



Elasticity of Demand and Supply

Price Elasticity of Demand

Determinants of the Price Elasticity of Demand

Price Elasticity of Supply

Other Elasticity Measures

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Why Price Elasticity of Demand

- Law of demand says that a higher price reduces quantity demanded, **BUT BY HOW MUCH** → the number sold decline by only a little or by a lot?
- 考慮 航空公司 希望提高總營收
 - ❑ 總營收 = 票價×旅客數
 - ❑ 票價和旅客數呈反向變動
 - ❑ 應該如何調整票價?

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Definition of Price Elasticity of Demand

- ***Price elasticity of demand measures how responsive consumers react to price change***

$$\text{Price elasticity of demand} = \frac{\text{Percentage change in quantity demanded}}{\text{Percentage change in price}}$$

See next slide

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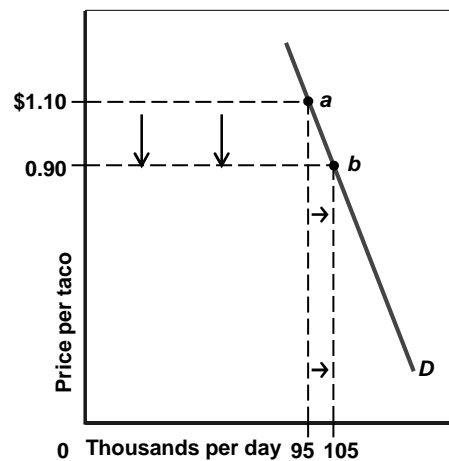


Demand Curve for Tacos

The average of \$1.10 and \$0.90 = \$1.00 → the change in price is -\$0.20 divided by \$1.00 → -20%

the average quantity demanded is 100,000 and the change in quantity demanded is 10,000 → 10% change

Price elasticity between a and b = $10\% / -20\% = -0.5$



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Price Elasticity of Demand

- Generalize the price elasticity formula
 - ❖ The price drops from p to p' , other things constant, the quantity demanded increases from q to q'
 - ❖ The change in price and the change in quantity as Δp and Δq , respectively.

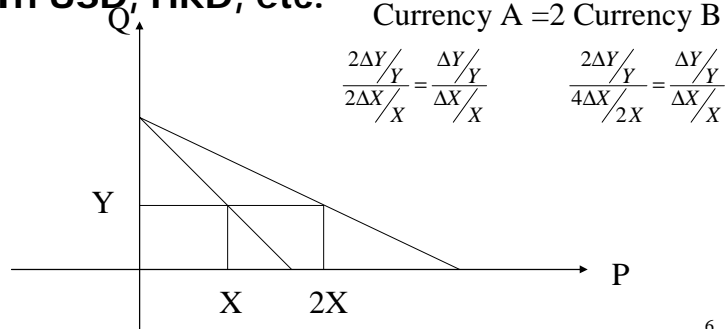
$$E_D = \frac{\frac{\Delta q}{(q + q')/2}}{\frac{\Delta p}{(p + p')/2}}$$

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Price Elasticity of Demand

- The focus is on the percent change, we need not be concerned with how output or price is measured
 - ❖ In KGs, pounds, tons, etc.
 - ❖ In USD, HKD, etc.



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Price Elasticity of Demand

- Elasticity expresses a relationship between two amounts
 - The percent change in quantity demanded
 - The percent change in price
- The law of demand states that price and quantity demanded are inversely related,
- → the change in price and the change in quantity demanded have opposite signs
→ the price elasticity of demand has a negative sign

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Price Elasticity of Demand

- Referring a negative number gets cumbersome, the price elasticity of demand is represented as an absolute value → positive number

$$E_D = \left| \frac{\frac{\Delta q}{(q + q')/2}}{\frac{\Delta p}{(p + p')/2}} \right|$$

- Ex: absolute value of the elasticity for tacos computed earlier will be referred to as 0.5 rather than -0.5

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Categories of Elasticity

- Three general categories
- *Inelastic:*
 - ❖ Elasticity is between 0 and 1.0
 - ❖ The percent change in quantity demanded is smaller than the percent change in price,
 - ❖ Quantity demanded is relatively *unresponsive* to a change in price
- *unit-elastic*
 - ❖ elasticity with an absolute value of 1.0
 - ❖ If the percent change in quantity demanded equals the percent change in price

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Categories

- *Elastic*
 - ❖ price elasticity has an absolute value exceeding 1.0
 - ❖ The percent change in quantity demanded exceeds the percent change in price

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Elasticity and Total Revenue

- Price elasticity can indicate the effect of a price change on total revenue
- *Total revenue* (TR) is the price (p) multiplied by the quantity demanded (q) at that price
→ $TR = p \times q$

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What happens to total revenue when price decreases ?

