

Individual & Market Demand

APEC 3001

Summer 2007

Readings: Chapter 4 in Frank

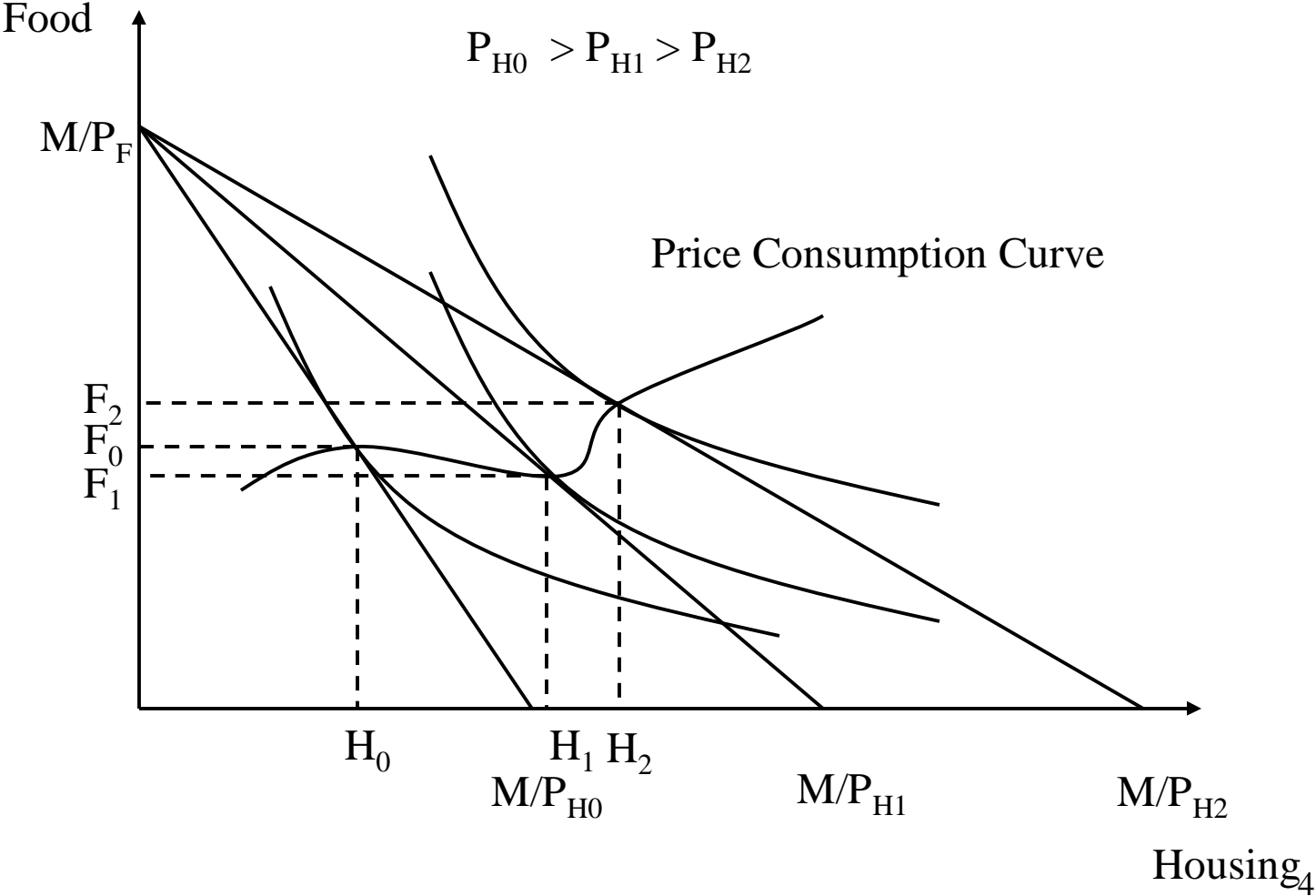
Objectives

- Deriving Individual Demand
- Engel Curves
- Income & Substitution Effects
 - Law of Demand & Violations
 - Complements & Substitutes
- Derivation of Market Demand From Individual Demands
- Elasticities:
 - Price Elasticity of Demand
 - Income Elasticity of Demand
 - Cross Price Elasticity of Demand

