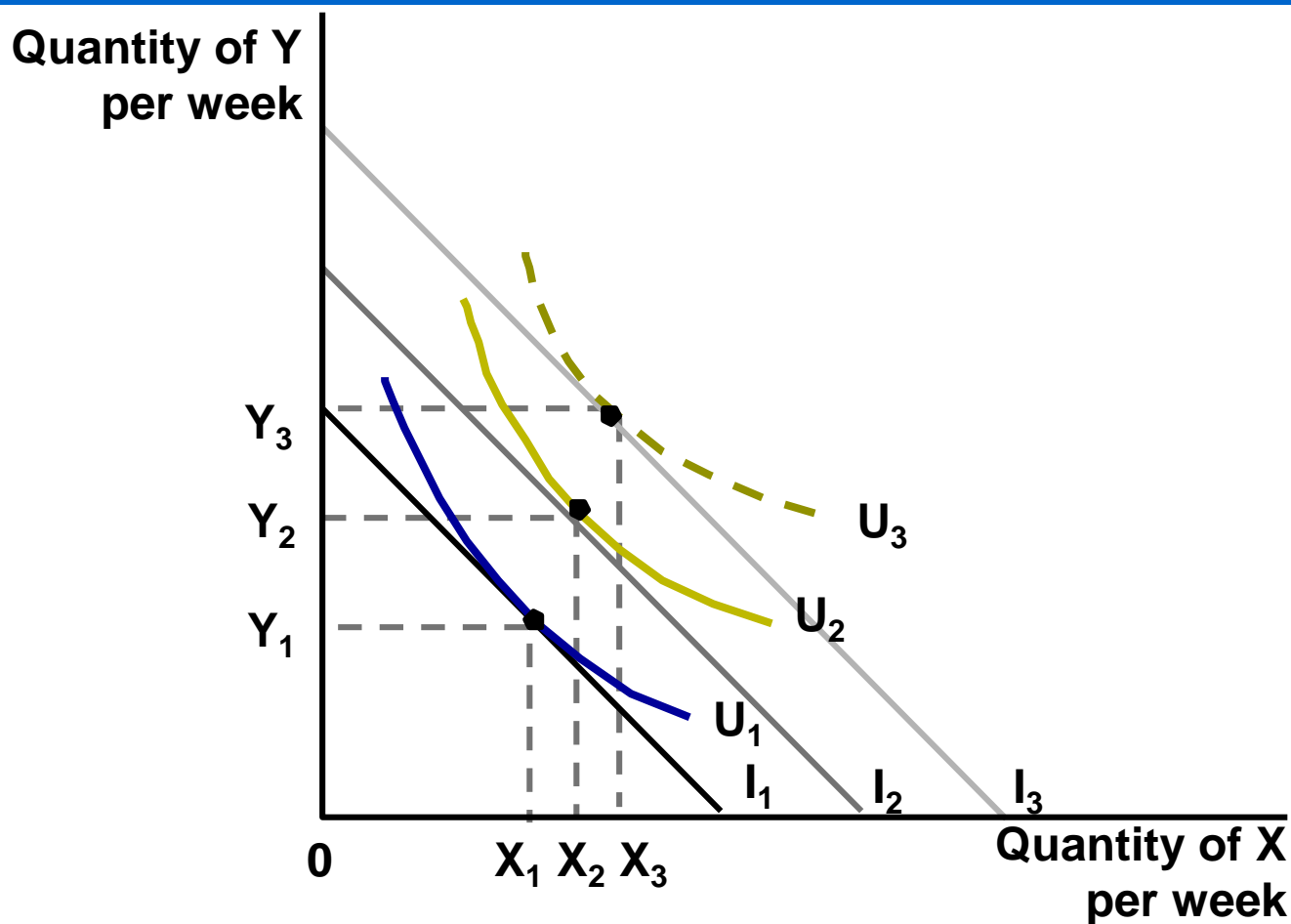
U_1

I_1

0   X_1

Quantity of X per week
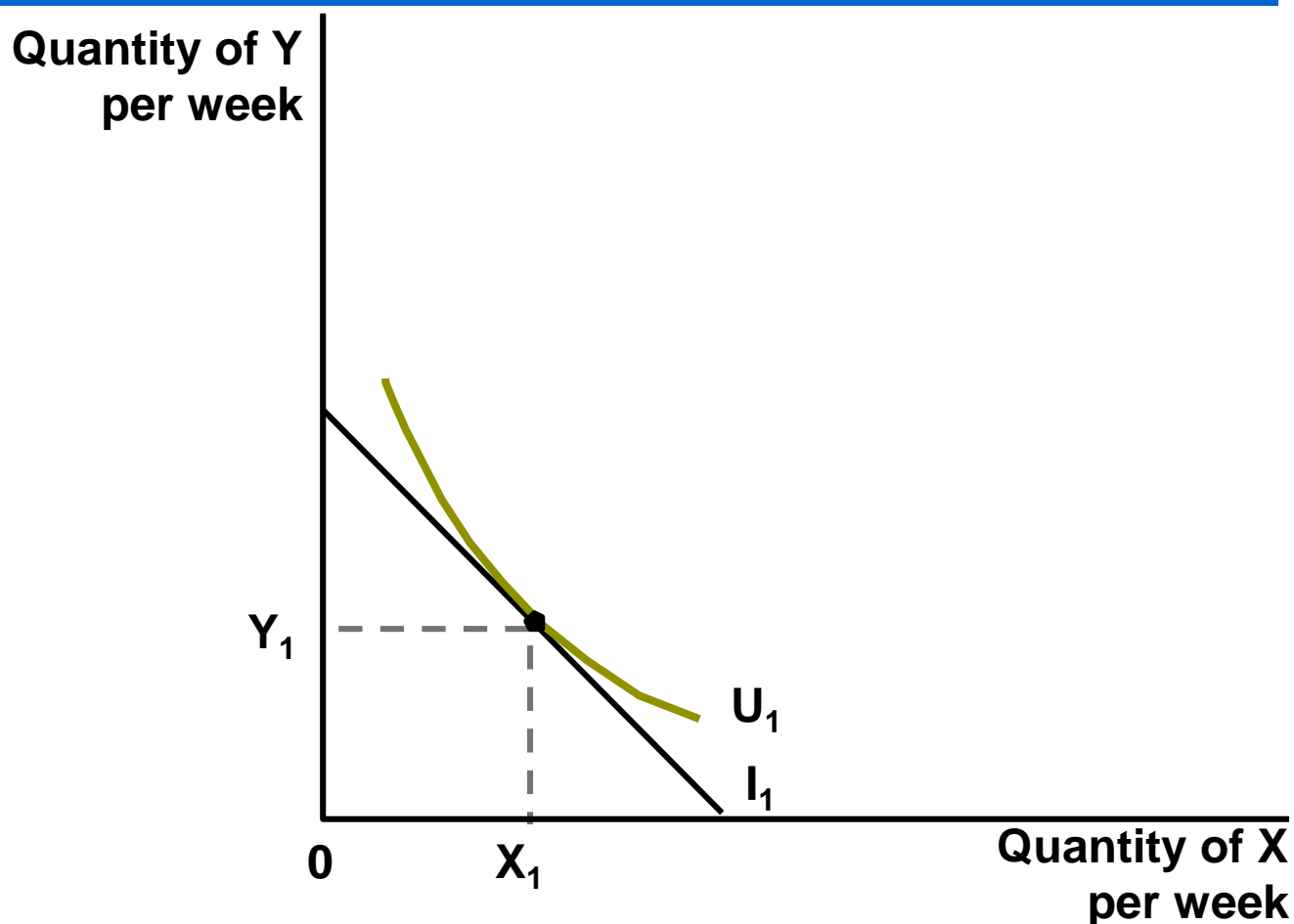
FIGURE 3.1: Effect of Increasing Income on Quantities of X and Y Chosen
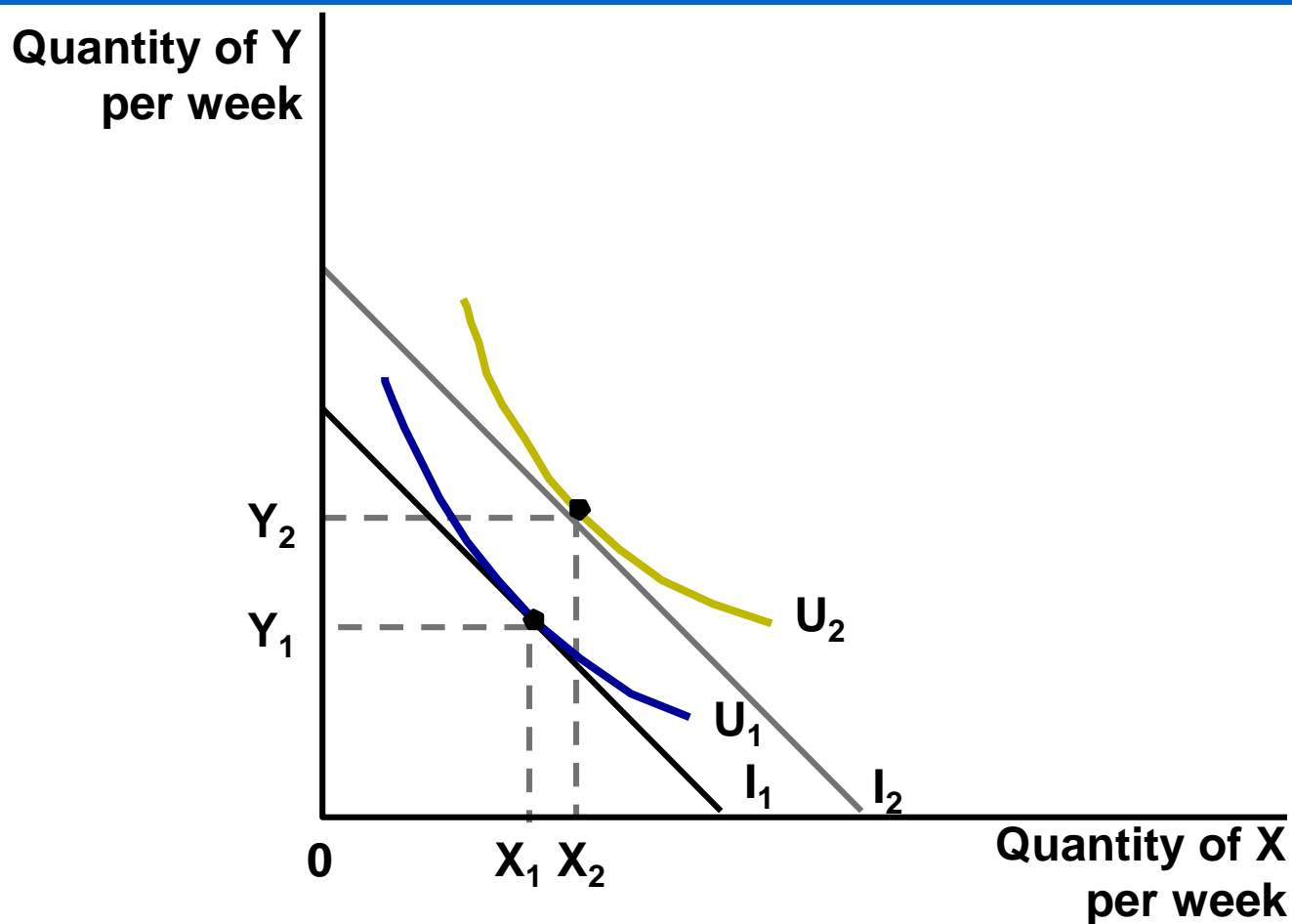
FIGURE 3.1: Effect of Increasing Income on Quantities of X and Y Chosen

Changes in Income

- In response to the increase in income the quantity of X purchased increases from X_1 to X_2 and X_3 while the quantity purchased of Y also increases from Y_1 to Y_2 to Y_3.

- Increases in income make it possible for a person to consume more reflected in the outward shift in the budget constraint that allows an increase in overall utility.

Normal Goods

- A **normal good** is one that is bought in greater quantities as income increases.

- If the quantity increases more rapidly than income the good is called a luxury good as with good Y in Figure 3.1.

- If the quantity increases less rapidly than income the good is called a necessity good as with good X in Figure 3.1.
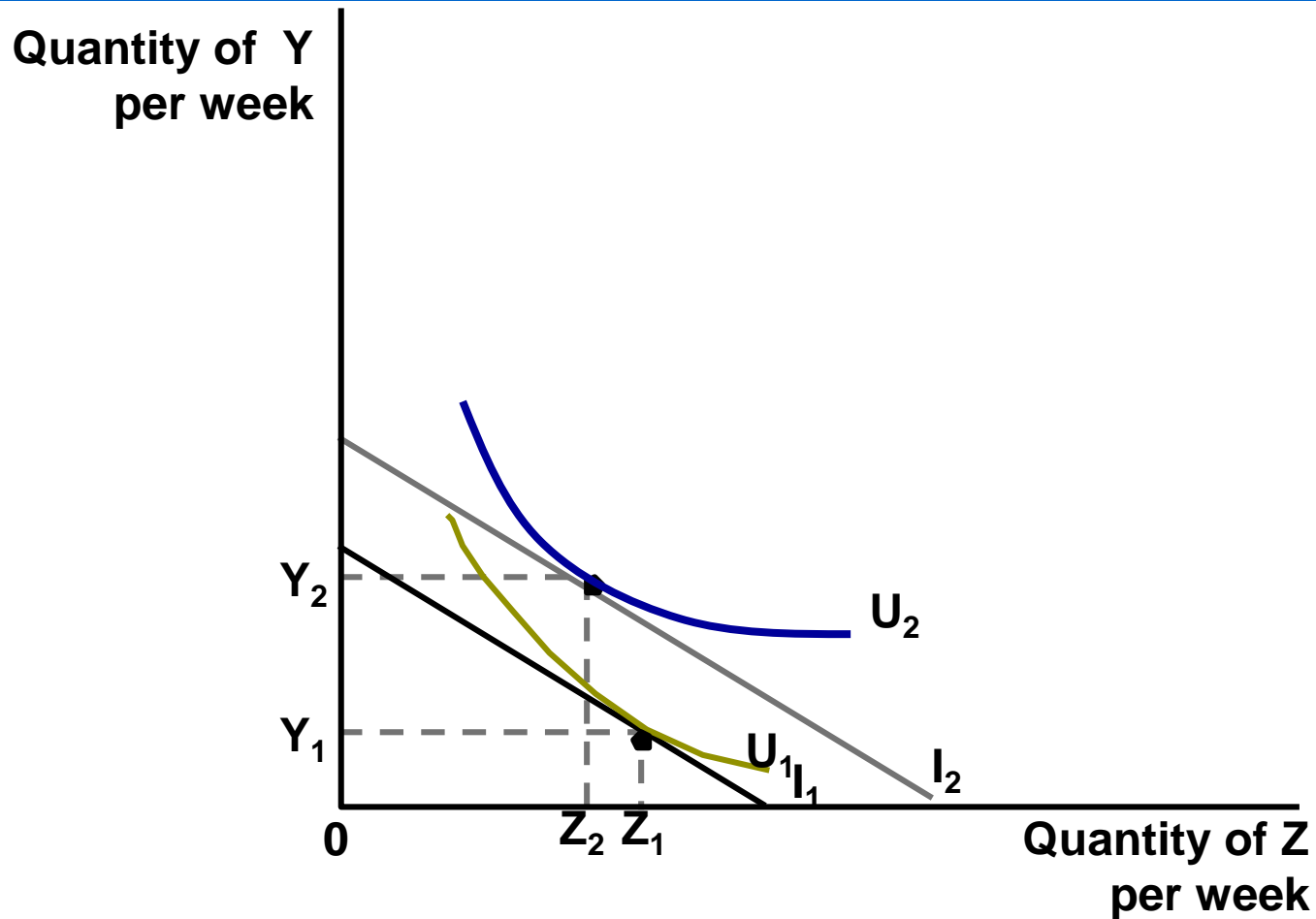
Inferior Goods

- An inferior good is one that is bought in smaller quantities as income increases.