- A lower price means producers get less for each unit sold which tends to decrease total revenue
- However, a lower price increases quantity demanded which tends to increase total revenue
- Thus, the overall impact of a lower price on total revenue depends on the net result of these opposite effects

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Relation between Elasticity and Total Revenue

- When demand is *elastic*,
 - percent increase in quantity demanded \geq percent decrease in price
 - Total revenue increases
- When demand is *unit elastic*,
 - percent increase in quantity demanded = percent decrease in price
 - total revenue remains unchanged
- When demand is *inelastic*,
 - percent increase in quantity demanded \leq the percent decrease in price
 - total revenue decreases

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Elasticity and Total Revenue

- These relationships can be tied together by looking at a linear demand curve

- See next slide

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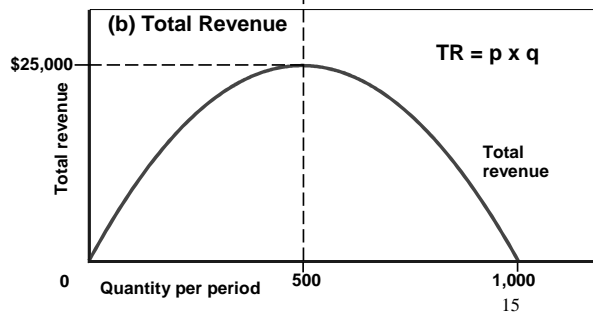
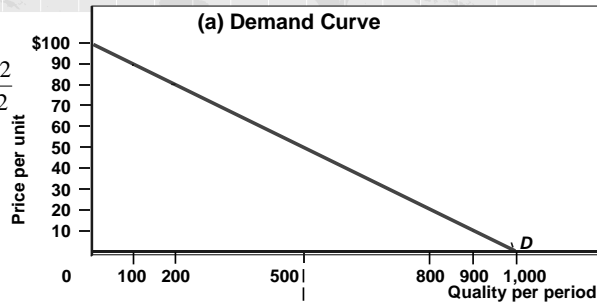


Demand, Price Elasticity and Total Revenue

$$E_D = \frac{\frac{\Delta q}{(q+q')/2}}{\frac{\Delta p}{(p+p')/2}} = \frac{\Delta q}{\Delta p} \times \frac{(p+p')/2}{(q+q')/2}$$

Slope is constant for linear model.

The price elasticity of demand is greater on the higher-price end of the demand curve than on the lower-price end.



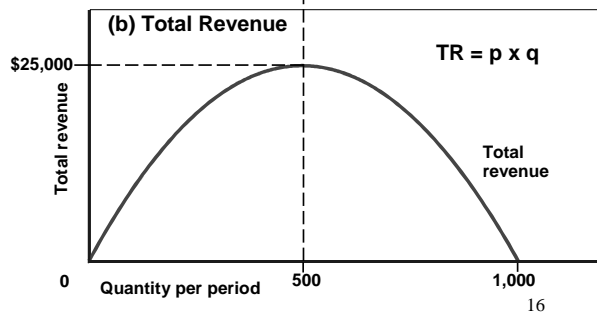
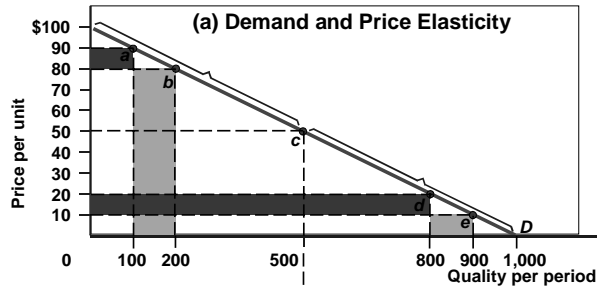
Demand, Price Elasticity and Total Revenue

Consider point *a*, *b* on the demand curve.
 Percent change of quantity $100/150 = 0.67$
 Percent change of price $10/85 = 12\%$ → the price elasticity of demand here is 5.6