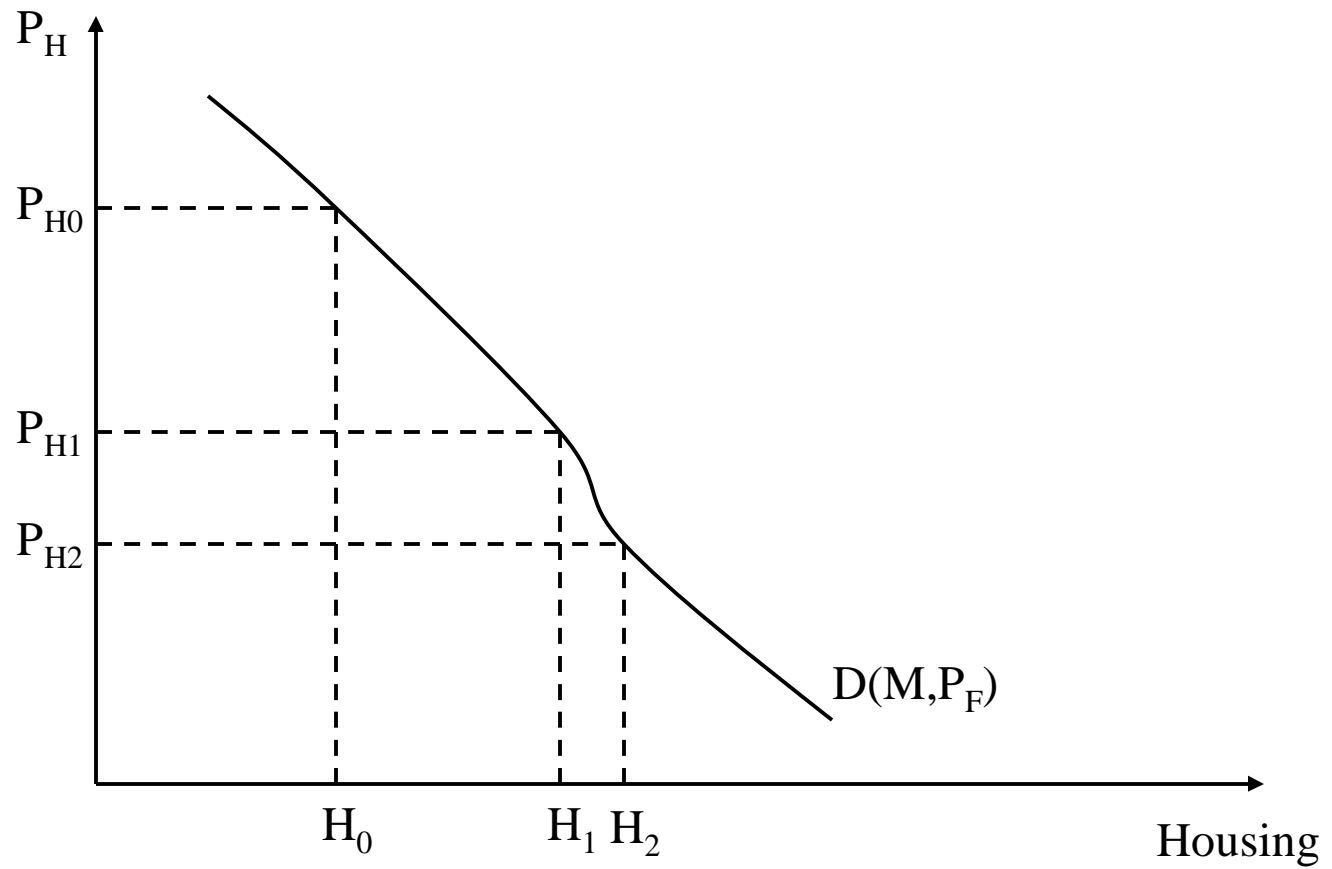
Deriving Individual Demand Definition

- Price Consumption Curve:
 - Holding income and the prices of other goods constant, the price consumption curve for a good is the set of optimal bundles as the price of the good varies.

Price Consumption Curve



Individual Demand Curve

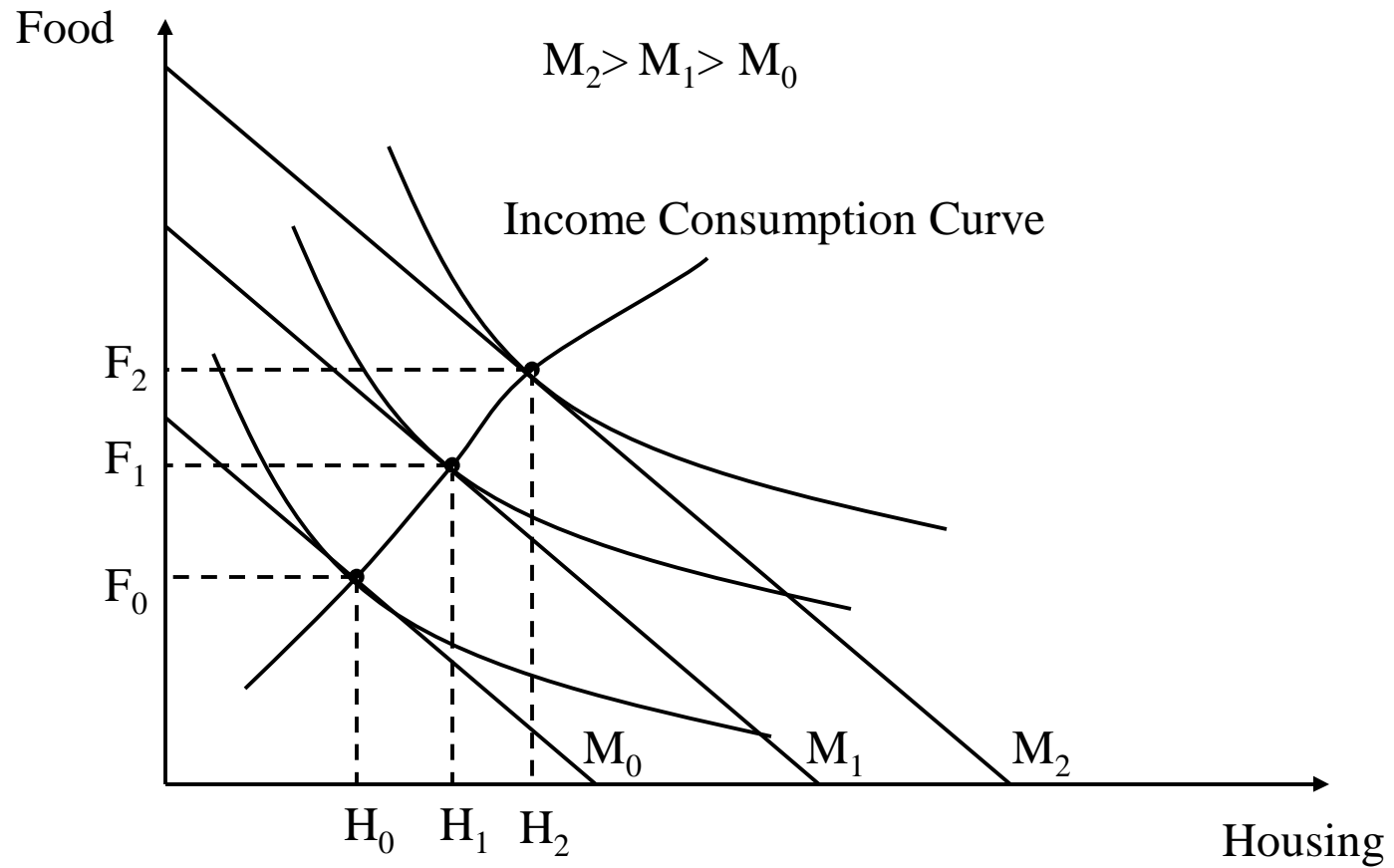


Engel Curves

Definition

- Income Consumption Curve:
 - Holding the price of all goods constant, the income consumption curve for a good is the set of optimal bundles as income varies.