- In Figure 3.2 as income increases from I_1 to I_2 to I_3, the consumption of inferior good Z decreases.

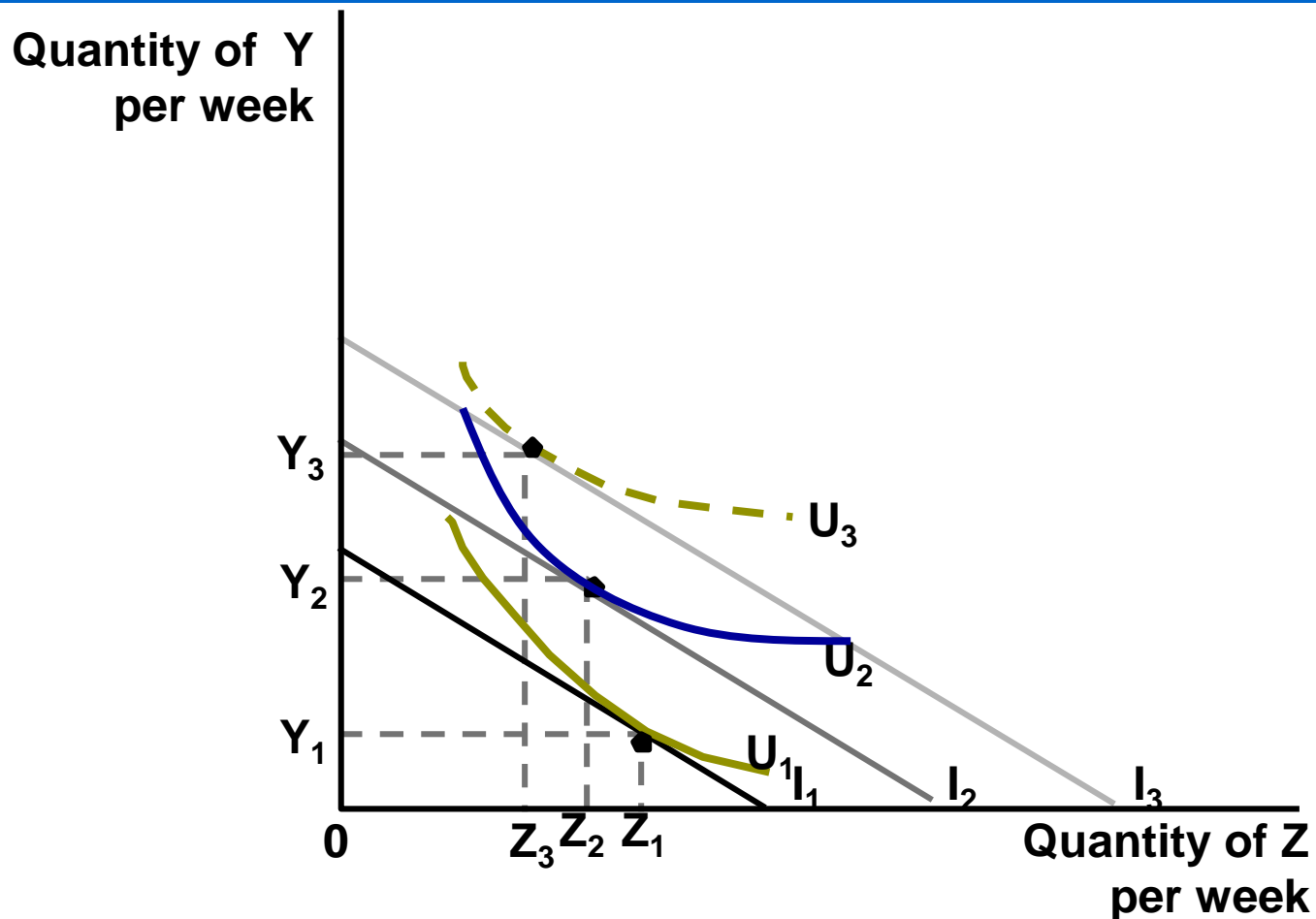- Goods such as "rotgut" whiskey, potatoes, and secondhand clothing are examples of inferior goods.
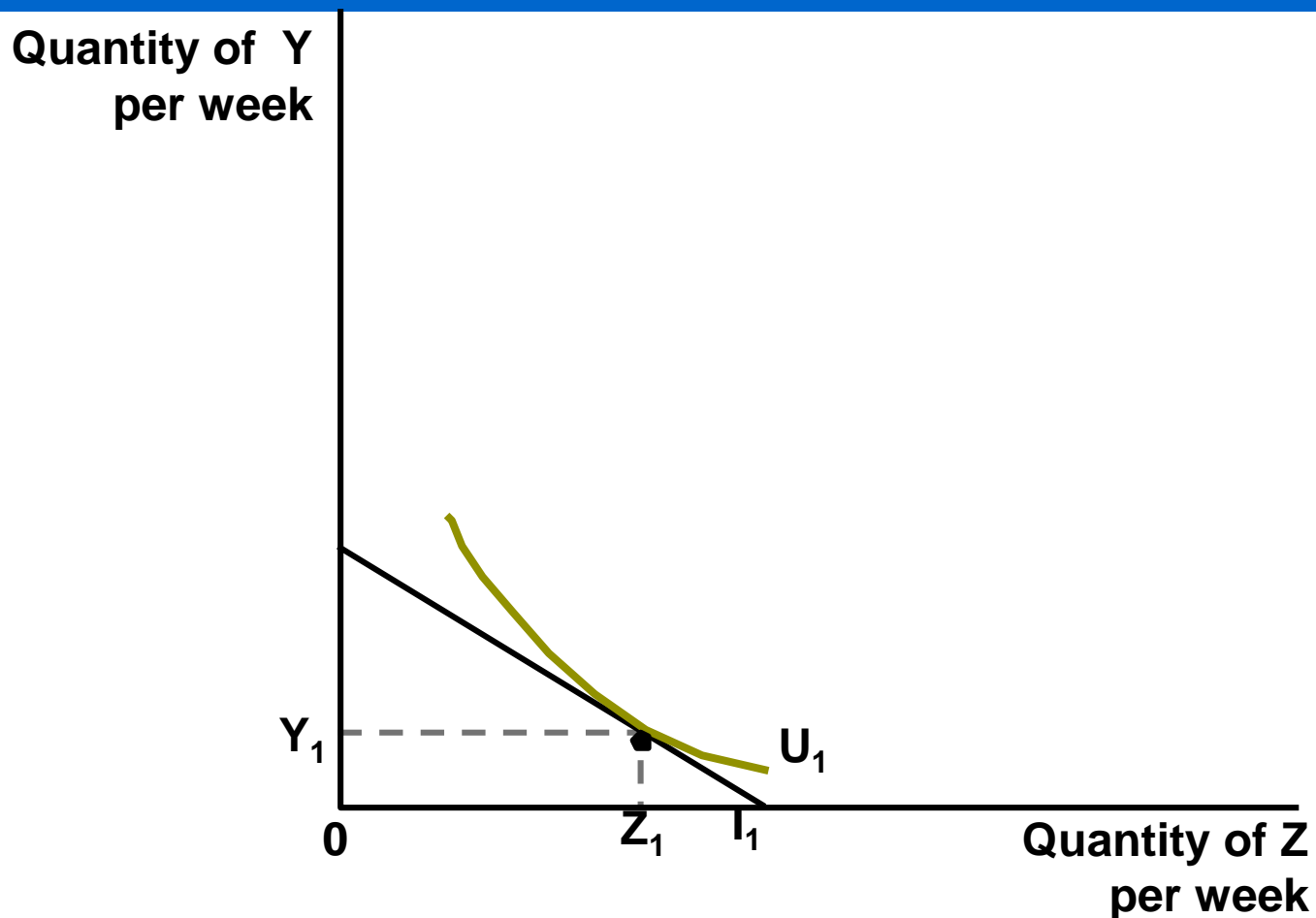
FIGURE 3.2: Indifference Curve Map Showing Inferiority

FIGURE 3.2: Indifference Curve Map Showing Inferiority

Quantity of Y per week

Y_2

Y_1

U_2

U_1

I_1

I_2

0   Z_2 Z_1

Quantity of Z per week

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FIGURE 3.2: Indifference Curve Map Showing Inferiority

Quantity of Y per week

Quantity of Z per week

U_3

U_2

U_1

I_1

I_2

I_3

Y_3

Y_2

Y_1

0

Z_3 Z_2 Z_1

Changes in a Good's Price

- A change in the price of one good causes both the slope and an intercept of the budget line to change.

- The change also involves moving to a new utility-maximizing choice on another indifference curve with a different MRS.

- The quantity demanded of the good whose price has changed changes.

Substitution Effect

- The part of the change in quantity demanded that is caused by substitution of one good for another is called the **substitution effect.**

- This results in a movement along an indifference curve.

- Consumption has to be changed to equate MRS to the new price ratio of the two goods.

Income Effect

- The part of the change in quantity demanded that is caused by a change in real income is called the **income effect.**

- The price change also changes "real" purchasing power and consumers will move to a new indifference curve that is consistent with this new purchasing power.

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Substitution and Income Effects from a Fall in Price

- As shown in Figure 3.3, when the price of good X falls, the budget line rotates out from the unchanged Y axis so that the X intercept lies father out because the consumer can now buy more X with the lower price.

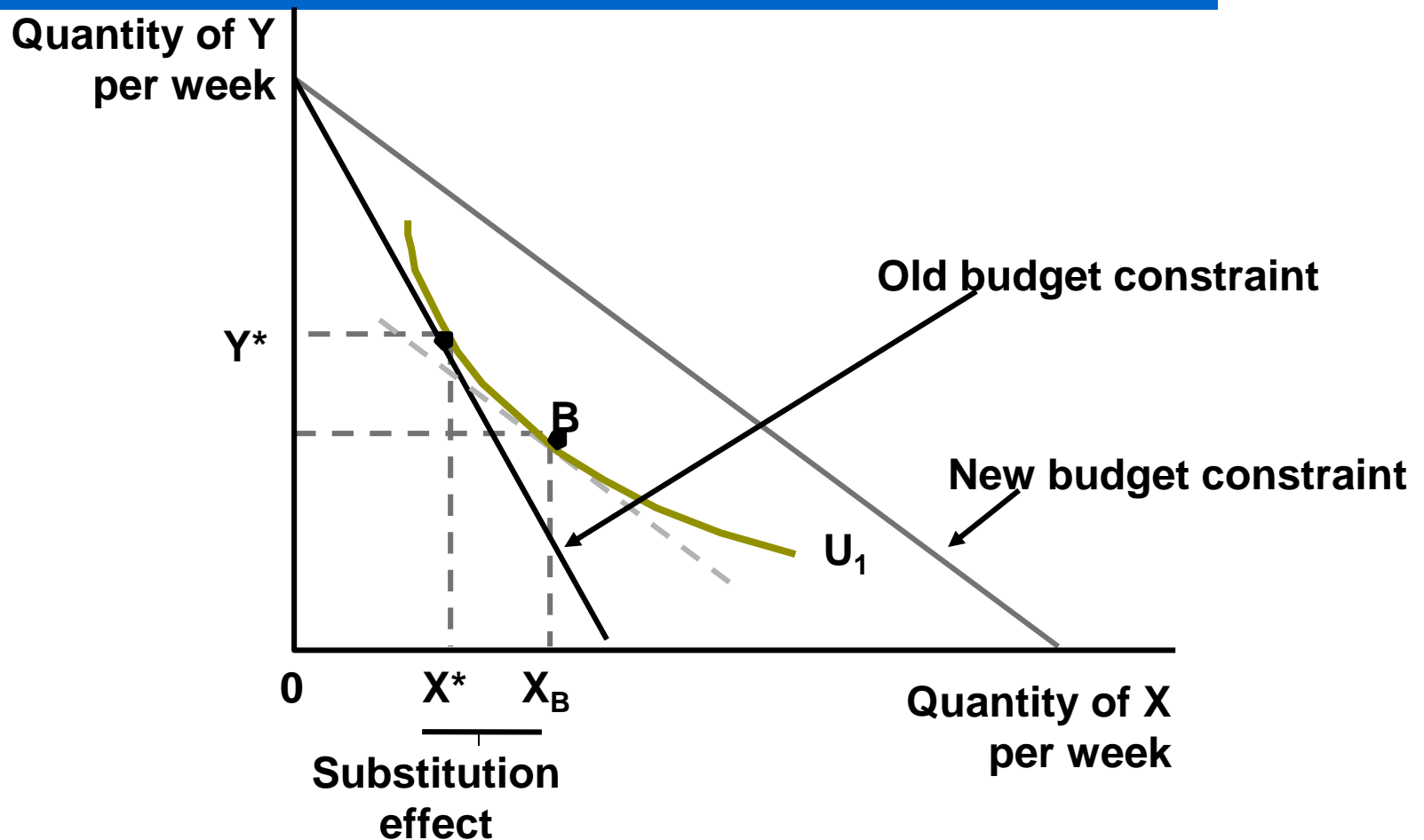- The flatter slope means that the relative price of X to Y (P_X/P_Y) has fallen.

Substitution Effect from a Fall in Price

- The consumer was originally maximizing utility at X^*, Y^* in Figure 3.3.

- After the fall in the price of good X, the new utility maximizing choice is X^{**}, Y^{**}.

