ST ANDREW'S JUNIOR COLLEGE
JC1 H1 ECONOMICS 2024

Price Mechanism and its Applications Part 2

The theme on Price Mechanism and its Applications provides an understanding of the various elasticity concepts and how they can be applied in the real-world context to explain the implications of differing degrees of elasticity on price and non-price decisions. For example, you will learn how changes in prices of a product affect a firm's sales and revenue.

Important concepts and tools of analysis

- Price Elasticity of Demand (PED)
- Price Elasticity of Supply (PES)
- Consumer Expenditure and Producer Revenue

Key questions to consider

1. What is the definition and formula for price elasticity of demand (PED)?
2. What does the sign and magnitude of PED mean?
3. What are the determinants of PED?
4. How can the understanding of PED be applied in real world?
5. What is the definition and formula for price elasticity of supply (PES)?
6. What does the sign and magnitude of PES mean?
7. What are the determinants of PES?
8. How can the understanding of PES be applied in real world?
9. What are the limitations of the use of elasticity concepts?

Contents

INTRODUCTION

In the previous topic, we have seen that the demand for and the supply of a good or service depends on changes in price and non-price determinants.

Changes in **price** can affect the quantity demanded for or quantity supplied of a good or service. Changes in the **non-price determinants** (factors other than the price of the good or service) can affect the demand for or the supply of a good or service.

RECALL
A **decrease** (increase) in the **price** of a good or service **will lead to an increase** (decrease) **in *quantity demanded*** for **a good or service**, **ceteris paribus**.

In contrast, a **decrease** (increase) in the **price** of a good or service **will lead to a decrease** (increase) **in *quantity supplied*** of **a good or service**, **ceteris paribus.**

From these relationships examined in the earlier topic, we know the **direction of change** in the quantity demanded and quantity supplied of a good or service when its price changes.

These relationships, however, do not reveal the ***extent* of the change in quantity demanded/supplied** of a good or service **when its price changes**. For example, if the price of oil changes by 1 per cent, what will the **extent** of the change in quantity of oil demanded/supplied be?

Similarly, we would also want to add more depth to our understanding by looking at the ***extent* of the changes in demand** and whether there is likely to be a **large or small impact on equilibrium**. For example, in some cases, a small increase in income may have a big impact on demand and this in turn may have a significant impact on the equilibrium price. In other cases, the same increase in income may have a little impact on demand and the market equilibrium.

Elasticity concepts help us understand the changes more precisely. Elasticity is a way of quantifying cause and effect relationships. It is generally a numerical measure of *the responsiveness of one dependent economic variable (effect) following a change in another independent variable (cause), ceteris paribus*.

Where relationships are *elastic* (responsive), a small change in the cause or independent variable has a large effect on the dependent economic variable. Where the relationships are *inelastic* (less responsive), a large change in the cause has a limited effect on the dependent variable.

1. PRICE ELASTICITY OF DEMAND (PED)

Key Question 1:
What is the definition and formula for price elasticity of demand (PED)?

1.1. Definition & Formula

Price elasticity of demand **measures the degree of responsiveness** of the ***quantity demanded*** for **a good or service** to a **given change** in ***its price***, **ceteris paribus**.

It can be computed using the following formula.

Price Elasticity of Demand (PED)

= % change in quantity demanded for Good X

% change in price for Good X

$$= \frac{\frac{\Delta Qd}{Qd0} \times 100\%}{\frac{\Delta P}{P0} \times 100\%}$$

Where $\Delta Q_d = (Q_{d1} - Q_{d0})$ Q_{d1} = new Q_d, Q_{d0} = original Q_d

$\Delta P = (P_1 - P_0)$ P_1 = new P, P_0 = original P

When the price of wheat increases from $4 to $5, the quantity of wheat demanded falls from 100kg to 60kg, ceteris paribus. In this case, the price elasticity of demand for wheat

Price Elasticity of Demand (PED)

= % change in quantity demanded for Good X
% change in price for Good X

$$= \frac{\frac{\Delta Qd}{Qd0} \times 100\%}{\frac{\Delta P}{P0} \times 100\%}$$

$$= \frac{\frac{60-100}{100} \times 100\%}{\frac{5-4}{4} \times 100\%}$$

$$= \frac{-40\%}{25\%}$$

$$= -1.6$$

This means for every 1% *increase* in the price of wheat, there is a 1.6% *decrease* in the quantity demanded, ceteris paribus. In other words, an increase in the price of wheat brings about a *more than proportionate* fall in quantity demanded, ceteris paribus.

1.2. Characteristics of Price Elasticity of Demand (PED)

Key Question 2:
What does the sign and magnitude of PED mean?

1.2.1. Values of Price Elasticity of Demand (PED)

Price elasticity of demand is **always a negative number**. However, **the negative sign is usually ignored as we only consider the absolute value.**

The negative sign simply reflects the inverse relationship between price and quantity demanded – (Recall the Law of Demand).

1.2.2. Graphical Representation of Price Elasticity of Demand

In examining the price elasticity of demand, we are considering the extent of *movement* along the demand curve, not a shift of the demand curve. This is because the percentage change in quantity demanded for a good or service is caused by a *change in the price* of the good or service, ceteris paribus.