Income Consumption Curve

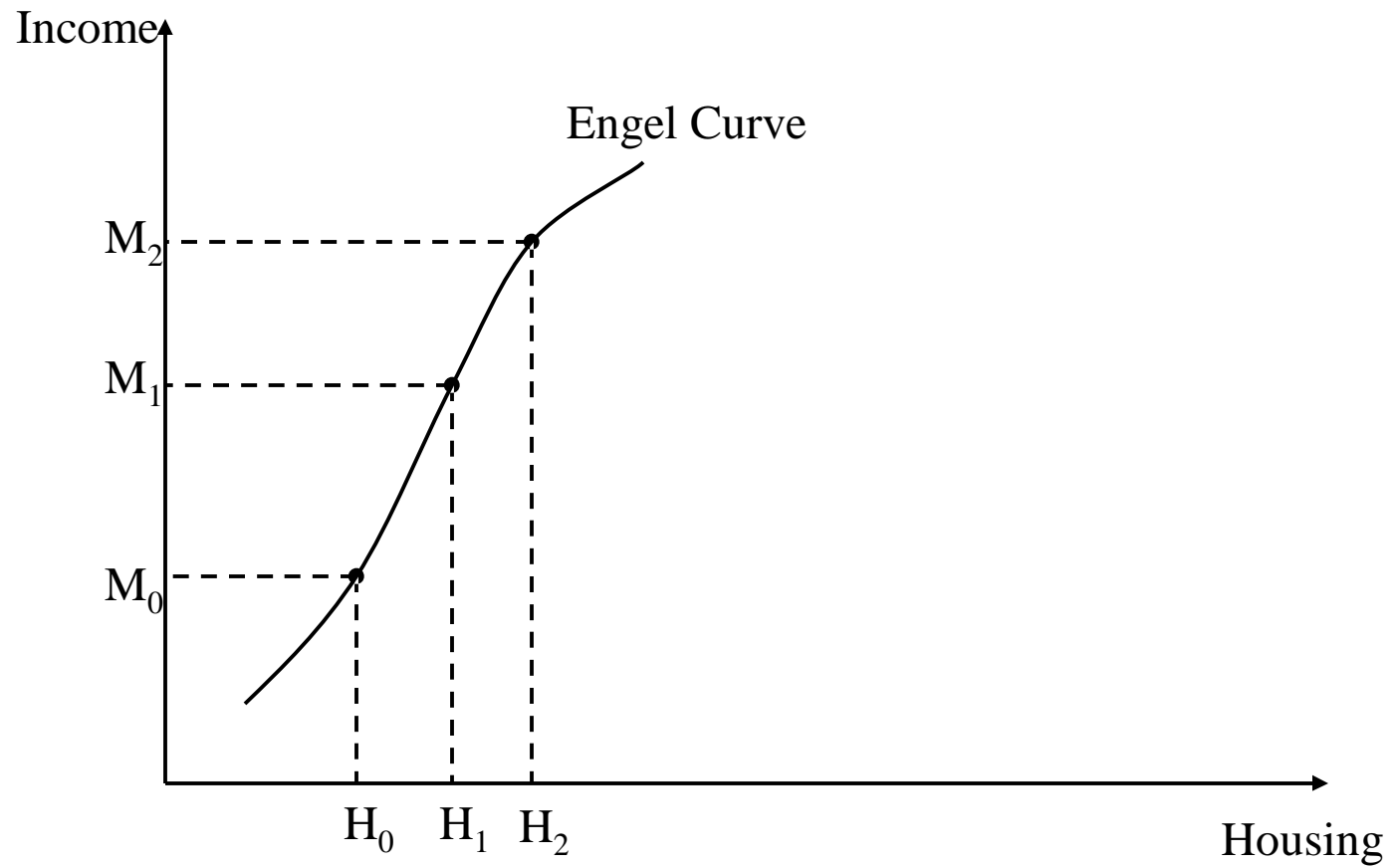


Engel Curves

Another Definition

- Engel Curve:
 - The curve that plots the relationship between the quantity of a good consumed and income.

Engel Curve



Engel Curves

Even More Definitions

- Normal Good:
 - A good whose quantity demanded rises as income rises.
- Inferior Good:
 - A good whose quantity demanded falls as income rises.

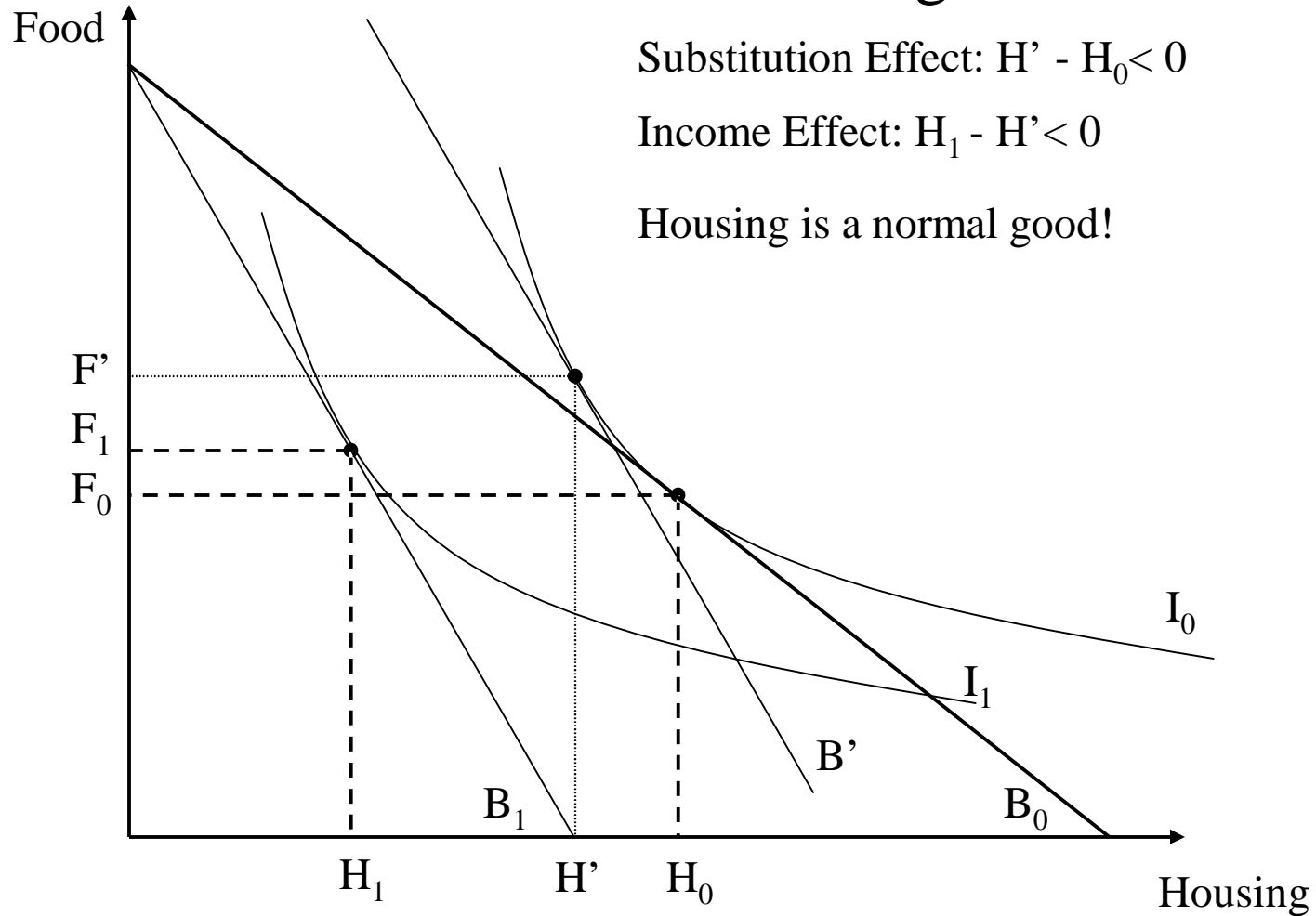
Important :Both these definitions assume prices do not change!

Income & Substitution Effects

Definitions

- Substitution Effect:
 - The component of the total effect of a price change that results from the associated change in the relative attractiveness of other goods.
- Income Effect:
 - The component of the total effect of a price change that results from the associated change in real purchasing power.