- The substitution effect is the movement on the original indifference curve to point B.
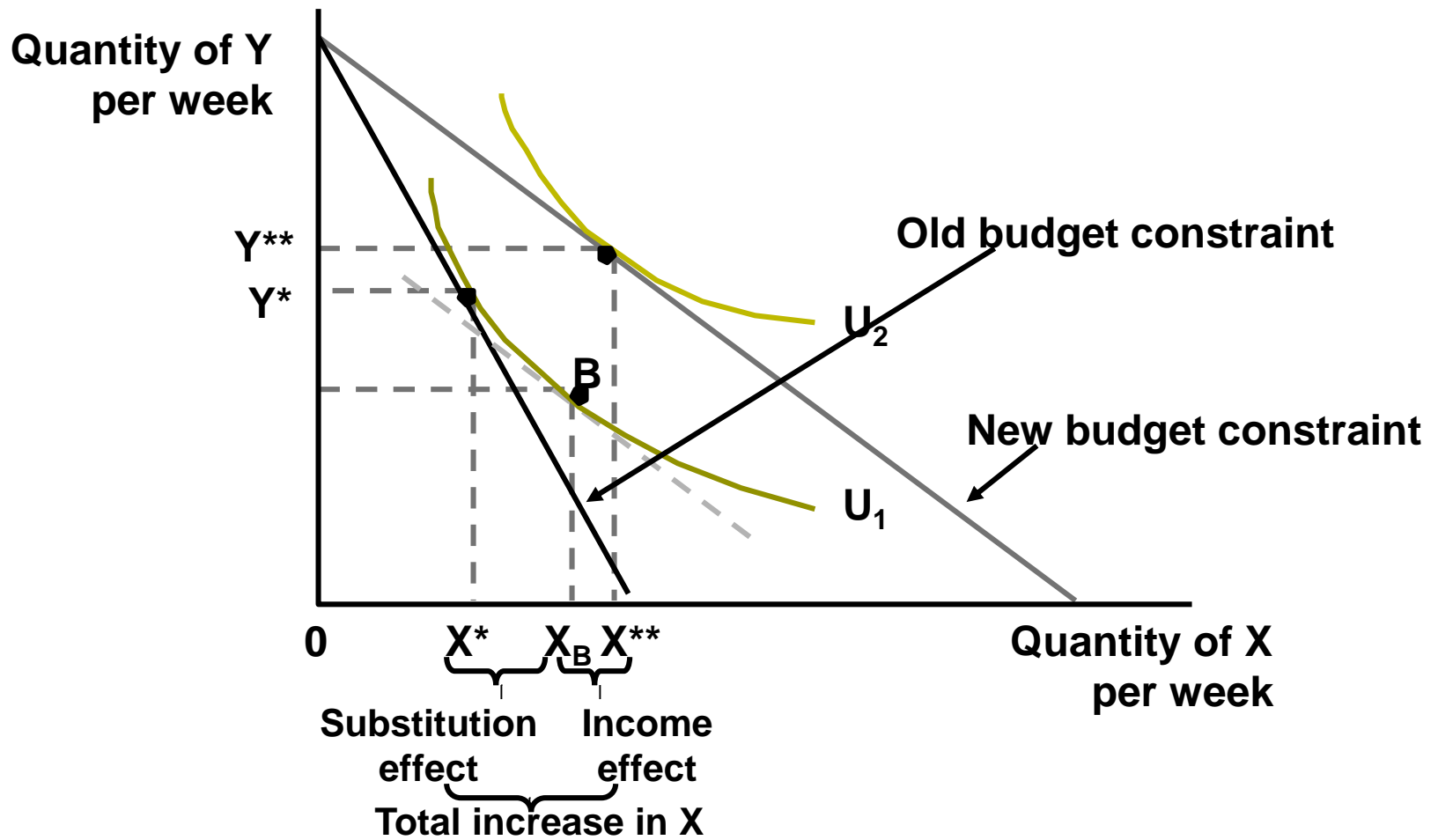
FIGURE 3.3: Income and Substitution Effects of a Fall in Price
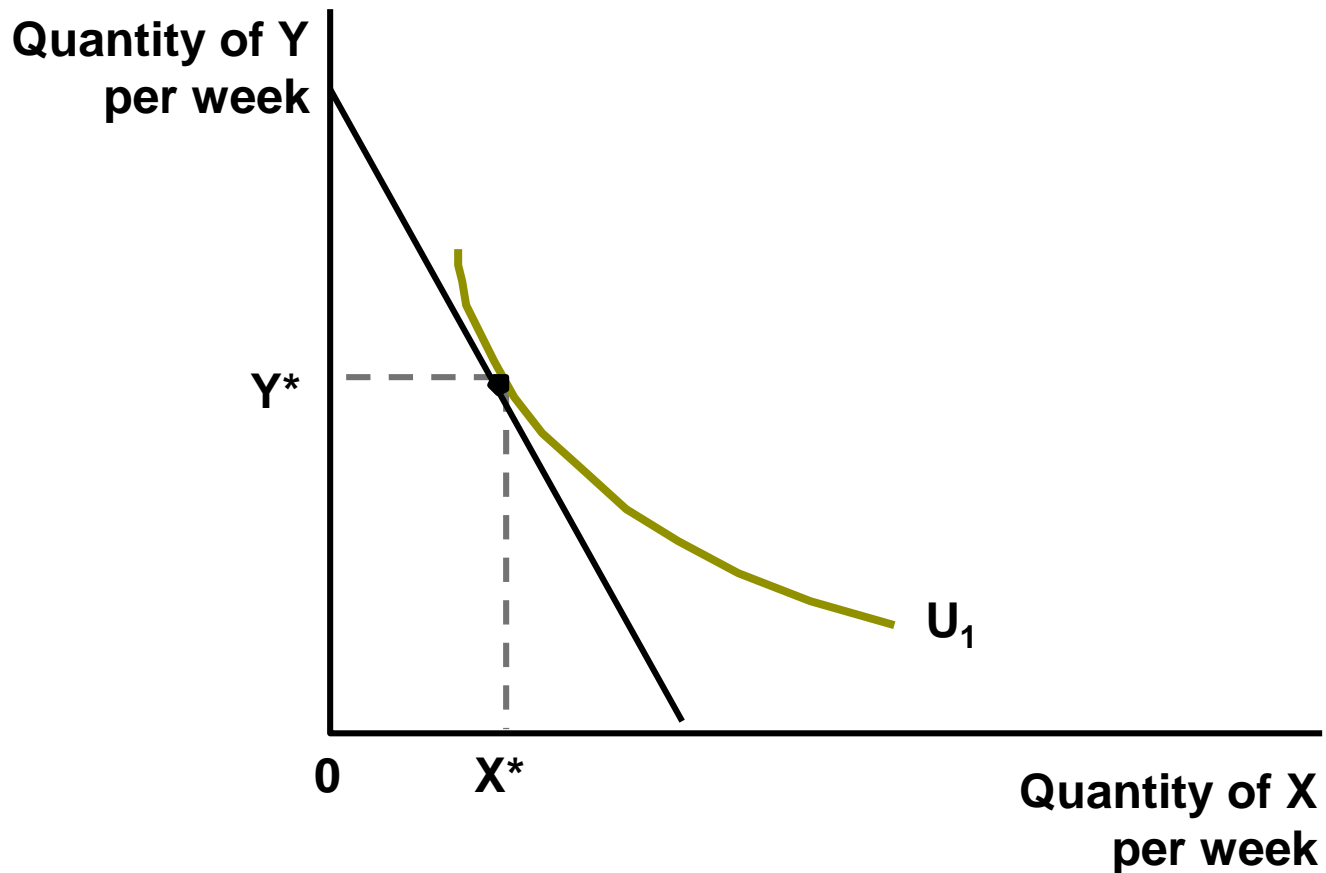
FIGURE 3.3: Income and Substitution Effects of a Fall in Price

FIGURE 3.3: Income and Substitution Effects of a Fall in Price

Quantity of Y per week

Old budget constraint

Y**
Y*

B

New budget constraint

U_2

U_1

0   X* X_B X**   Quantity of X per week

Substitution effect   Income effect

Total increase in X

Substitution Effect from a Fall in Price

- If the individual had to stay on the U_1 with the new price ratio, the consumer would choose B since that is the point where the MRS is equal to the slope of the new budget line (shown by the dashed line).

- Staying on the same indifference curve is the same as holding "real" income constant.

- The consumer buys more good X.

Income Effect

- The movement from point B to X^{**}, Y^{**} results from the increase in purchasing power.

- Because P_X falls but nominal income (I) remains the same, the individual's "real" income increases so that he or she can be on utility level U_3.

- The consumer buys more good X.

The Effects Combined

- Using the hamburger-soft drink example from Chapter 2, suppose the price of soft drinks falls from $.50 to $.25.

- Previously the consumer could purchase up to 20 soft drinks, but now he or she can purchase up to 40.

- This price decrease shifts the budget line outward and increases utility.

The Effects Combined

- If the consumer bought his or her previous choice it would now cost $7.50 so that $2.50 would be unspent.

- If the individual stayed on the old indifference curve he or she would equate MRS to the new price ratio (consuming 1 hamburger and 4 soft drinks).

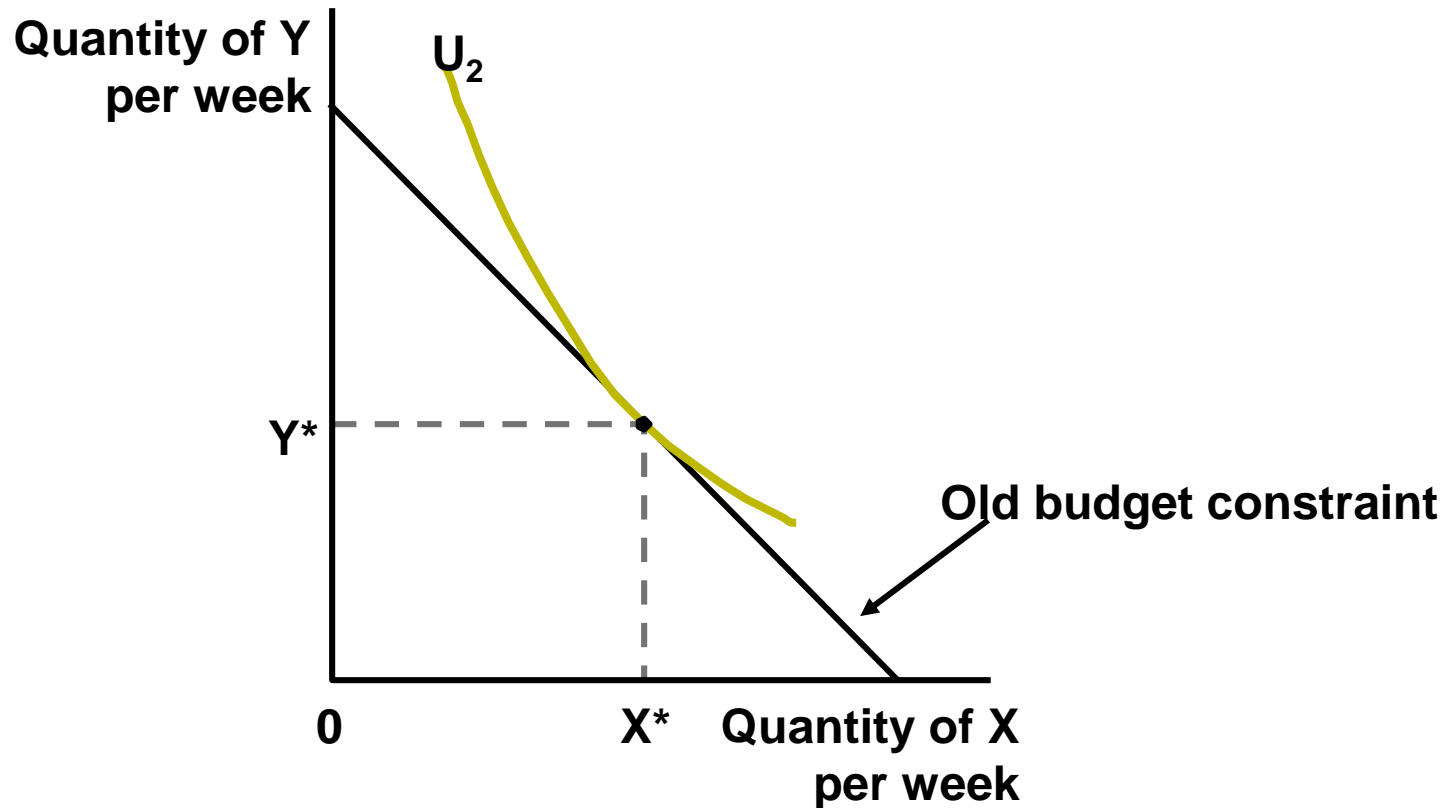- This move is the substitution effect.

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The Effects Combined

- Even with constant real income the consumer will buy more soft drinks since the opportunity cost of eating a burger in terms of the soft drinks forgone is now higher.

- Since real income has increased the person will choose to buy more soft drinks so long as soft drinks are a normal good.
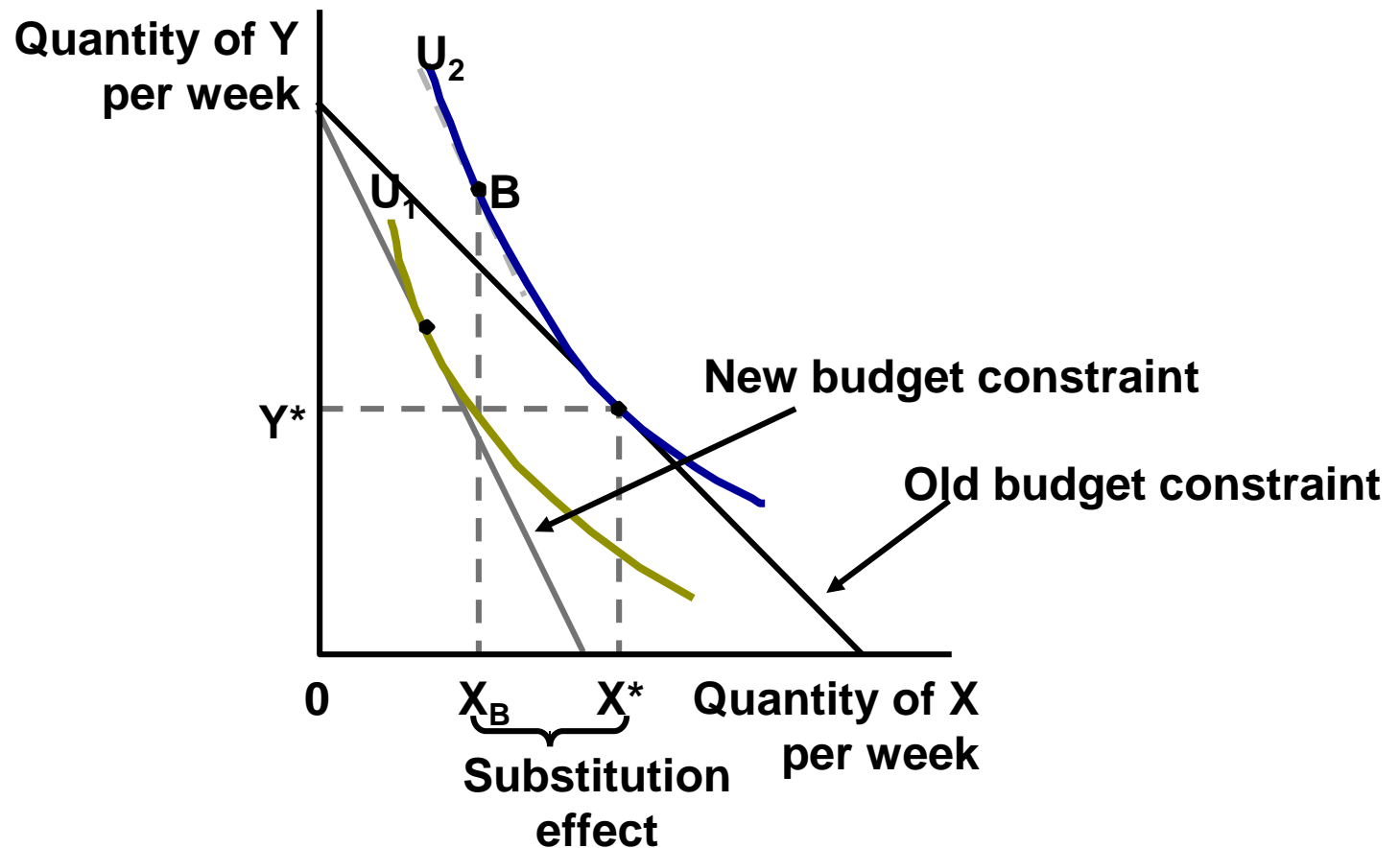
Substitution and Income Effects from an Increase in Price

- An increase in P_X will shift the budget line in as shown in Figure 3.4.