Price drop from 90 → 80
 Loss: $10 \times 100 = 1000$
 Gain $80 \times 100 = 8000 \rightarrow TR \uparrow$

Consider points *d* and *e*
 Percent change of quantity $100/850 = 12\%$
 Percent change of price $10/15 = 67\%$ → a price elasticity of 0.2

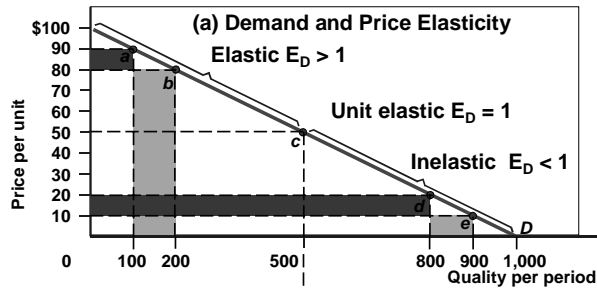
Price drop from 20 → 10
 Loss: $10 \times 800 = 8000$
 Gain $10 \times 100 = 1000 \rightarrow TR \downarrow$



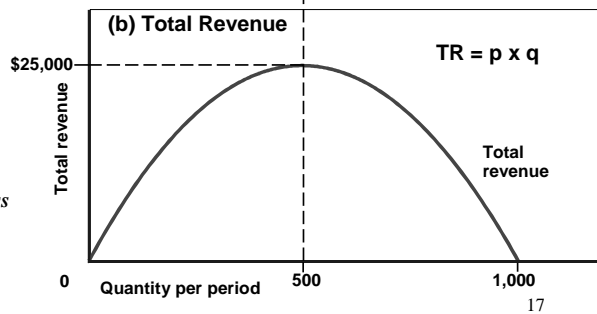


Demand, Price Elasticity and Total Revenue

Where demand is elastic, a decrease in price will increase total revenue because the gain in revenue from selling more units exceeds the loss in revenue from selling at the lower price.



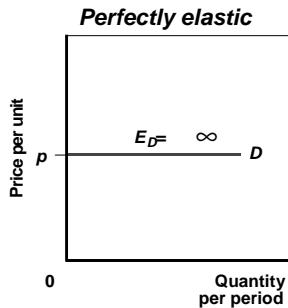
Where demand is inelastic, a price decrease reduces total revenue because the gain in revenue from selling more units is less than the loss in revenue at the lower price.



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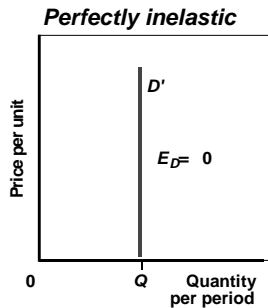


Constant Elasticity Demand Curves



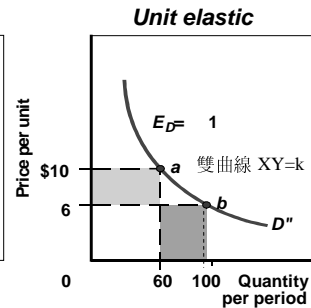
Consumers demand all that is offered at the given price, p . If the price rises above p , quantity demanded drops to zero → perfectly elastic demand curve.

消費者有眾多選擇



Quantity demanded does not vary when the price changes → no matter how high the price, consumers will purchase the same quantity → perfectly inelastic demand curve.

消費者別無選擇



unit-elastic demand curve: Percent change in price results in an identical percent change in quantity demanded.

消費金額固定

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● 論文: 從差別訂價與需求彈性論台電之「夏日電價」 (柯伯昇)

- 台電自民國七十八年起，實施所謂的夏日電價。主要目的在於引導用戶抑制夏季尖峰用電負載，以減緩發供電設備投資，抑低發電成本，進而維持低廉電價水準。」其最終目的無非就是希望「以價制量」以解決國內季節性供電短缺的問題
- 推論: 一般營業處所在正常上班的時間，不太可能會因電價的上升而減少冷氣空調的使用，所以夏日電價對於營業用電之價格需求彈性應該是很小。至於一般家庭冷氣空調的使用，試想一個消費者既然願意購買冷氣空調，還會在乎每度平均約上漲二成的電費嗎？
- 電力的價格需求彈性並不大，所以台電的夏日電價措施欲藉由以價制量來抑低夏日尖峰用電的負載，其效果不彰，是可預見的結果。