Substitution and Income Effects for an Increase in the Price of Housing



Income & Substitution Effects

Law of Demand & Violations

- Substitution Effect:
 - Negative for Own Price Increase
 - Positive for Own Price Decrease
- Income Effect:
 - Positive
 - Price Increase & Inferior Good
 - Price Decrease & Normal Good
 - Negative
 - Price Increase & Normal Good
 - Price Decrease & Inferior Good
- Violations of Law of Demand: Giffen Good
 - Inferior Good
 - Income Effect > Substitution Effect

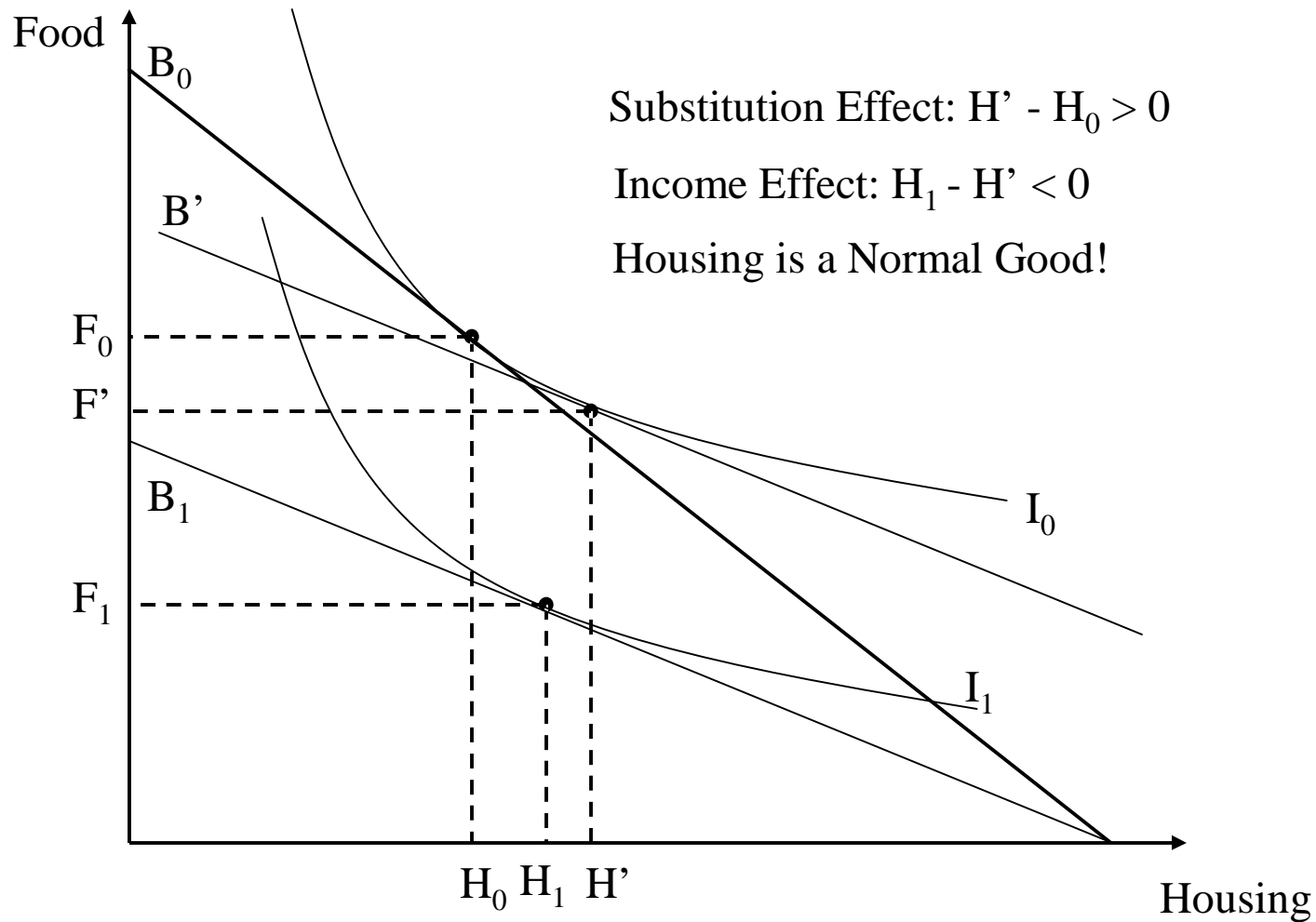
Income & Substitution Effects

Complements & Substitutes

Definitions

- Substitute Good:
 - A goods whose consumption increases when the price of another good increases.
- Complement Good:
 - A goods whose consumption decreases when the price of another good increases.

Substitution and Income Effects for a Change in the Price of Another Good: Increase in the Price of Food



Income & Substitution Effects

Complements & Substitutes

- Substitution Effect (Assuming Only Two Goods):
 - Positive for Price Increase of Other Good
 - Negative for Price Decrease of Other Good
- Income Effect:
 - Positive
 - Price Increase & Inferior Good
 - Price Decrease & Normal Good
 - Negative
 - Price Increase & Normal Good
 - Price Decrease & Inferior Good
- Complements: Normal Good & Income Effect $>$ Substitution Effect
- Substitutes:
 - Normal Good & Substitution Effect $>$ Income Effect
 - Inferior Good

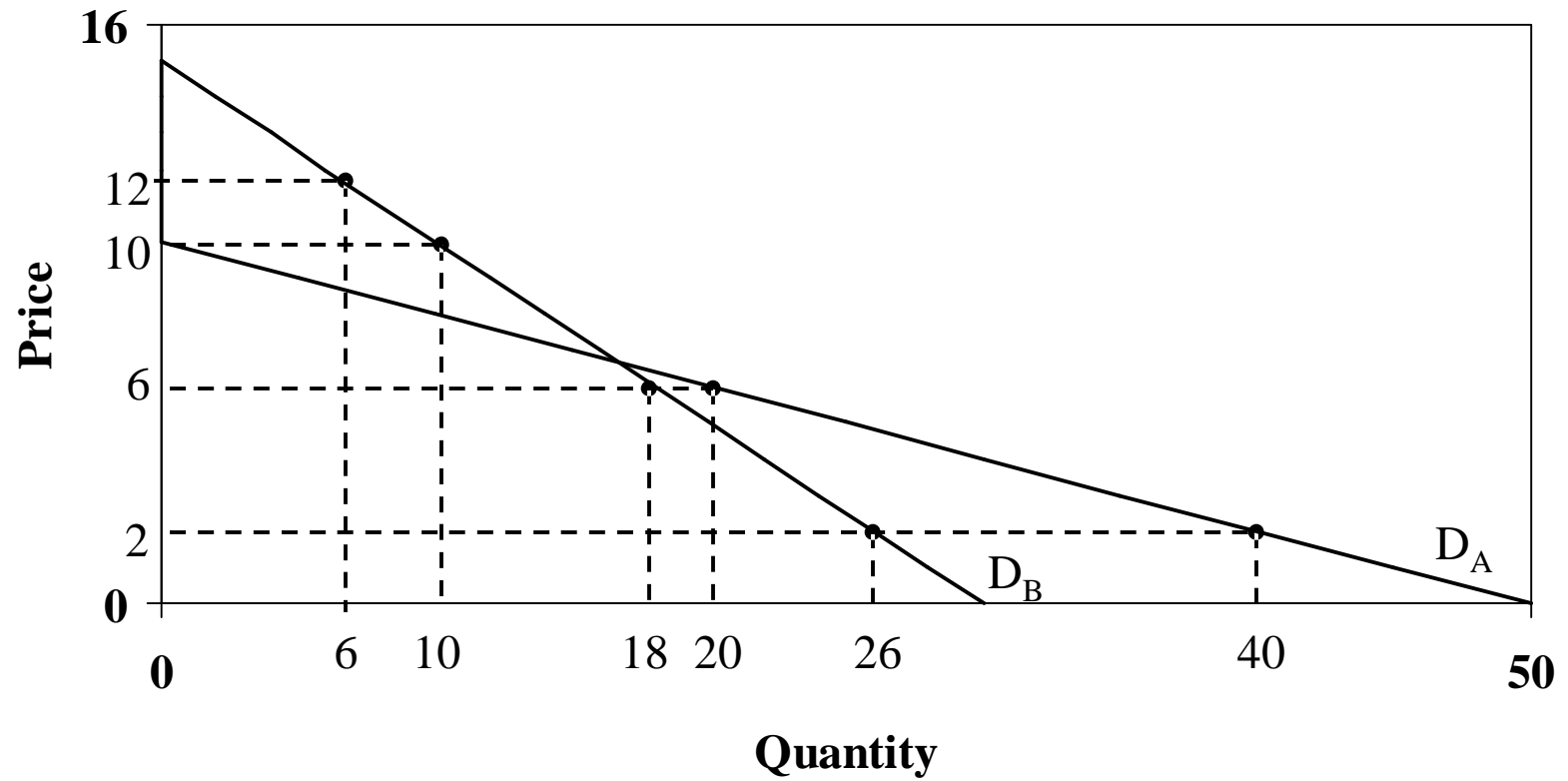
Derivation of Market Demand From Individual Demands