- The substitution effect, holding "real" income constant, is the move on U_2 from X^*, Y^* to point B.

- Because the higher price causes purchasing power to decrease, the movement from B to X^{**}, Y^{**} is the income effect.
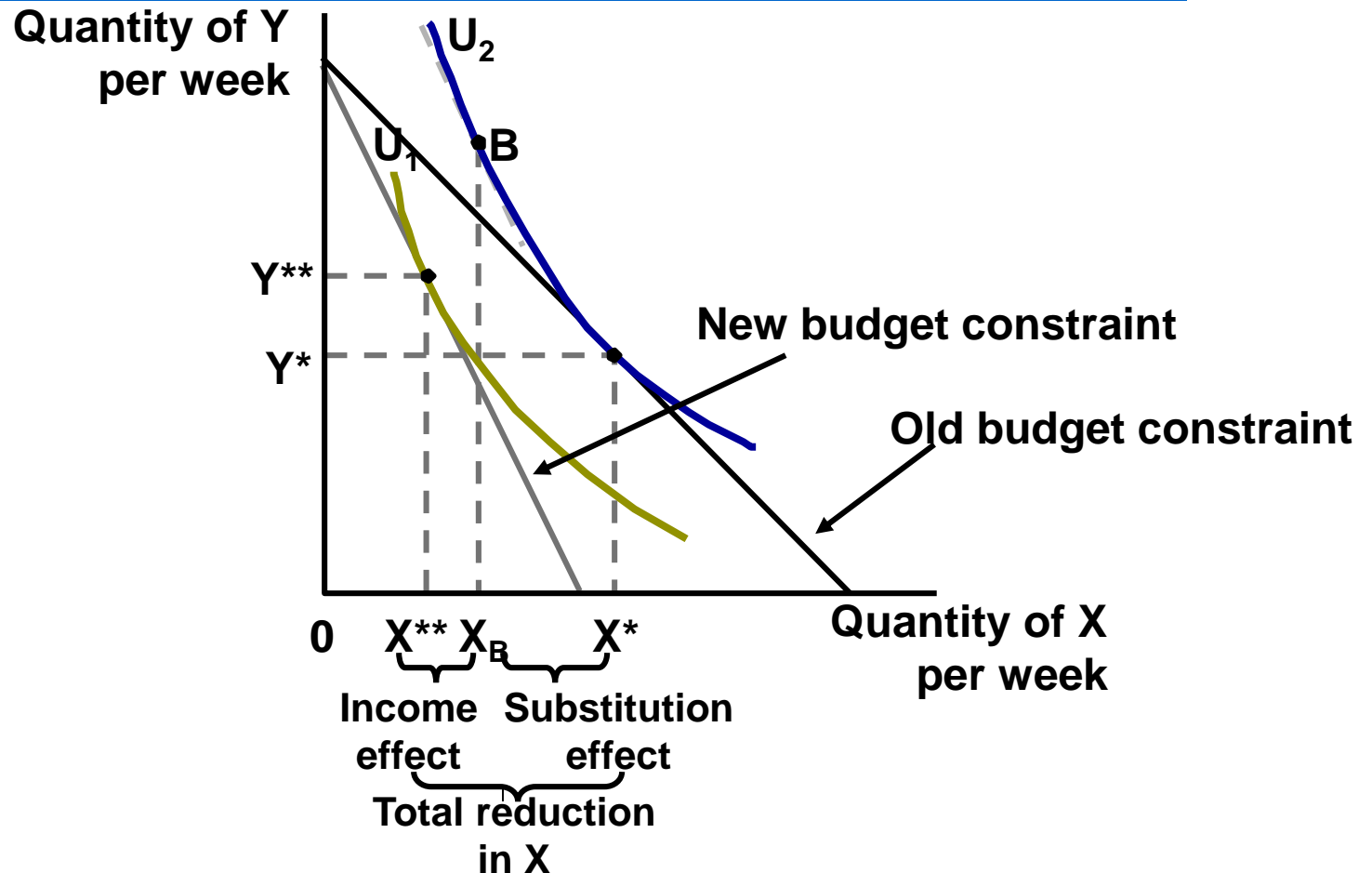
FIGURE 3.4: Income and Substitution Effects of an Increase in Price

FIGURE 3.4: Income and Substitution Effects of an Increase in Price

FIGURE 3.4: Income and Substitution Effects of an Increase in Price

Quantity of Y per week

U$_2$

U$_1$ •B

Y**

Y*

New budget constraint

Old budget constraint

0   X** X$_B$ X*   Quantity of X per week

Income effect   Substitution effect

Total reduction in X

Substitution and Income Effects from an Increase in Price

- In Figure 3.4, both the substitution and income effects cause the individual to purchase less soft drinks do to the higher price of soft drinks.

Substitution and Income Effects for a Normal Good: Summary

- As shown in Figures 3.3 and 3.4, the substitution and income effects work in the same direction with a normal good.

- When the price falls, both the substitution and income effects result in more purchased.

- When the price increases, both the substitution and income effects result in less purchased.

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Substitution and Income Effects for a Normal Good: Summary

- This provides the rational for drawing downward sloping demand curves.

- This also helps to determine the steepness of the demand curve.

- If either the substitution or income effects are large, the change in quantity demanded will be large with a given price change.

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Substitution and Income Effects for a Normal Good: Summary

- If the substitution and income effects are small, the effect of a given price change in the quantity demanded will also be small.

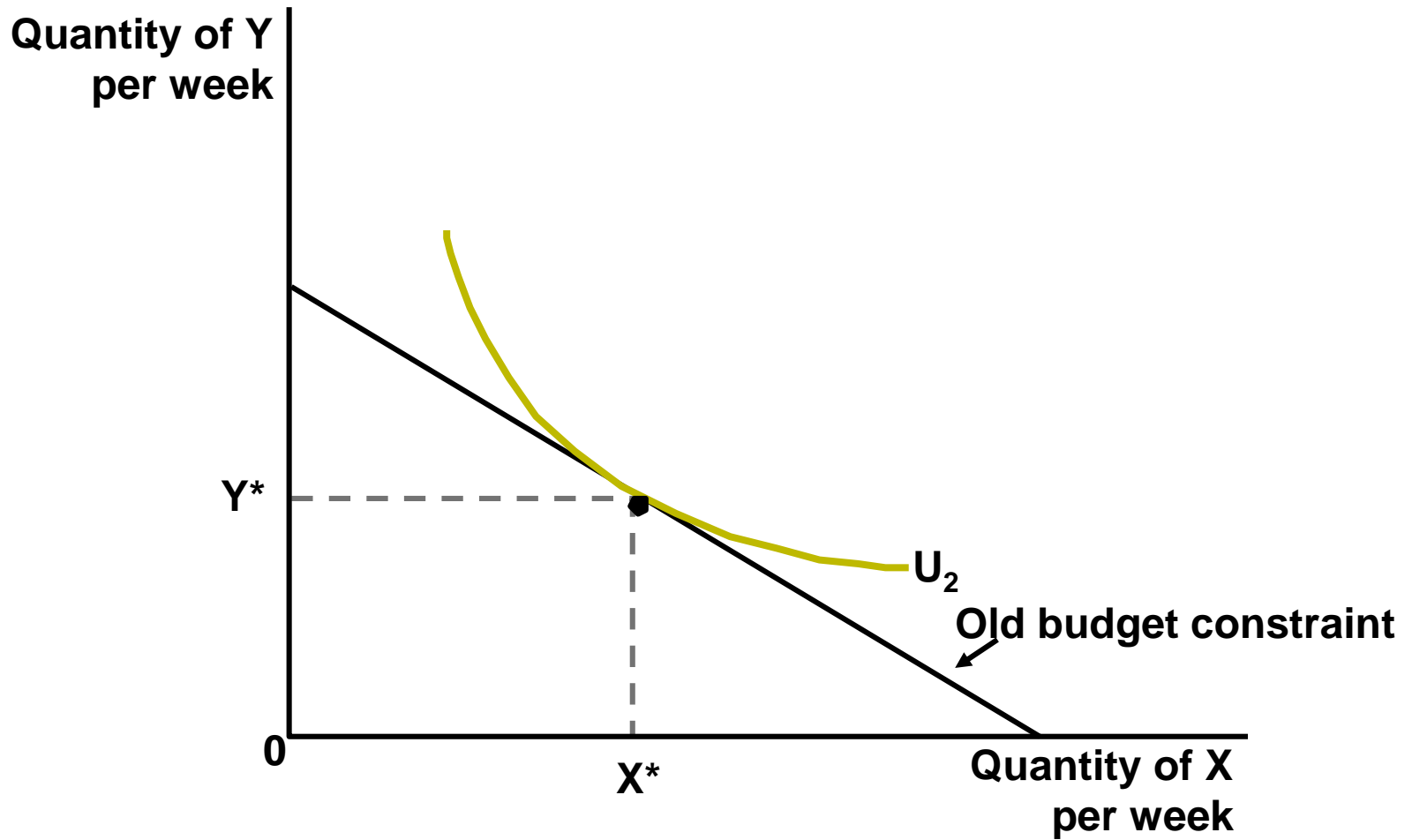- This kind of analysis also offers a number of insights about some commonly used economic statistics.

Substitution and Income Effects for Inferior Goods

- With an inferior good, the substitution effect and the income effects work in opposite directions.

- The substitution effect results in decreased consumption for a price increase and increased consumption for a price decrease.
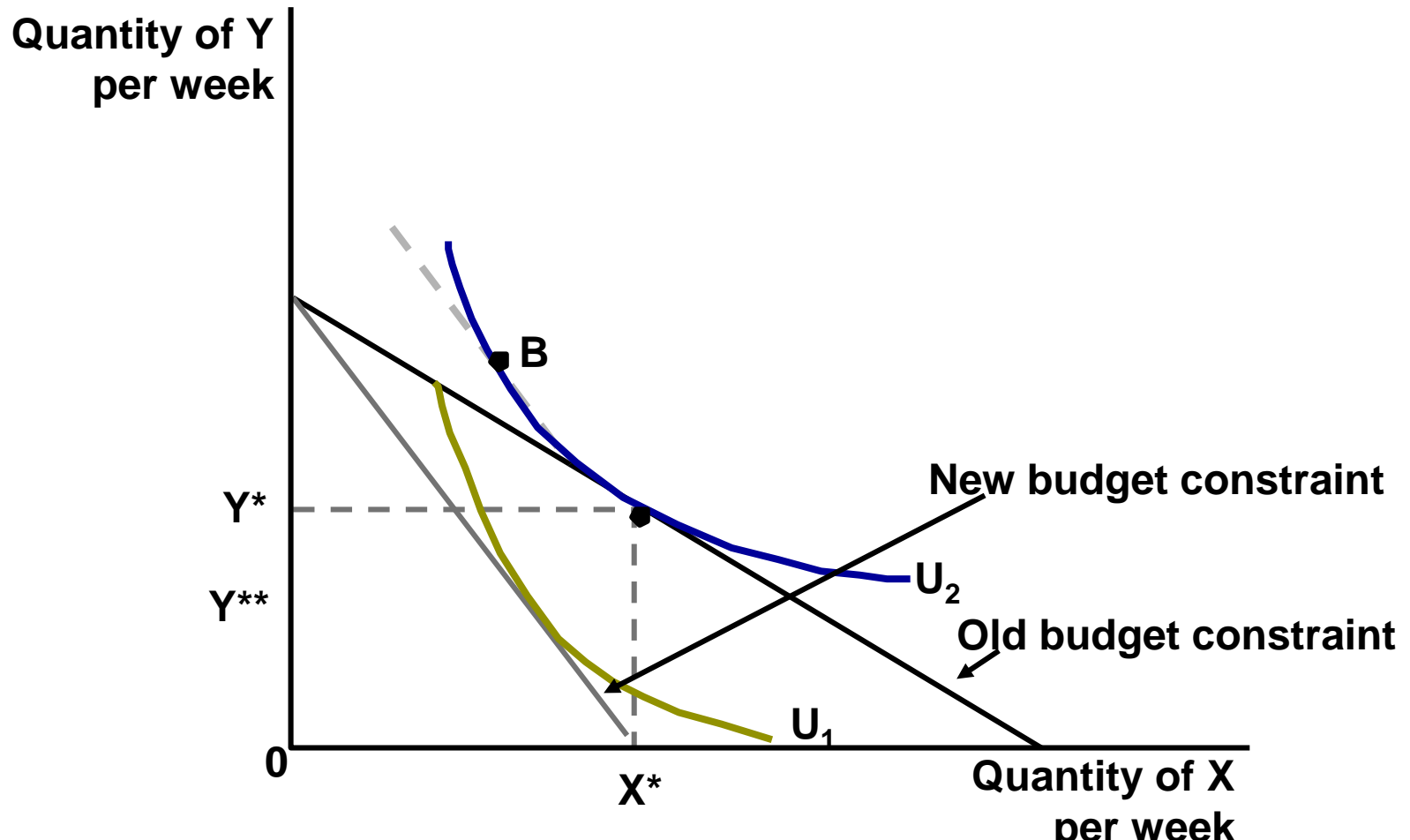
Substitution and Income Effects for Inferior Goods

- The income effect results in increased consumption for a price increase and decreased consumption for a price decrease.