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● *Elasticity of Demand and Supply*

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Determinants

- **Why price elasticities of demand vary for different goods**

- **Three basic determinants**
 - Availability of substitutes
 - Proportion of the consumer's budget spent on the good
 - A matter of time

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Availability of Substitutes

- **The greater the availability of substitutes**
- **The closer the substitutes,**
- **→ The greater the good's price elasticity of demand**

- **The number and similarity of substitutes depend on how we define the good**
 - The more broadly we define a good, the fewer the substitutes and the less elastic the demand

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Example of Availability of Substitutes

- ⊕ Shoes is less elastic than running shoes
 - ⊗ Substitutes for running shoes: tennis shoes ..
- ⊕ Running shoes is less elastic than Nike running shoes.

- ⊕ Much ads. is aimed at the uniqueness of a product → No substitutes. Why?

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Proportion of Consumer's Budget

- **If spending on some goods represents a large share of the consumer's budget,**
 - ⊗ **Change in the price of such a good has a substantial impact on the purchase power**
 - ⊗ **考慮房子 vs. 衛生紙**

- **Generally, the more important the item is as a share of the consumer's budget,**
- **→ The greater will be the income effect of a change in price**
- **→ The more price elastic will be the demand for the item**

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A Matter of Time

- The process of finding substitutes takes time
- The longer the adjustment period,
- The greater the consumers' ability to find substitute
 - → The more responsive the change in quantity demanded is to a given change in price
- See next slide

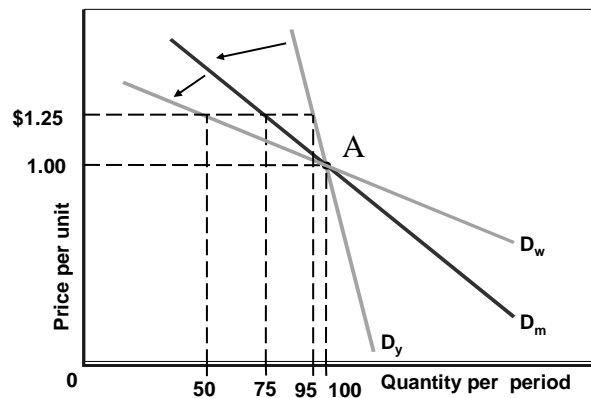
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Demand Becomes More Elastic over Time

D_w = the demand curve one week after the price change
 D_m = one month after
 D_y = one year after.

Suppose the price now increases to \$1.25. The more time for consumers to respond to price increase, the greater the reduction in quantity demanded.



At A, the flatter the demand curve, the more price elastic the demand.

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大陸新聞 羅奇：面對高油價中國 應節能和尋找可替代能源

- 對於可替代能源,中國現在已經轉向了核發電,並且在過去幾年已有了相應的計劃或專案。對於石油價格與全球經濟增長的關係,羅奇認為,如果今後幾個月石油價格仍然維持目前每桶50美元不變,將足以導致2005年之後全球經濟的嚴重衰退。

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Elasticity Estimates

- consumers have little time to adjust – the *short run* –
- Consumers can more fully adjust to a price change – the *long run*.
- Next slide provides some short-run and long-run price elasticity estimates for selected products

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Selected Price Elasticities of Demand

Product	Short Run	Long Run
Cigarettes (among adults)	—	0.4
Electricity (residential)	0.1	1.9
Air travel	0.1	2.4
Medical care and hospitalization	0.3	0.9
Gasoline	0.4	1.5
Milk	0.4	—
Fish (cod)	0.5	—
Wine	0.7	1.2
Movies	0.9	3.7
Natural gas (residential)	1.4	2.1
Automobiles	1.9	2.2



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Other Elasticity Measures



Price Elasticity of Supply

The *price elasticity of supply* measures how responsive producers are to a price change

$$\text{Price elasticity of supply} = \frac{\text{percent change in quantity supplied}}{\text{Percentage change in price}}$$

- Higher price → usually increased quantity supplied,
- → Percent change in price and the percent change in quantity supplied move in the same direction
- → the price elasticity of supply is usually a positive number