- Once we have everyone's individual demand, we need to find the market demand.
- The market demand for a product is the horizontal sum of individual demands.
 - The sum of individual quantity demands for alternative prices.
- Suppose we only have two people Mr. A and Ms. B:
 - $Q_A = 50 - 5P$
 - $Q_B = 30 - 2P$

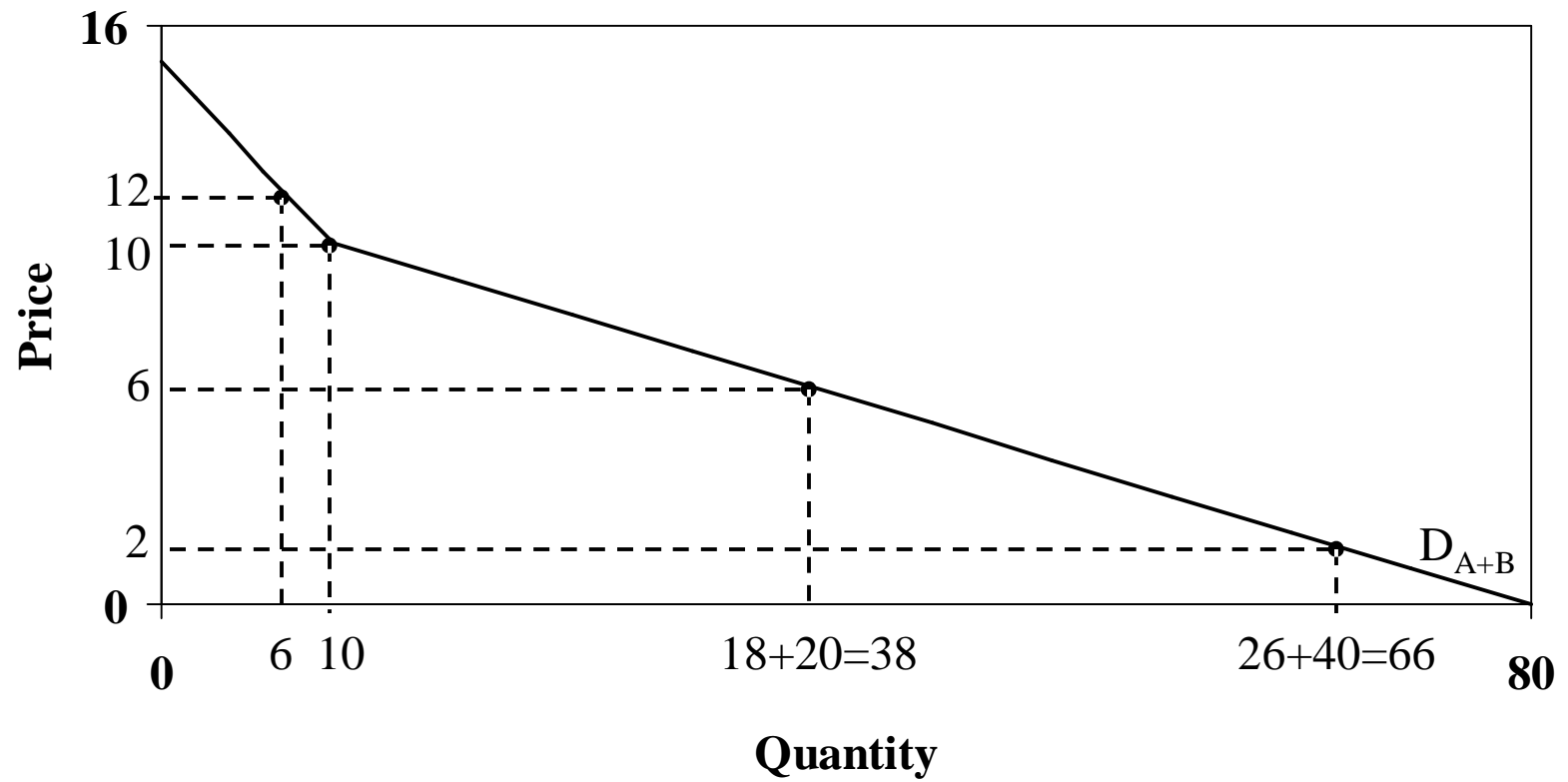
Horizontal Sum of Individual Demands

Price	A's Quantity Demanded	B's Quantity Demanded	Market Demand
15	0	0	0
14	0	2	2
13	0	4	4
12	0	6	6
10	0	10	10
9	5	12	17
8	10	14	24
7	15	16	31
6	20	18	38
5	25	20	45
4	30	22	52
3	35	24	59
2	40	26	66
1	45	28	73
0	50	30	80

Derivation of Market Demand



Derivation of Market Demand



Summary

- For $P \geq 15$: $Q_M = 0$
- For $15 > P \geq 10$: $Q_M = Q_B = 30 - 2P$
- For $10 > P \geq 0$: $Q_M = Q_A + Q_B = 50 - 5P + 30 - 2P = 80 - 7P$

Important Word of Caution: This works so well because we are looking at quantity demanded as a function of price. If we had written $P = 10 - 0.2Q_B$ & $P = 15 - 0.5Q_A$, we would need to solve these demands in terms of quantity before adding up. Price is the same for both individuals, but the quantity demanded need not be the same.

Price Elasticity of Demand

- Slope of Demand: Characterizes the sensitivity of quantity demanded to price.
 - But is this the best way measure this relationship?
 - No, because the slope isn't unit free.
 - Suppose the demand for bagels is $Q_1 = 1200 - 24P$ where Q_1 is the quantity demanded of individual bagels and P is the price of individual bagels.
 - This demand for bagels can also be written as $Q_{12} = 100 - 2P$ where Q_{12} is the quantity demanded of a dozen bagels and P is the price of individual bagels.
 - Looking at the slopes of these demand curves, one might conclude that the first is more sensitive to price than the second.
 - This is also a problem if we want to compare price sensitivity for different products: milk & bagels.