- Figure 3.5 shows the two effects for an increase in P_X.

- The substitution effect, holding real income constant, is shown by the move from X^*, Y^* to point B both on U_2.

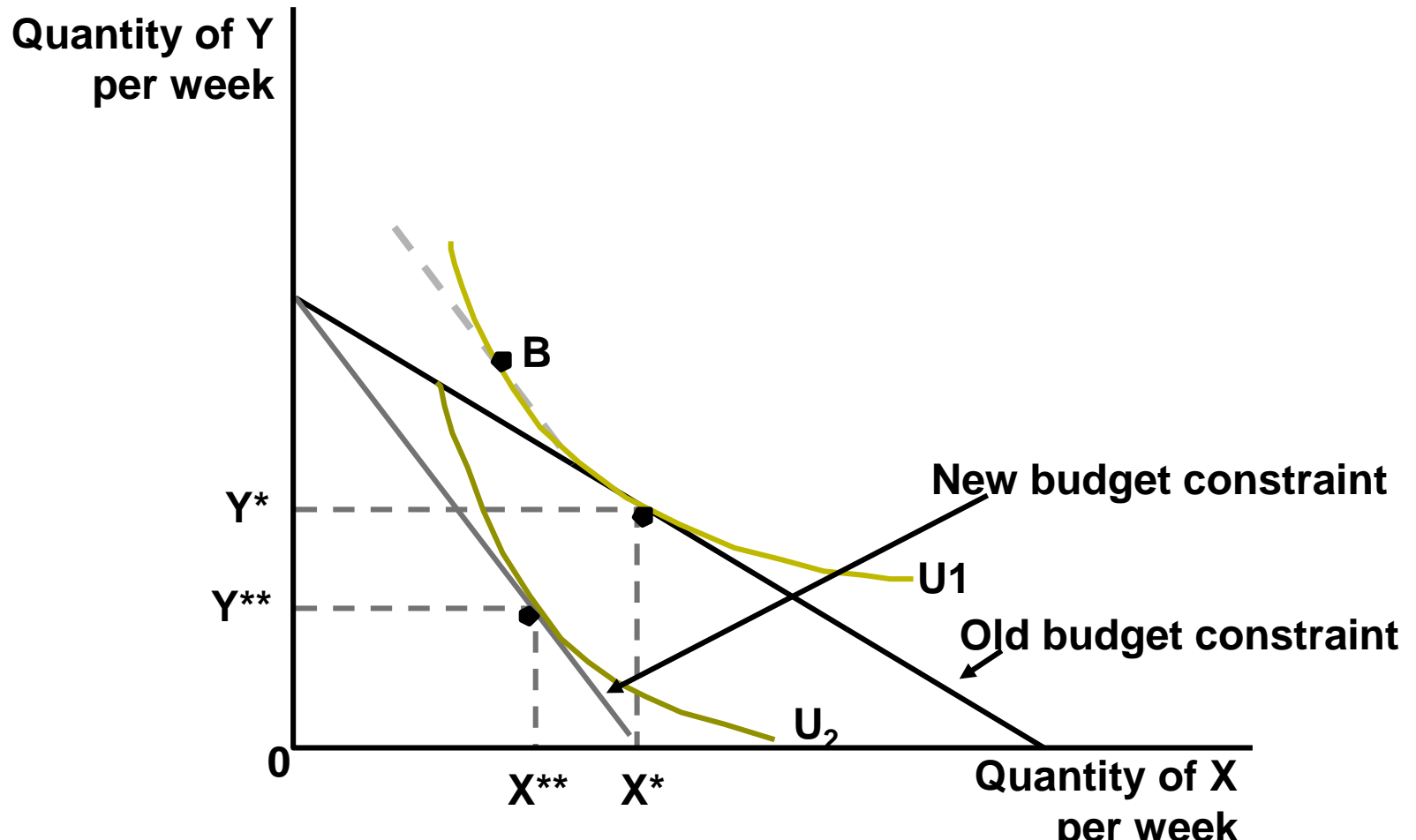# FIGURE 3.5: Income and Substitution Effects for an Inferior Good

Quantity of Y per week

Y*

U₂

Old budget constraint

0

X*

Quantity of X per week

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FIGURE 3.5: Income and Substitution Effects for an Inferior Good

Quantity of Y per week

B

Y*

Y**

New budget constraint

Old budget constraint

U_2

U_1

0

X*

Quantity of X per week

FIGURE 3.5: Income and Substitution Effects for an Inferior Good

Substitution and Income Effects for Inferior Goods

- The income effect reflects the reduced purchasing power due to the price increase.
- Since X is an inferior good, the decrease in income results in an increase in the consumption of X shown by the move from point B on U_1 to the new utility maximizing point X^{**}, Y^{**} on U_1.

Substitution and Income Effects for Inferior Goods

- Since X^{**} is less than X^* the price increase in X results in a decrease in the consumption of X.
- This occurs because the substitution effect, in this example, is bigger than the income effect.
- Thus, if the substitution effect dominates, the demand curve is negatively sloped.

The Lump Sum Principle

- The "lump-sum principle" hold that taxes that are imposed on general purchasing power will have a smaller welfare costs than will taxes imposed on a narrow selection of commodities.

- Consider Figure 3.6 where the individual initially has I dollars to spend and chooses to consume X^* and Y^* yielding U_3 utility.
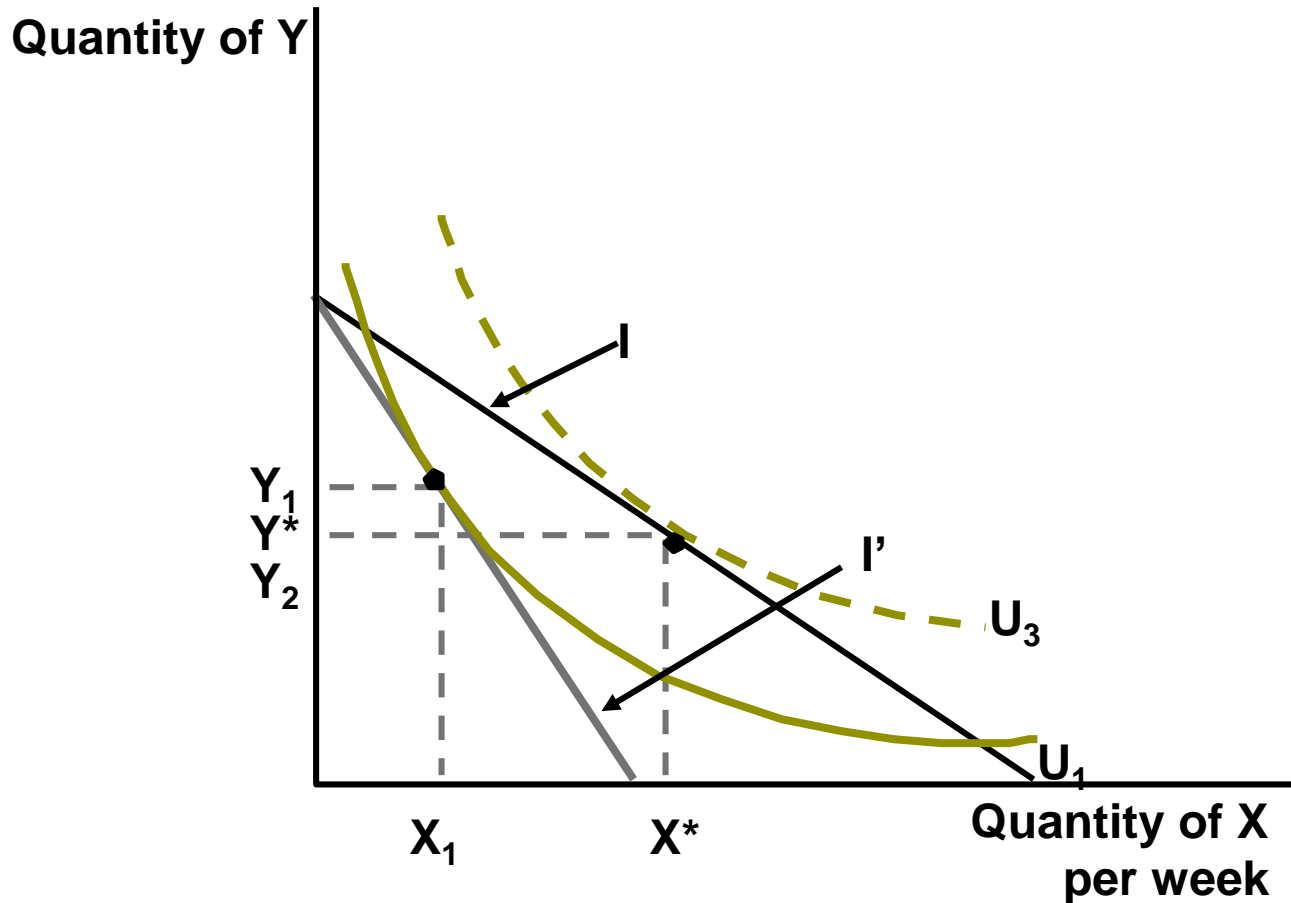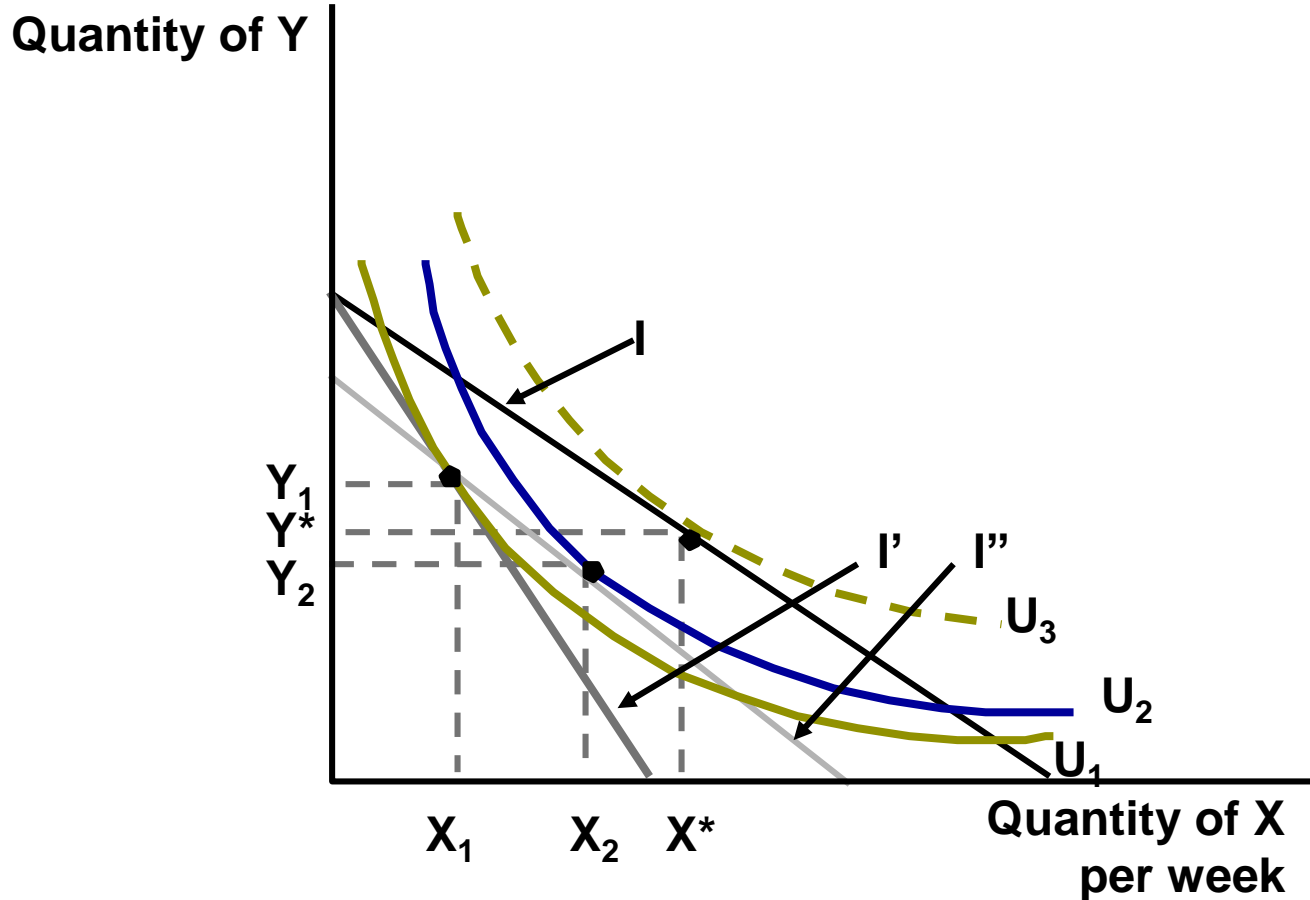
FIGURE 3.6: The Lump-Sum Principle