- Next slide depicts a typical upward-sloping supply curve

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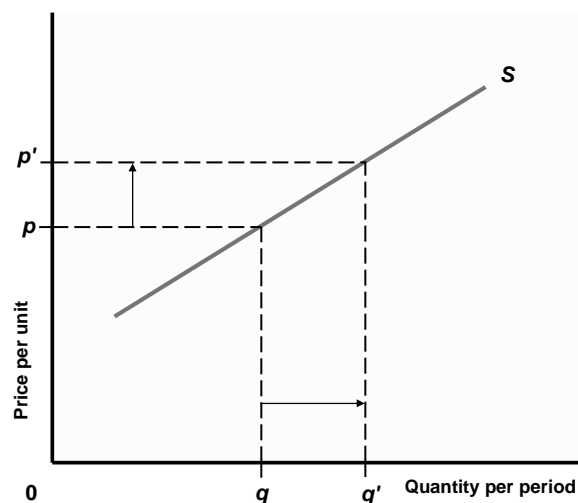
Figure of Price Elasticity of Supply

If the price increases from p to p' , the quantity supplied increases from q to q'

The price elasticity of E_s , is

$$E_s = \frac{\Delta q / (q' + q) / 2}{\Delta p / (p' + p) / 2}$$

Where Δq is the change in quantity supplied and Δp is the change in price.



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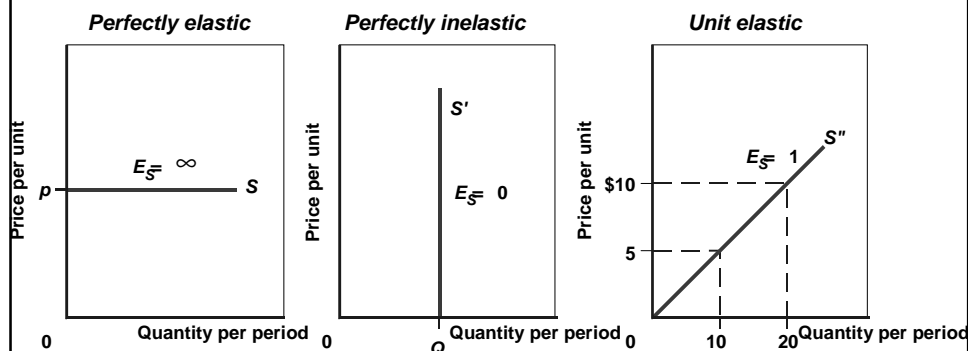
Categories of Supply Elasticity

- The terminology for supply elasticity is the same as for demand elasticity
 - If supply elasticity is less than 1.0, *supply is inelastic*
 - If it equals 1.0, *supply is unit elastic*
 - If it exceeds 1.0, *supply is elastic*

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Constant-Elasticity Supply Curves



Producers will supply none of the good at a price below p . The supply curve is horizontal.

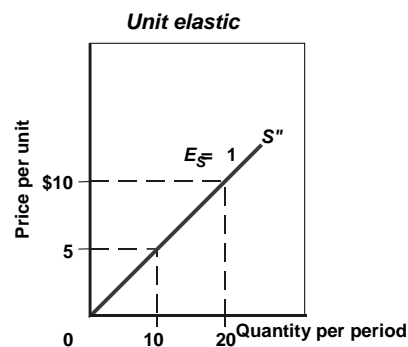
There is no change in the quantity supplied regardless of the price. The supply curve is perfectly vertical.

Any supply curve that is a straight line from the origin is a *unit-elastic supply curve*.

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In Class Exercise

- Why any supply curve that is a straight line from the origin must be a *unit-elastic supply curve*?



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Determinants

- The elasticity of supply indicates how responsive producers are to a change in price
- Their responsiveness depends on how easy it is to alter output when price changes
 - If the marginal cost rises sharply
 - higher price will elicit little increase in supplied
 - If the marginal cost rises slowly
 - the lure of a higher price will prompt a large increase in output

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Length of Time

- Like Demand, supply also becomes more elastic over time as producers adjust to price changes
- The longer the time period under consideration, the more able producers are to adjust to changes in relative prices
- See next slide