Price Elasticity of Demand (η)

Definition

- The percentage change in the quantity of a good demanded that results from a percentage change in price.
- If ΔQ_D is the change in quantity demanded & ΔP is change in price:

$$h = \frac{\frac{\Delta Q_D}{Q_D}}{\frac{\Delta P}{P}} = \frac{\Delta Q_D}{\Delta P} \frac{P}{Q_D}$$

Important Note: Demand curves are downward sloping, so the elasticity of demand based on this formula will always be negative. Sometimes, a positive elasticity is reported assuming the negative is just understood.

Price Elasticity of Demand Linear Demands

- $Q_D = a_D - b_D P$

$$h = -b_D \frac{P}{Q_D}$$

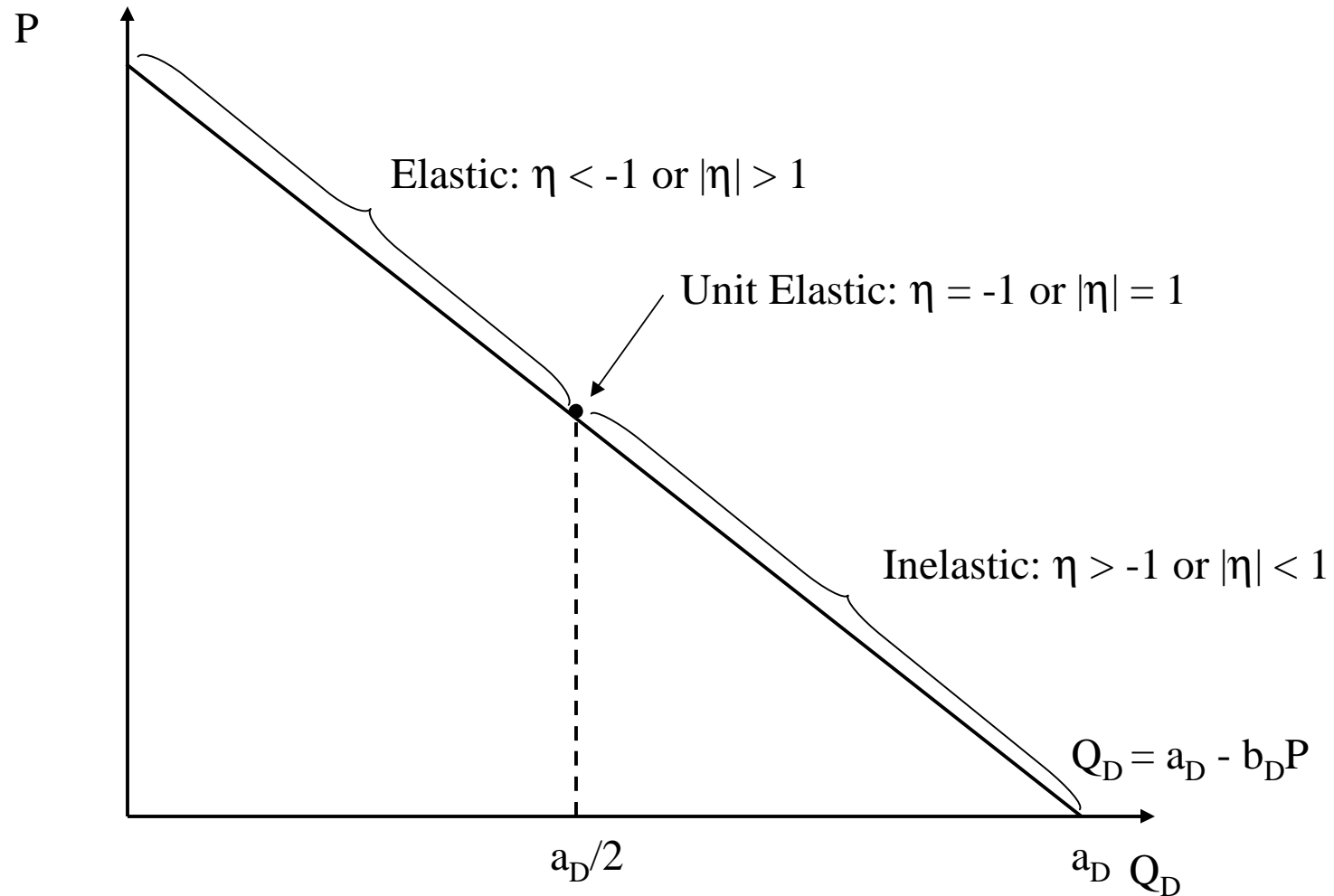
- $P = c_D - k_D Q_D$

$$h = -\frac{1}{k_D} \frac{P}{Q_D}$$

For Example

- Suppose the demand is $Q_D = 1,200 - 60P$.
- Question: What is the elasticity of demand when $P = 10$?
- Answer:
 - $a_D = 1,200$
 - $b_D = 60$
 - $Q_D = 1,200 - 60 \times 10 = 600$
 - such that $h = \frac{\Delta Q_D}{\Delta P} \frac{P}{Q_D} = -60 \frac{10}{600} = -1$

Elastic, Unit Elastic, and Inelastic Regions of a Linear Demand Curve



Price Elasticity of Demand In General

- $Q_D = D(P)$

$$h = \frac{P}{Q_D} D'(P)$$

- $P = D^{-1}(Q_D)$

$$h = \frac{P}{D^{-1}'(Q_D) Q_D}$$

What does the price elasticity of demand tells us?

- It tells us how sensitive the quantity demanded is to price.
- It tells us how a price increase will affect total revenue (TR) from the sale of a product.