Quantity of Y

I

Y*

U₃

X*

Quantity of X
per week
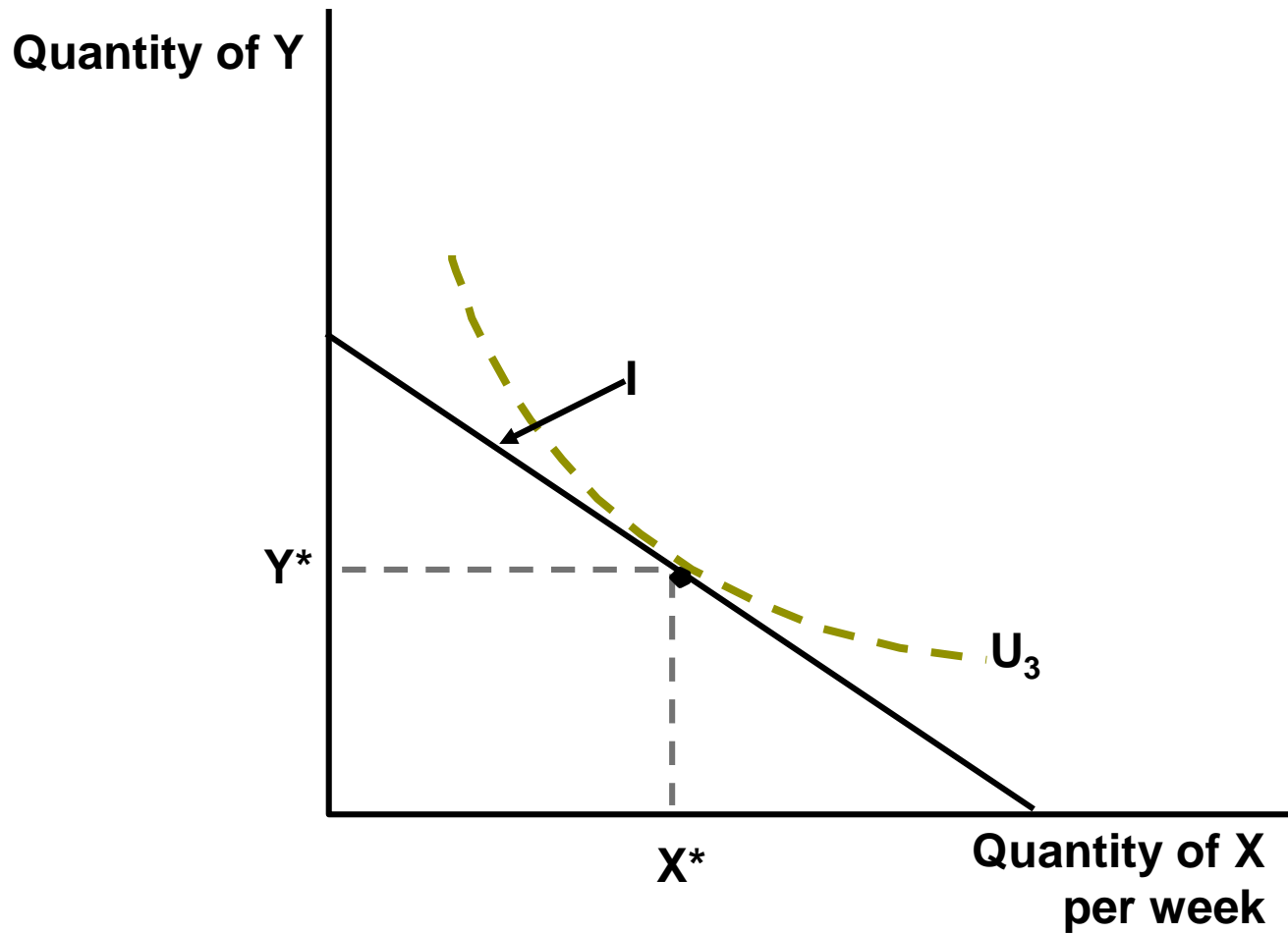
The Lump Sum Principle

- A tax on only good X raises its price resulting in budget constraint I' and consumption reduced to X_1, Y_1 and utility level U_1.

- A general income tax that generates the same total tax revenue is represented by budget constraint I'' that goes though X_1, Y_1.

FIGURE 3.6: The Lump-Sum Principle

Quantity of Y

I

I'

U_3

Y_1
Y^*
Y_2

U_1

X_1 X^*

Quantity of X per week

FIGURE 3.6: The Lump-Sum Principle

The Lump Sum Principle

- The utility maximizing choice on I'' is X_2, Y_2 yielding utility level U_2.

- The lump-sum general income tax generates the same amount of tax revenue but leaves the consumer on a higher utility level (U_2) than the utility level associated with the tax only on good X (U_1).

The Lump Sum Principle

- The intuitive explanation of the lump-sum principle is that a single-commodity tax affects people in two ways:
  - it reduces their purchasing power,
  - it directs consumption away from the good being taxed.
- The lump-sum tax only has the first of these two effects.

Generalizations of the Lump-Sum Principle

- The utility lass associated with the need to collect a certain amount of tax revenue will be minimized by taxing goods for which the substitution effect is small.

- Even though the tax will reduce purchasing power, it will minimize the impact of directing consumption away from the good being taxed.

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FIGURE 1: The Superiority of an Income Grant
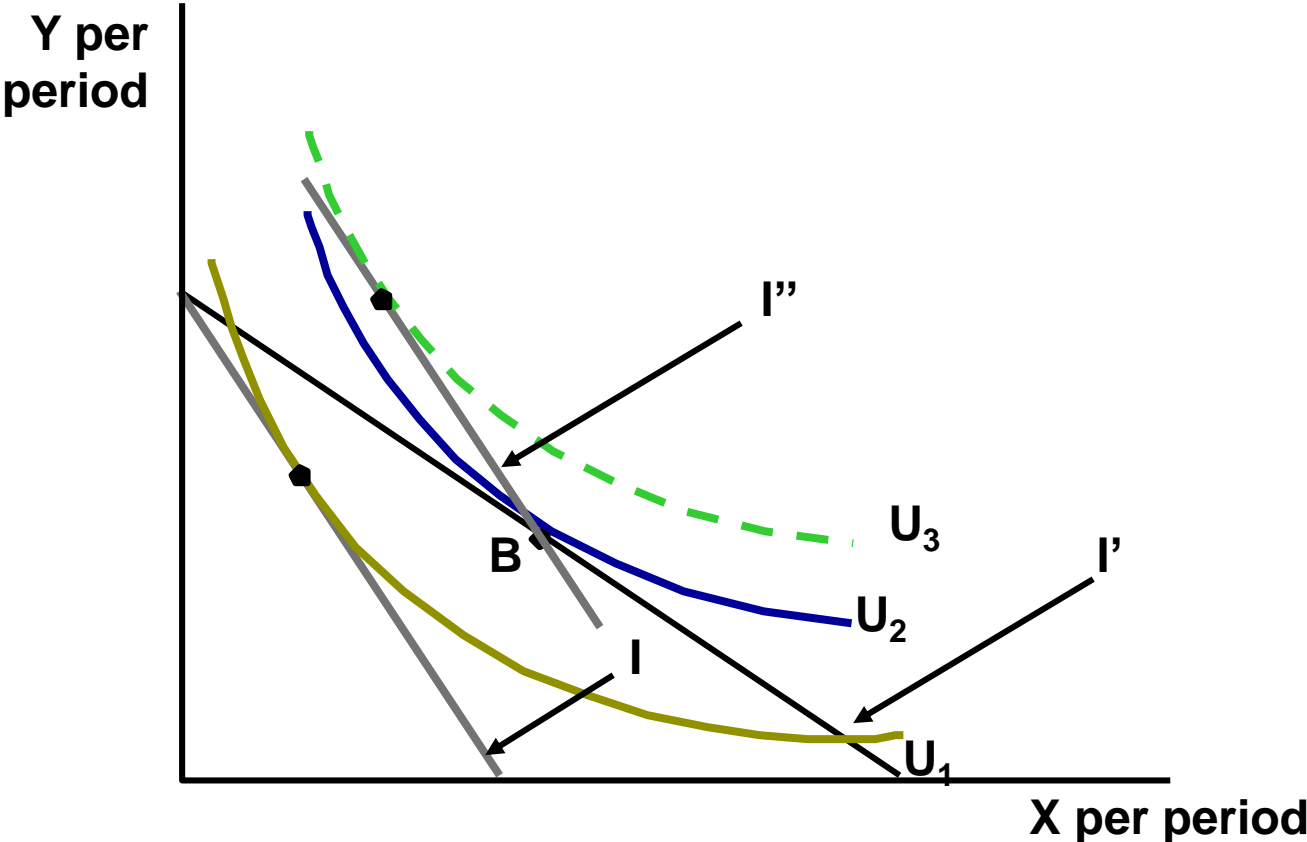
Changes in the Price of Another Good

- When the price of one good changes, it usually has an affect on the demand for the other good.

- In Figure 3.3, the increase in the price of X (a normal good) caused both an income and substitution effect that caused a reduction in the quantity demanded of X.

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Changes in the Price of Another Good

- In addition, the substitution effect caused a decrease in the demand for good Y as the consumer substituted good X for good Y.

- However, the increase in purchasing power brought about by the price decrease causes an increase in the demand for good Y (also a normal good).

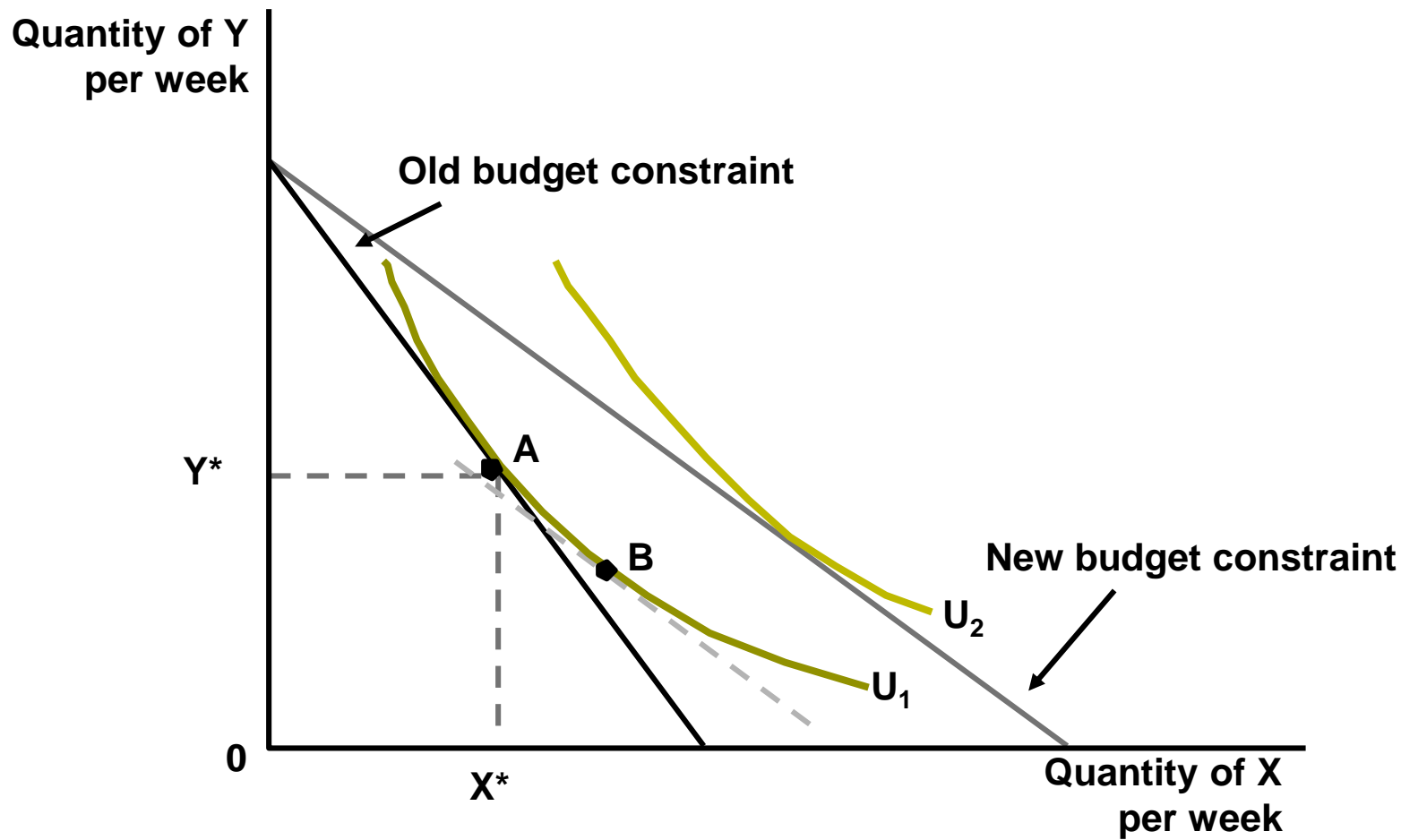# Changes in the Price of Another Good

- Since, in this case, the income effect had a dominant effect on good Y, the consumption of Y increased due to a decrease in the price of good X.

- With flatter indifference curves as shown in Figure 3.7, the situation is reversed.

- A decrease in the price of good X causes a decrease in good Y, as before.