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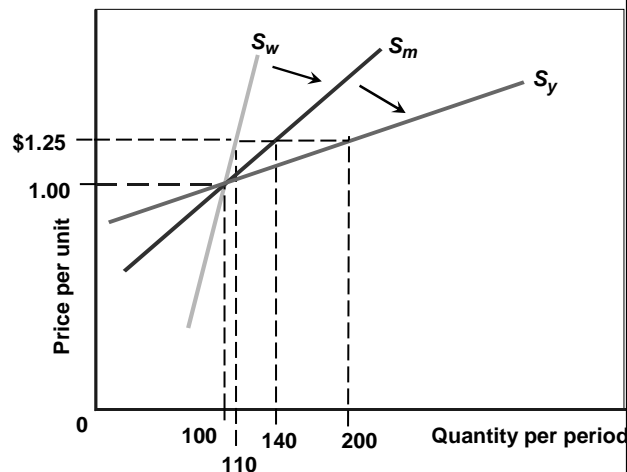


Supply Becomes More Elastic over Time

S_w is the supply curve when the period of adjustment is a week.

Price \$1.00 → \$1.25
Quantity 100 → 110

S_m is the supply curve when the adjustment period is one month. Here the firms have a greater ability to vary output
Price \$1.00 → \$1.25
Quantity 100 → 140



Supply is even more elastic when the adjustment period is a year as shown by S_y

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新聞: 石油價格

- 由於全球原油供給彈性（註:考慮伊拉克,墨西哥灣）降低，短期因素對原油價格波動的影響將會增加，加上全球主要區域（中國、日本、歐洲）戰備儲油提升，又使原油供需吃緊，因此預期原油將維持高檔
- 然而從長期而言，在足夠可的調整時間情況，由於新的能源開發，使得能源替代性以.及消費偏好與習慣的改變，因而需求彈性相對提高，從而價格波動變小。

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Income Elasticity of Demand

- The *income elasticity of demand* measures the percent change in demand divided by the percent change in income
- Categories of Income Elasticity of Demand
 - Goods with income elasticities less than zero are called *inferior goods* → demand declines when income increases

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分析:小孩是劣等財嗎? (莊奕琦)

- 台灣人的生育率像自由落體，在很短時間內急速下降，現已在全世界敬陪末座。民國四十年，台灣每位婦女生7.04個小孩；到民國七十年，該是四十年次婦女生育的時候，她們卻只生2.46個。到了去年，生育率更跌至只有1.18個，連續幾年「創歷史新低」，更和世界婦女生育值的2.8個差一截。
- 隨著經濟發展，不盡然如馬爾薩斯所言，小孩的個數會增加，因為當工資普遍增加時，婦女撫育小孩的機會成本也增加，同時教育小孩的費用亦提高（因在經濟發展進步的時代，小孩反而必須具備更專業的技能，接受更多的教育），凡此種種均使小孩的相對價格大幅上漲，其結果反而造成擁有小孩的數量減少。這正是經濟因素的力量促使婦女生育率隨經濟發展而普遍下降的主要原因。
- 當然，如果小孩的價格持續上漲，導致消費者主觀交換率小於小孩相對價格（即市場客觀交換率），可能會造成最適小孩個數為零，亦即不生小孩。換言之，不生小孩也可以是消費者理性的選擇，不是不愛擁有小孩，而是小孩實在是一種負擔不起的昂貴奢侈財！

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Categories of Income Elasticity of Demand

- **Normal goods** have income elasticities greater than zero → demand increases when income increases
 - Normal goods with income elasticities greater than zero but less than 1 are called *income inelastic goods* → demand increases not as much as income does
 - Goods with income elasticity greater than 1 are called *income elastic* → demand increases more than does income does

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Selected Income Elasticities of Demand