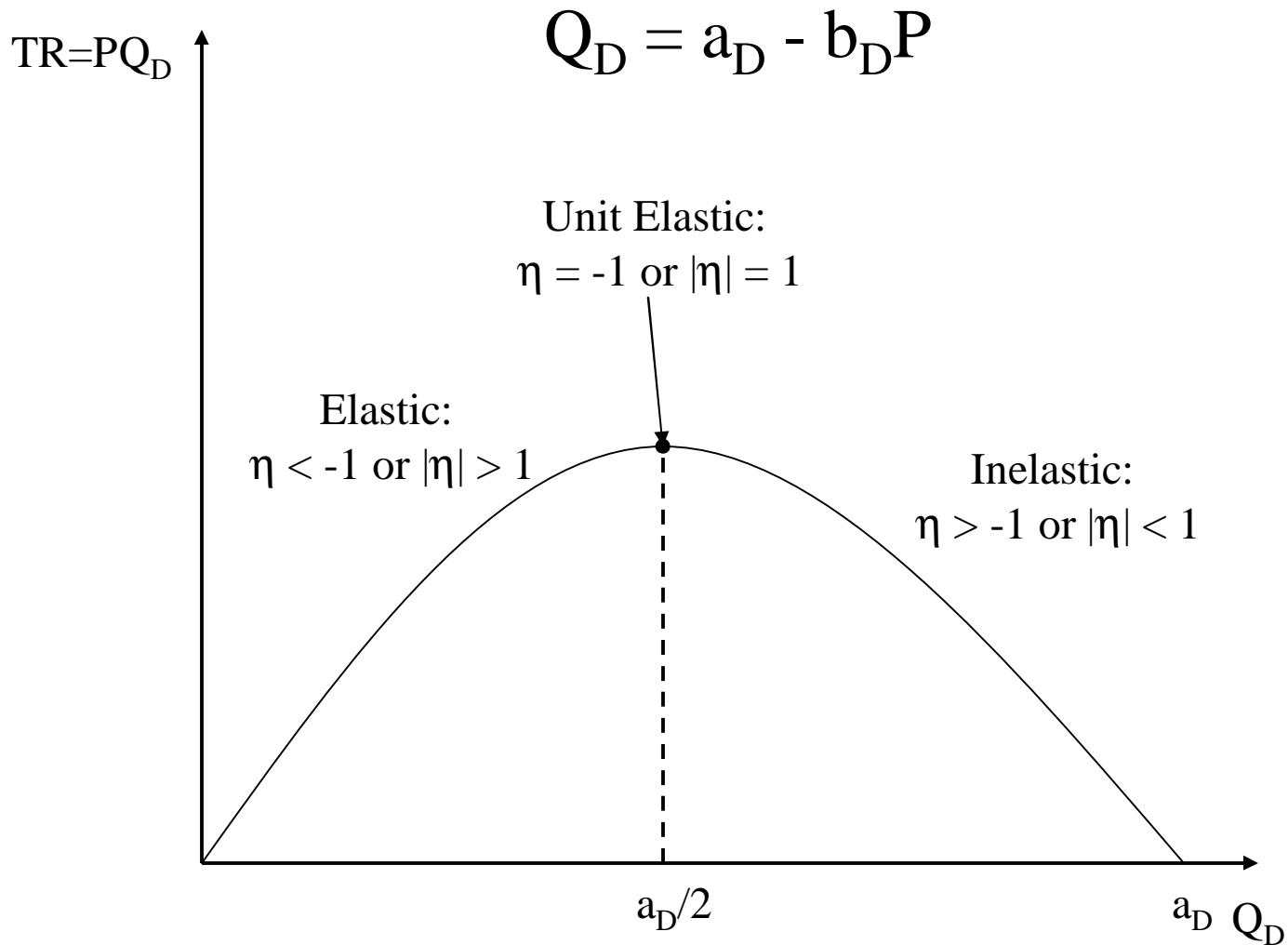
$$TR = PQ_D = PD(P)$$

$$TR' = D(P) + PD'(P)$$

$$TR' = D(P)(1 + \eta)$$

Therefore, for $\eta < -1$ or $|\eta| > 1$, $TR' < 0$;
for $\eta = -1$ or $|\eta| = 1$, $TR' = 0$; and
for $\eta > -1$ or $|\eta| < 1$, $TR' > 0$.

Relationship Between Total Revenue and the Elasticity of Demand with a Linear Demand Curve:



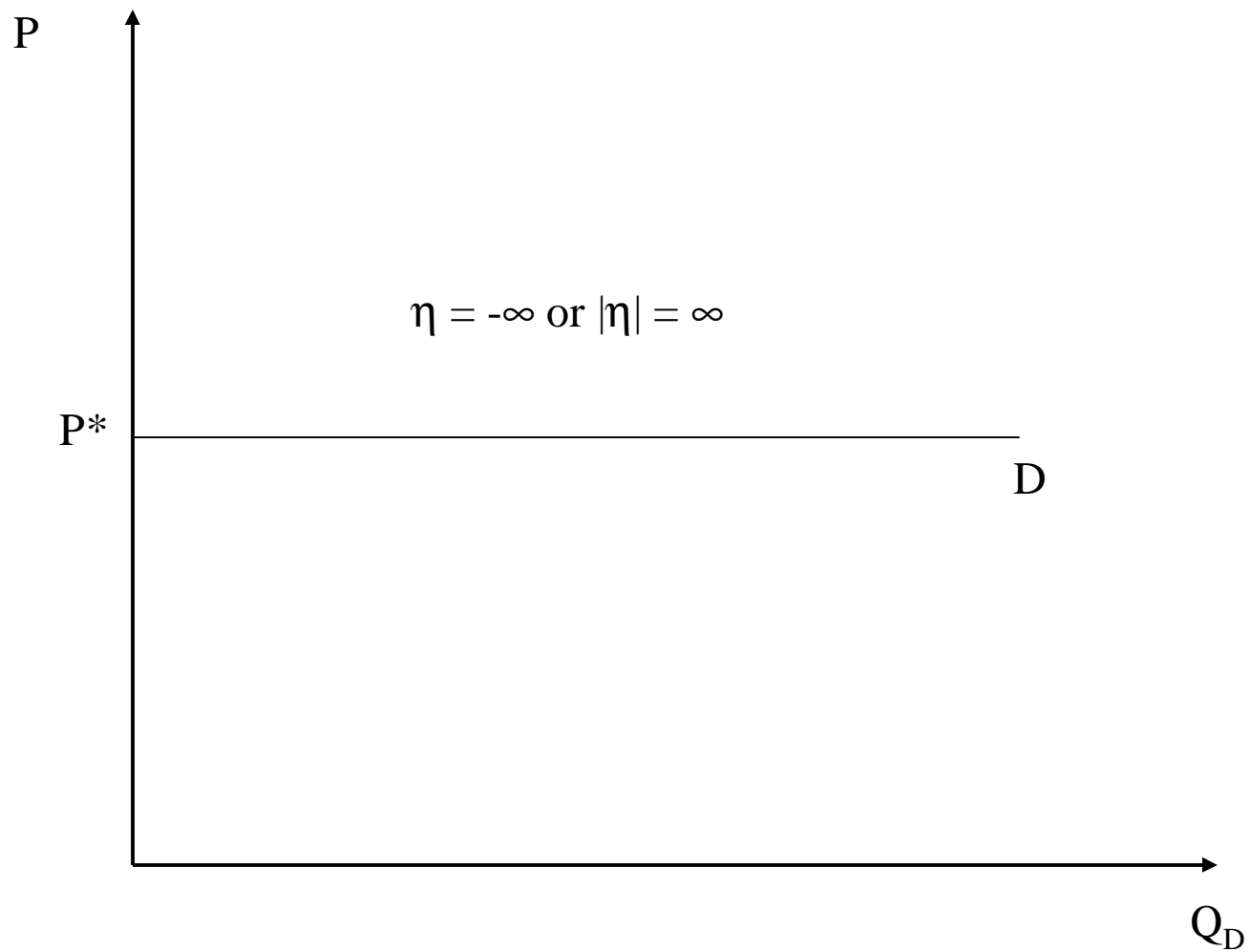
Determinants of the Price Elasticity of Demand

- Substitution Possibilities:
 - If there are lots of substitutes available, the demand for a good is more elastic.
- Budget Share:
 - If more of your total income is spend on a good, the demand for that good is more elastic.
- Direction of the Income effect:
 - Normal goods tend to be more elastic than inferior goods because the income effect reinforces the substitution effect.
- Time:
 - When there is more time available for individuals to respond to price changes, demand is more elastic.