FIGURE 3.7: Effect on the Demand for Good Y of a Decrease in the Price of Good X

Quantity of Y per week

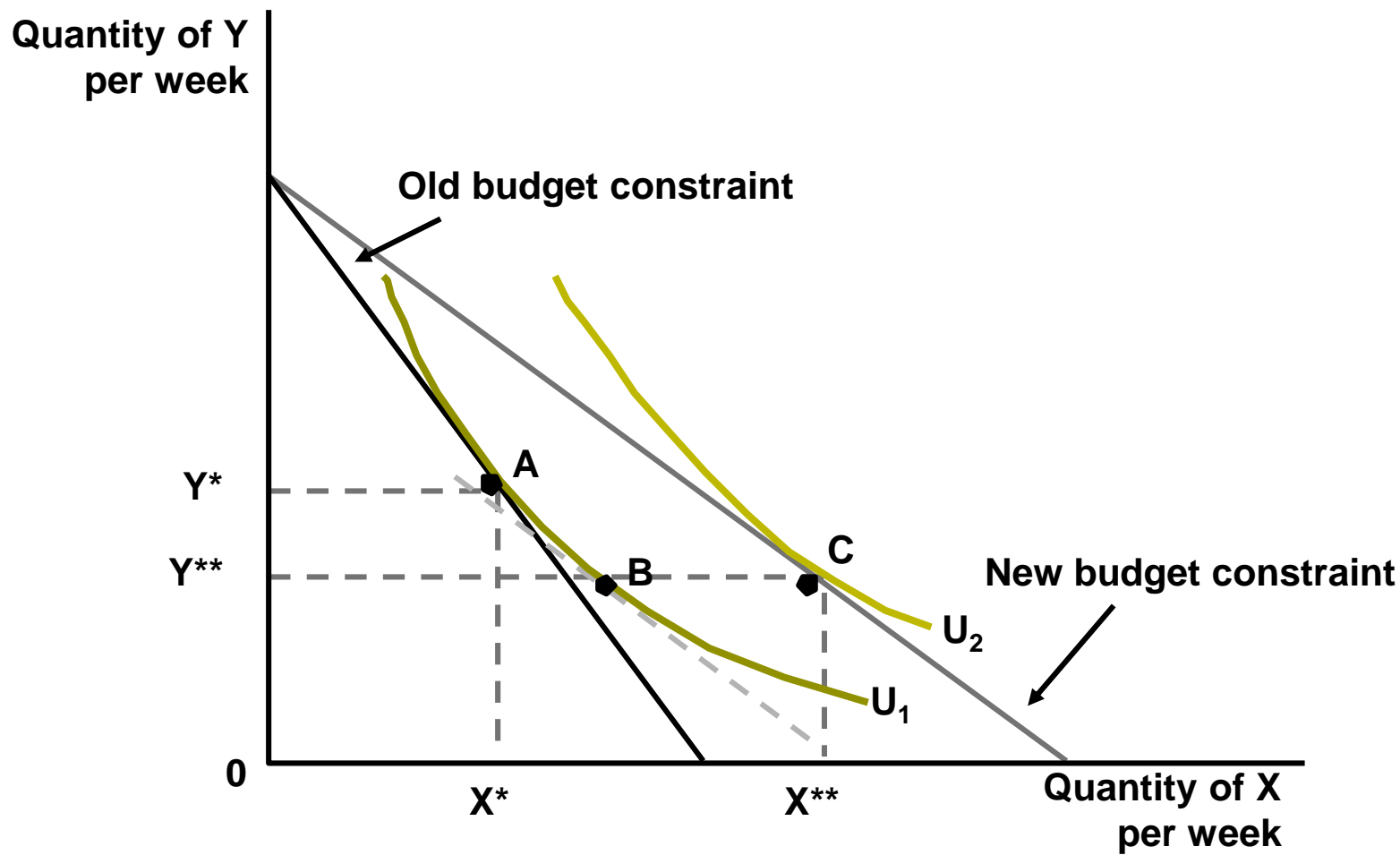Old budget constraint

Y*

X*

Quantity of X per week

U₁

0
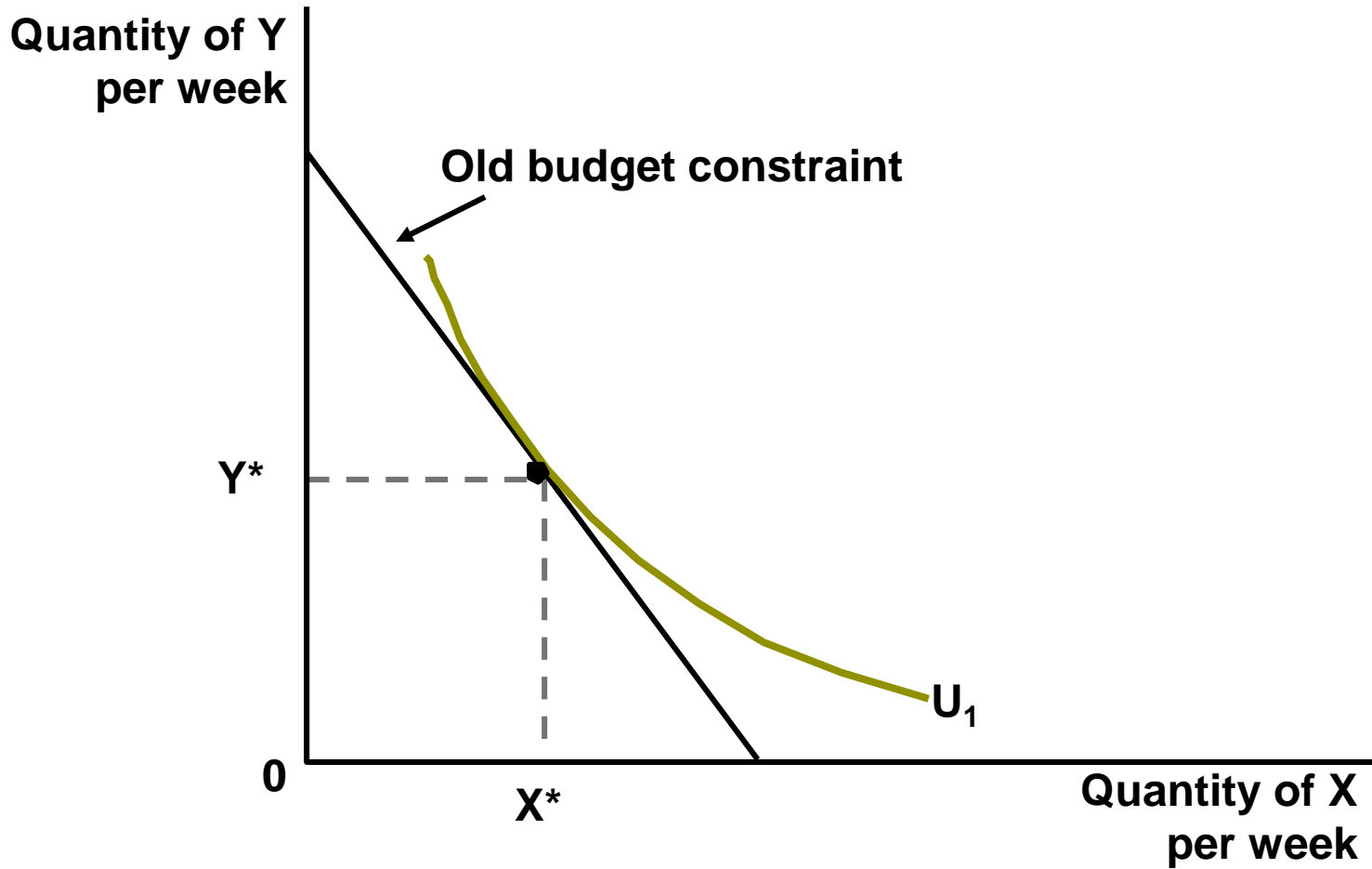
FIGURE 3.7: Effect on the Demand for Good Y of a Decrease in the Price of Good X

FIGURE 3.7: Effect on the Demand for Good Y of a Decrease in the Price of Good X

Changes in the Price of Another Good

- However, in this case, the income effect is much smaller than the substitution effect so that the consumer ends up consuming less of good Y at Y^{**} after the decrease in the price of X.

- Thus, the effect of a change in the price of one good has an ambiguous effect on the demand for the other good.

Complements

- Complements are goods that go together in the sense that people will increase their use of both goods simultaneously.

- Two goods are **complements** if an increase in the price of one causes a decrease in the demanded of the other or a decrease in the price of one good causes an increase in the demand for the other.

Substitutes

- Substitutes are goods that are goods that are used for essentially the same purpose.

- Two goods such that if the price of one increases, the demand for the other rises are **substitutes.**

- If the price of one good decreases and the demand for the other good decreases, they are also substitutes.

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Construction of Individual Demand Curves

- An **individual demand curve** is a graphic representation between the price of a good and the quantity of it demanded by a person holding all other factors (preferences, the prices of other goods, and income) constant.

- Demand curves limit the study to the relationship between the quantity demanded and changes in the own price of the good.
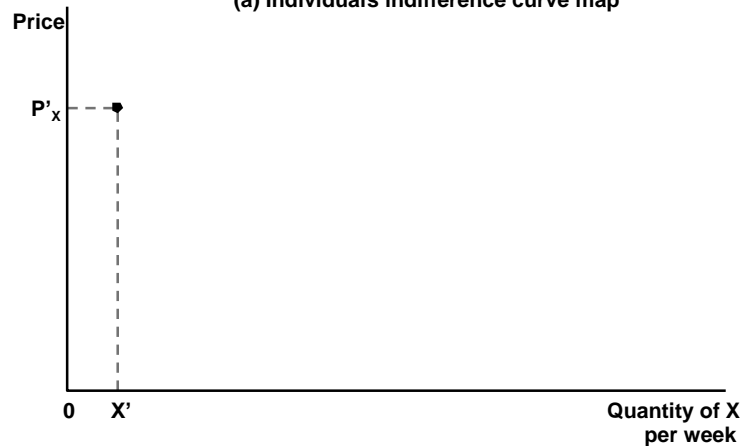
Construction of Individual Demand Curves

- In Panel a of Figure 3.8 an individual's indifference curve map is drawn using three different budget constraints in which the price of X decreases.

- The decreasing prices are P'_X, P''_X, and P'''_X respectively.

- The individual's utility maximizing choices of X are X', X', and X''' respectively.

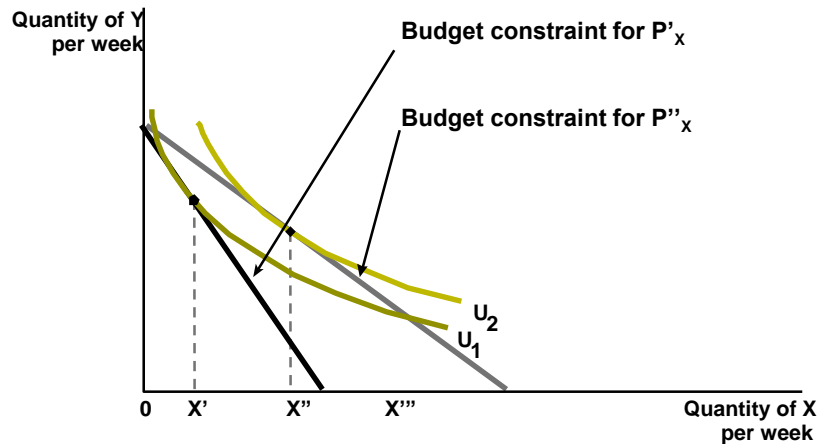# FIGURE 3.8: Construction of an Individual's Demand Curve
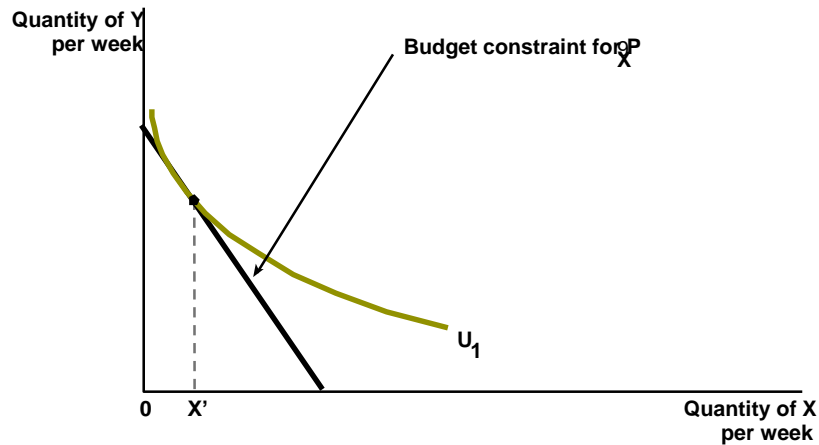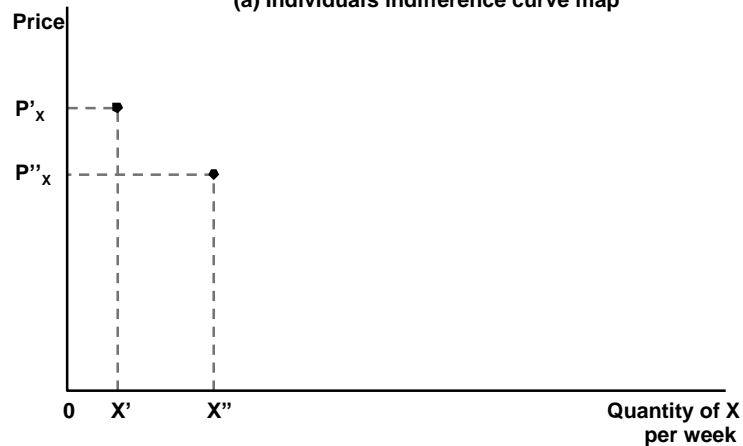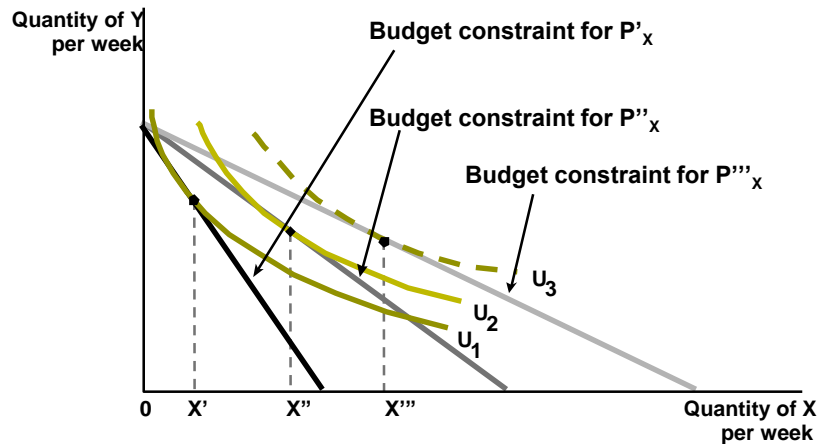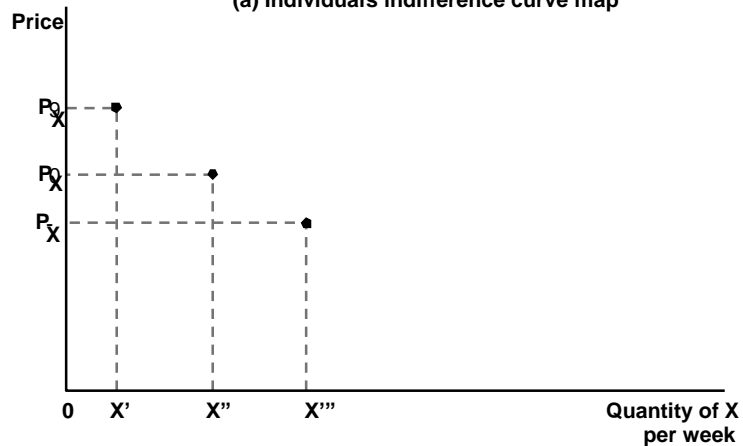

(a) Individual's indifference curve map

(b) Demand curve

FIGURE 3.8: Construction of an Individual's Demand Curve

(a) Individual's indifference curve map

(b) Demand curve

FIGURE 3.8: Construction of an Individual's Demand Curve

Quantity of Y per week

Budget constraint for P'_X

Budget constraint for P''_X

Budget constraint for P'''_X

U_3

U_2

U_1

0   X'   X"   X'''   **Quantity of X per week**

(a) Individual's indifference curve map

Price

P'_X

P''_X

P'''_X

0   X'   X"   X'''   **Quantity of X per week**

(b) Demand curve

FIGURE 3.8: Construction of an Individual's Demand Curve

(a) Individual's indifference curve map

(b) Demand curve

Construction of Individual Demand Curves

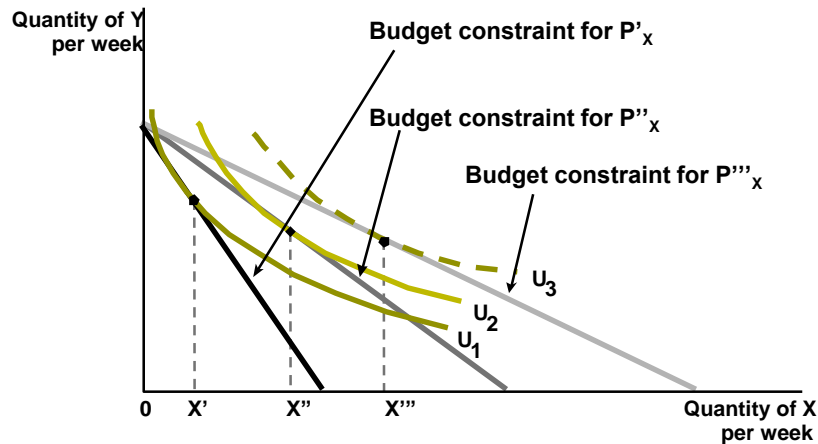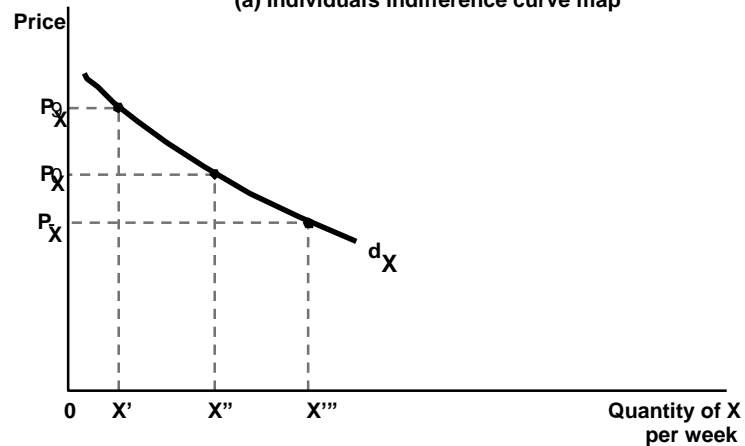- These three choices show that the quantity demanded of X increases as the price of X falls.