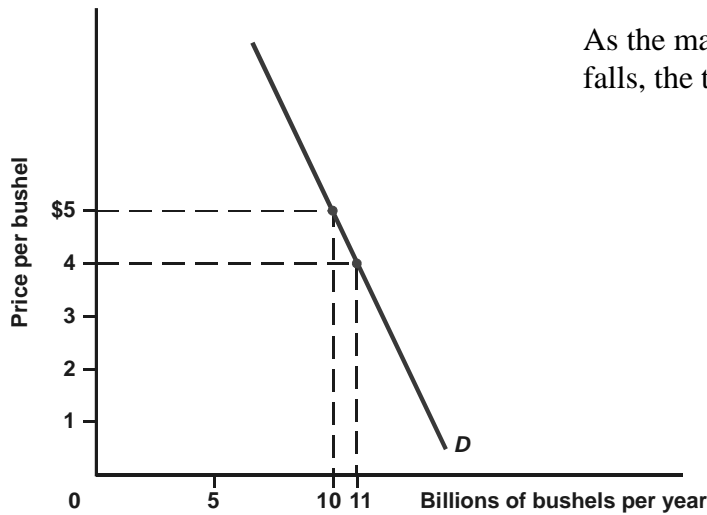
Product	Income Elasticity	Product	Income Elasticity
Private education	2.46	Physicians' services	0.75
Automobiles	2.45	Coca-Cola	0.68
Wine	2.45	Beef	0.62
Owner-occupied housing	1.49	Food	0.51
Furniture	1.48	Coffee	0.51
Dental service	1.42	Cigarettes	0.50
Restaurant meals	1.40	Gasoline and oil	0.48
Shoes	1.10	Rental housing	0.43
Chicken	1.06	Beer	0.27
Spirits ("hard" liquor)	1.02	Pork	0.18
Clothing	0.92	Flour	-0.36

Both income elasticity of food and the demand of food is inelastic. This results in problems in agriculture markets.

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The Demand for Grain is Price is Inelastic

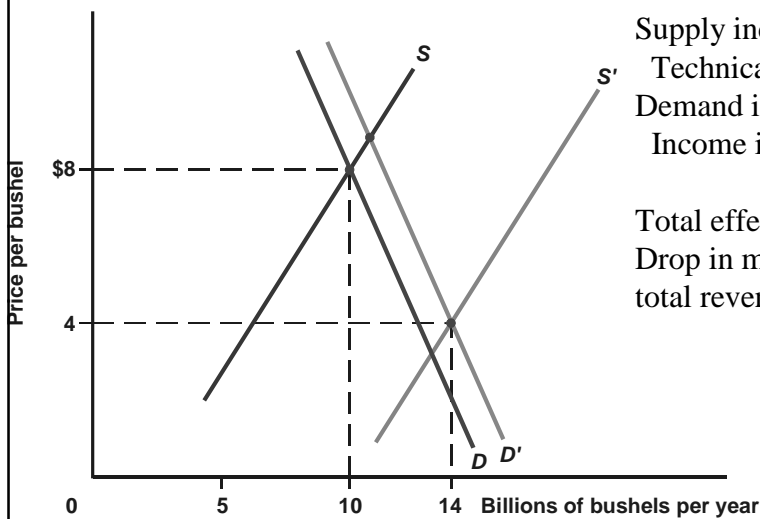


As the market revenues falls, the total revenue falls.

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The Effect of Increases in Supply and Demand on Farm Revenue



Supply increases ($S \rightarrow S'$)
Technical advances.
Demand increases ($D \rightarrow D'$)
Income increases.

Total effect:
Drop in market price and
total revenue.

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Cross-Price Elasticity of Demand

- Since firms often produce an entire line of products, it has a special interest in how a change in the price of one product will affect the demand for another
- The responsiveness of the demand for one good to changes in the price of another good is called the *cross-price elasticity of demand*
- Defined as the percent change in the demand of one good divided by the percent change in the price of another good


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Substitutes and Complements

- If an increase in the price of one good leads to an increase in the demand for another good, their cross-price elasticity is positive → the two goods are *substitutes*
- If an increase in the price of one good leads to a decrease in the demand for another, their cross-price elasticity is negative → the two goods are *complements*
- Otherwise, two goods are unrelated.
- (Jump to Appendix 5)

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課堂報告

- ⊕ 請說明何謂 Price Elasticity of Demand, 並說明考慮 Elasticity 之下, 價格變動對 Total revenue 的影響
- ⊕ 請說明何謂 demand is inelastic, 請舉例說明有哪些商品的 quantity demand 逼近 perfectly inelastic
- ⊕ 請說明 adjustment period 的長度如何影響 Price Elasticity of Demand
- ⊕ 請說明為什麼 Price Elasticity of Supply 的值通常為正數
- ⊕ 請定義何謂 cross elasticity of demand, 請說明為何 substitutes 和 complements 的 elasticity 分別為正和負

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Homework

- ⊕ 2. Explain the relationship between the price elasticity of demand and total revenue
- ⊕ 10. Compute price elasticity and total revenue
- ⊕ 11. Compute the income elasticity of demand

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