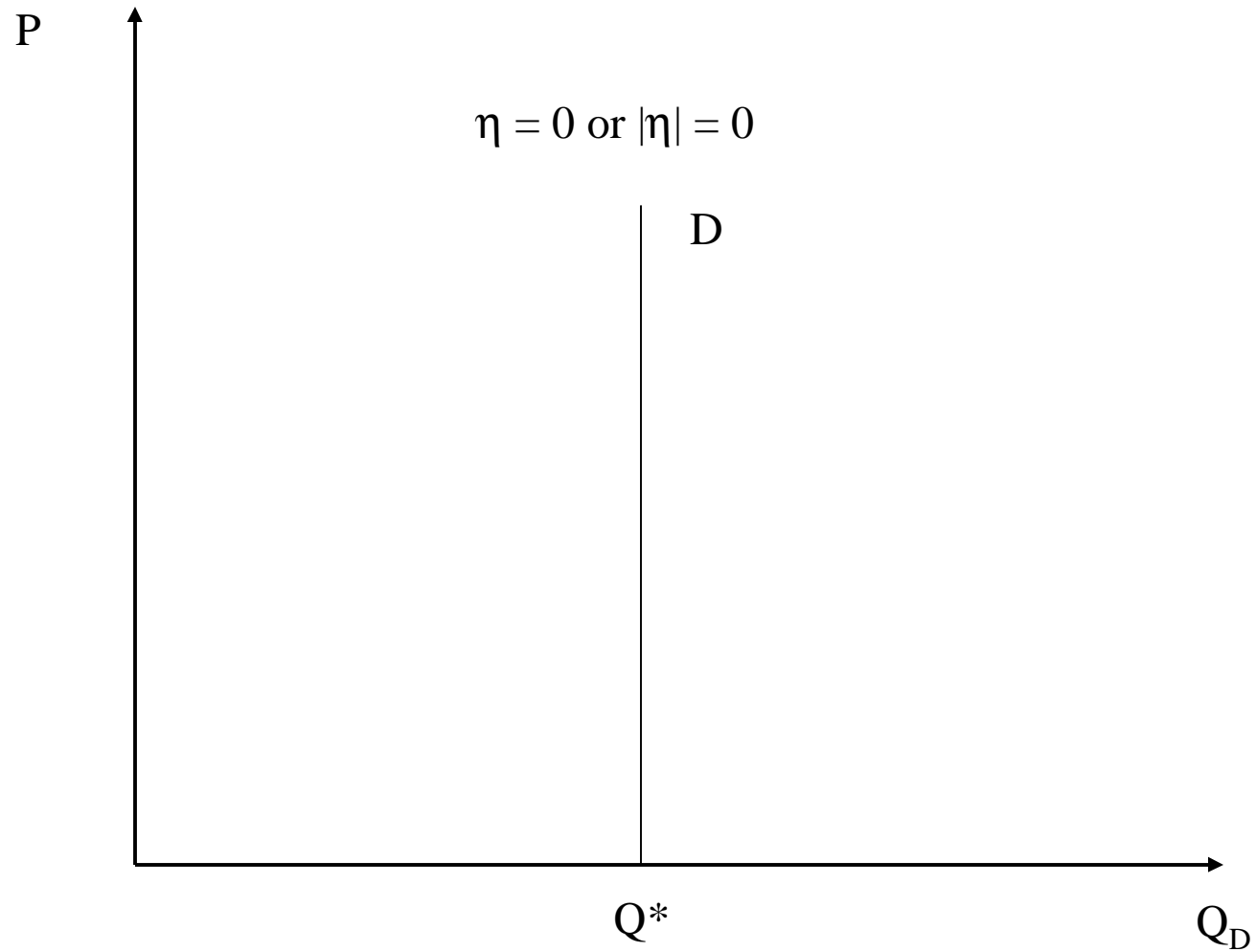
Special Cases of the Price Elasticity of Demand

- Perfectly Elastic: $\eta < -\infty$ or $|\eta| > \infty$
- Perfectly Inelastic: $\eta = 0$ or $|\eta| = 0$

Perfectly Elastic Demand Curve



Perfectly Inelastic Demand Curve



Income Elasticity of Demand (ϵ)

Definition

- The percentage change in the quantity of a good demanded that results from a one percent increase in income.
- If ΔQ_D is the change in quantity demanded & ΔM is change in income:

$$e = \frac{\frac{\Delta Q_D}{Q_D}}{\frac{\Delta M}{M}} = \frac{\Delta Q_D}{\Delta M} \frac{M}{Q_D}$$

For Example

- Suppose demand is $Q_D = 200 + 2M - 60P$.
- Question: What is the income elasticity of demand when $P = 10$ and $M = 500$?
- Answer:
 - $\Delta Q_D / \Delta M = 2$
 - $Q_D = 200 + 2 \times 500 - 60 \times 10 = 600$
 - such that $e = \frac{\Delta Q_D}{\Delta M} \frac{M}{Q_D} = 2 \frac{500}{600} = \frac{5}{3}$

What does the income elasticity of demand tell us?

- It tells us how sensitive the quantity demanded is to change in income.
 - For normal goods, $\epsilon > 0$.
 - For inferior goods, $\epsilon < 0$.
- But we can even refine this classification:
 - For necessities, $1 > \epsilon > 0$.
 - For luxuries, $\epsilon > 1$.

Cross-Price Elasticity of Demand (η_{xz}) Definition

- The percentage change in the quantity of one good demanded that results from a one percent change in the price of another good.
- If ΔQ_X is the change in quantity demanded of good X & ΔP_Z is change in the price of good Z:

$$h_{xz} = \frac{\frac{\Delta Q_X}{Q_X}}{\frac{\Delta P_Z}{P_Z}} = \frac{\Delta Q_X}{\Delta P_Z} \frac{P_Z}{Q_X}$$

For Example

- Suppose the demand for good x is $Q_x = 500 - 2P_y - 10P_x$.
- Question: What is the cross price elasticity of demand for good x when $P_x = 25$ and $P_y = 50$?
- Answer:
 - $\Delta Q_x / \Delta P_y = -2$
 - $Q_x = 500 - 2 \times 50 - 10 \times 25 = 150$
 - such that $h_{xz} = -2 \frac{50}{150} = -\frac{2}{3}$

What does the cross-price elasticity of demand tell us?

- It tells us how sensitive the quantity demanded of one good is to change in the price of another good.
 - For substitute goods, $\eta_{xz} > 0$.
 - For complement goods, $\eta_{xz} < 0$.

What You Need to Know

- How individual demand is derived from the rational choice problem.
- How Engel curves are derived from the rational choice problem
- Income & Substitution effects and how to use them.
- Derivation of market demand from individual demands.
- How to calculate & interpret the
 - Price Elasticity of Demand
 - Income Elasticity of Demand
 - Cross Price Elasticity of Demand