- Panel b shows how the three price and quantity choices can be used to construct the demand curve.

Construction of Individual Demand Curves

- The price of X is shown on the vertical axis and the quantity of X is shown on the horizontal axis.

- The demand curve (d_X) is downward sloping showing that when the price of X falls, the quantity demanded of X increases.

- As previously shown, this result follows from the substitution and income effects.

Shape of the Demand Curve

- If a good, say X, has close substitutes, a increase in its price will cause a large decrease in the quantity demanded as the substitution effect will be large.

  – The demand curve for a type of breakfast cereal will likely be relatively flat due to the strong substitution effect.

Shape of the Demand Curve

● If the good has few substitutes, the substitution effect of a price increase or decrease will be small and the demand curve will be relatively steep.

   – Water is an example of a good with few substitutes.

Shape of the Demand Curve

- Food has no substitutes so it might be thought that no change in consumption would occur with a price increase.

- But food constitutes a large part of an individual's budget so that price changes will cause relatively larger effects on the quantity demanded that might be thought due to the income effect.
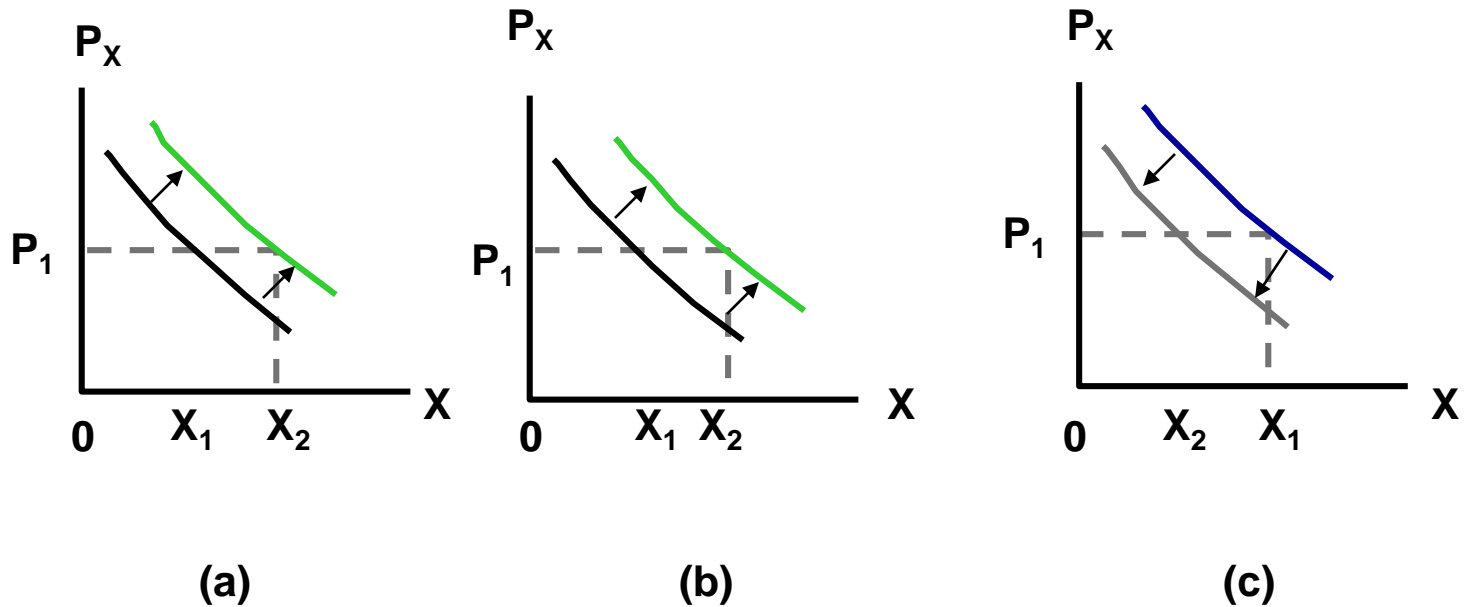
Shifts in an Individual's Demand Curve

- When one of the variables that are held constant (price of another good, income or preferences) on a demand curve changes, the entire curve shifts.

- Figure 3.9 shows the kinds of shifts that might take place.

- If X is a normal good and income increases, demand increases as shown in Panel a.

FIGURE 3.9: Shifts in Individual's Demand Curve

(a)   (b)   (c)

FIGURE 3.9: Shifts in Individual's Demand Curve

(a)　　　　　　　　　(b)　　　　　　　　　(c)
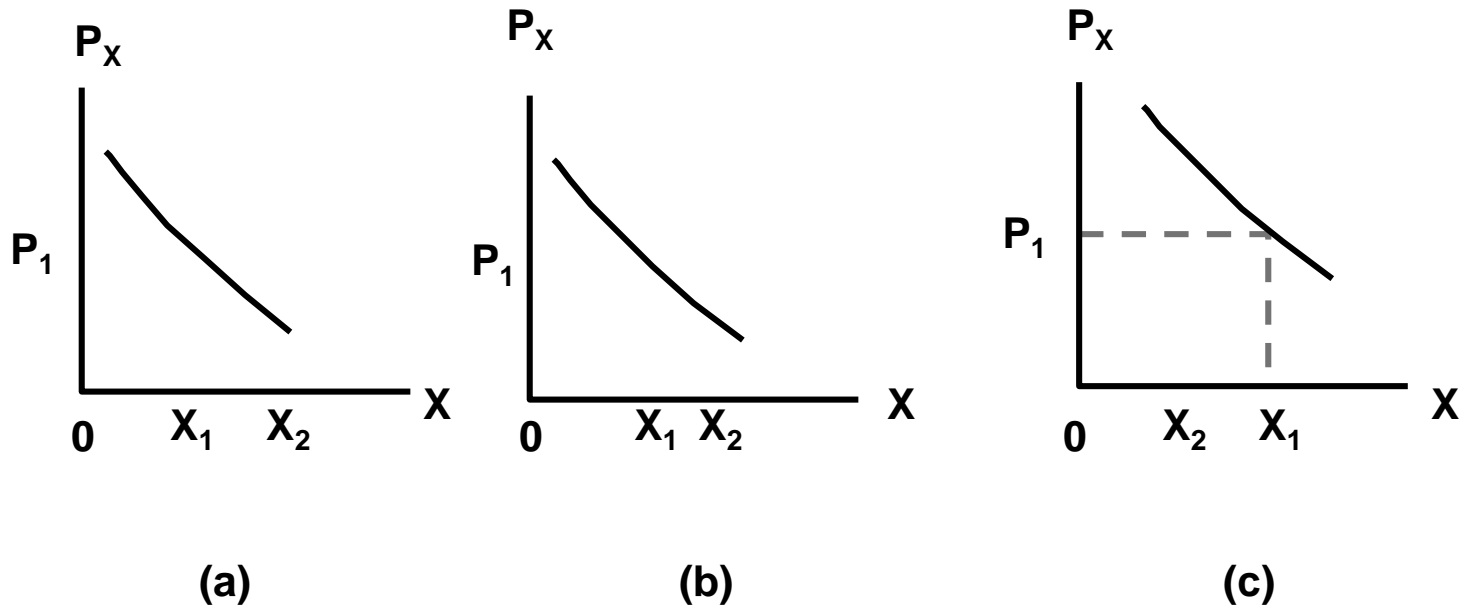
Shifts in an Individual's Demand Curve

- If X and Y are substitutes and the price of Y increases, the demand for X increases as shown in Panel b.

- Alternatively, if X and Y are complements, the increase in the price of Y will cause a decrease in the demand for X as shown in Panel c.

Shifts in an Individual's Demand Curve

- Changes in preferences can also shift demand curves.

- Panel b could represent an increased preference for cold drinks when a sudden hot spell occurs.

- Increased environmental consciousness during the 1980's and 1990s increased the demand for recycling and organic food.

Be Careful in Using Terminology

- A movement downward along a stationary demand curve in response to a fall in price is called an increase in **quantity demanded** while a rise in the price of the good results in a decrease in **quantity demanded.**

- A rightward shift in a demand curve is called an increase in **demand** while a leftward shift is a decrease in **demand.**

Consumer Surplus

- The extra value individuals receive from consuming a good over what they pay for it is called **consumer surplus.**

- **Consumer surplus** is also what people would be willing to pay for the right to consume a good at its current price.

- This concept is used to study the welfare effects of price changes.

Consumer Surplus

- The demand curve for T-shirts is shown in Figure 3.10.

- At the price of $11 the individual chooses to consume ten T-shirts.

- In other words, the individual is *willing to pay* $11 for the tenth T-shirt that they buy.

- With a price of $9, the individual chooses fifteen T-shirts, so implicitly they value the fifteenth shirt at only $9.

Consumer Surplus

- Because a good is usually sold at a single market price, people choose to buy additional units of the good up to the point at which their marginal valuation is equal to the price.

- In Figure 3.10, if T-shirts sell for $7, the individual will buy twenty shirts because the twentieth T-shirt is worth precisely $7.

- They will not buy the twenty-first T-shirt because it is worth less than $7.

Consumer Surplus

- Because the individual would be willing to pay more than $7 for the tenth or fifteenth T-shirt, it is clear that they get a "surplus" on those shirts because the individual is actually paying less than the maximal amount that they would be willing to pay.

- **Consumer surplus** is the difference between the maximal amounts a person would pay for a good and what he or she actually pays.

Consumer Surplus

- In graphical terms, **consumer surplus** is given by the area below the demand curve and above the market price.

- In Figure 3.10, total consumer surplus is given by area AEB ($80).
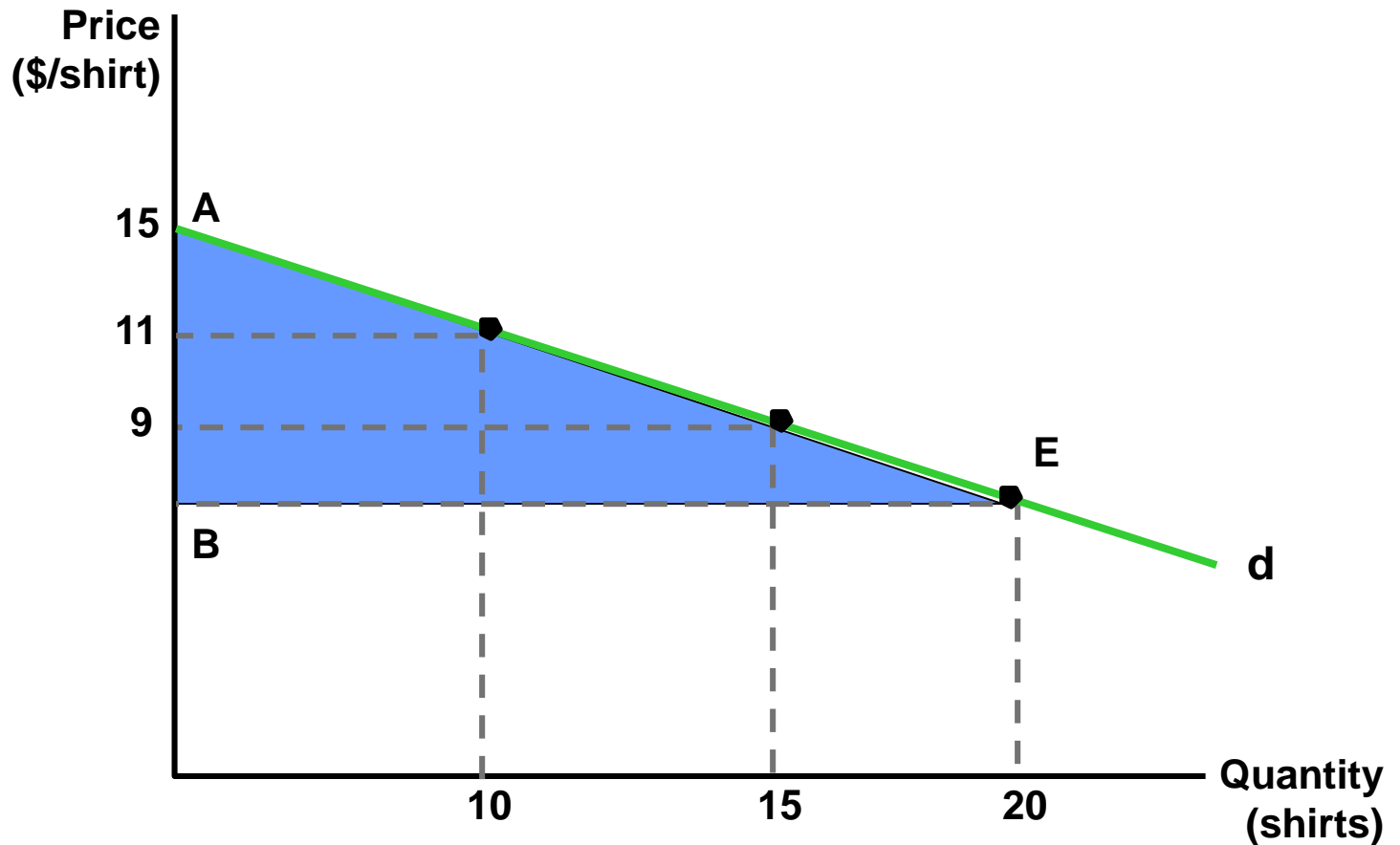
Consumer Surplus and Utility

- Figure 3.11 illustrates the connection between consumer surplus and utility

- Initially, the person is at E with utility U1.

- He or she would need to be compensated by amount AB in other goods to get U1 if T-shirts were not available.

Consumer Surplus and Utility

- In Figure 3.11, the individual would be willing to pay BC for the right to consume T-shirts rather than spending I only on other goods.

- Both distance AB and BC approximate the consumer surplus area in Figure 3.10.

FIGURE 3.11: Consumer Surplus and Utility

Price ($/shirt)

A

B

C

E

U_1

I

U_0

I'

20

Quantity (shirts)