With reference to Figure 1, when price of a good or service falls by 10% from $10 to $9, the quantity demanded increases by 30% from 50 units to 65 units, i.e., there is a more than proportionate increase in quantity demanded given the decrease in price. In this case, we would say that the demand is relatively price elastic.

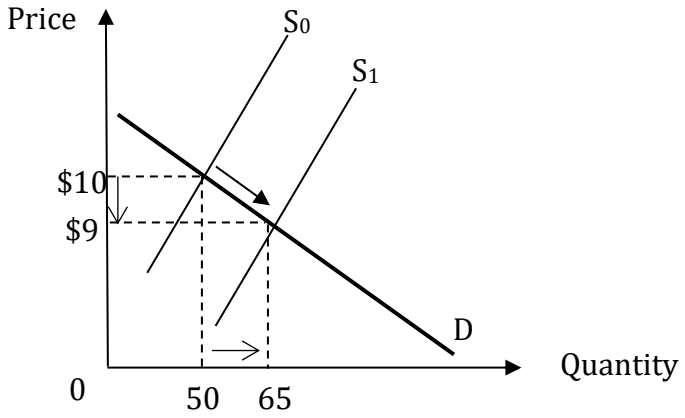


Figure 1: Downward movement along the demand curve

The magnitude or the absolute value of price elasticity of demand can be

1) greater than one $|PED|>1$,
2) less than one $|PED|<1$,
3) equal to one $|PED| = 1$.

If the price elasticity of demand is **greater than one,** the demand for the good or service is **price elastic.** This means, if the price of the good or service increases by 1%, the quantity demanded for the good or service will decrease by more than 1%, (for example, 3%), **ceteris paribus.** We would say that an increase in the price would lead to a **more than proportionate** decrease in quantity demanded, ceteris paribus.

If the price elasticity of demand is **less than one,** the demand for the good or service is **price inelastic.** In this case, when the price of the good or service increases by 1%, the quantity demanded for the good or service will decrease by less than 1%, (for example, 0.6%), **ceteris paribus.** We would say that an increase in the price would lead to a **less than proportionate** decrease in quantity demanded, ceteris paribus.

If the price elasticity of demand is **equal to one,** the demand for the good or service is **unitary elastic.** This occurs when a 1% increase in the price of the good or service leads to a 1% decrease in the quantity demanded for the good or service, **ceteris paribus.** We would say that an increase in the price would lead to a **proportionate** decrease in quantity demanded, ceteris paribus.

Explain what happens to the quantity demanded for the good given a fall in its price in the following scenarios:

a) $|PED|>1$
b) $|PED|<1$
c) $|PED|=1$

1.2.3. Relationship between Price Elasticity of Demand and Total Revenue

Total revenue (TR) is the total amount of money that the producer receives from the sale of a good/service.

To calculate total revenue, we multiply price per unit by the quantity sold.

Total revenue (TR) = Price per unit (P) × total quantity sold (Q)

$$TR = P \times Q$$

Case 1: Price Elastic Demand |PED|>1

When the price falls from $0P_0$ to $0P_1$, there will be a more than proportionate increase in quantity demanded from $0Q_0$ to $0Q_1$, ceteris paribus. The loss in revenue from the fall in price (area P_0XYP_1) is less than the gain in revenue from the more than proportionate increase in quantity demanded (area Q_0YZQ_1). Hence, total revenue increases from area $0P_0XQ_0$ to $0P_1ZQ_1$.

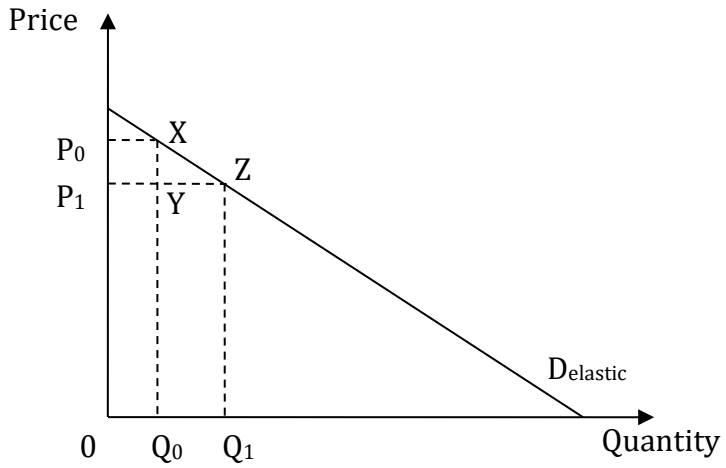


Figure 2: Effect of a change in price on TR where demand is price elastic

On the other hand, if price increases from $0P_1$ to $0P_0$, total revenue will decrease. **(Try and see if you can figure out why)**

In conclusion, when demand for a good or service is ***price elastic***, a fall in price will lead to an increase in total revenue, ceteris paribus. Conversely, a rise in price will lead to a decrease in total revenue, ceteris paribus.

Case 2: Price Inelastic Demand |PED|<1

When the price falls from $0P_0$ to $0P_1$, there will be a less than proportionate increase in quantity demanded from $0Q_0$ to $0Q_1$, ceteris paribus. The loss in revenue from the fall in price (area P_1P_0XY) is greater than the gain in revenue from the less than proportionate increase in quantity demanded (area Q_0YZQ_1). Hence, total revenue decreases from area $0P_0XQ_0$ to $0P_1ZQ_1$.

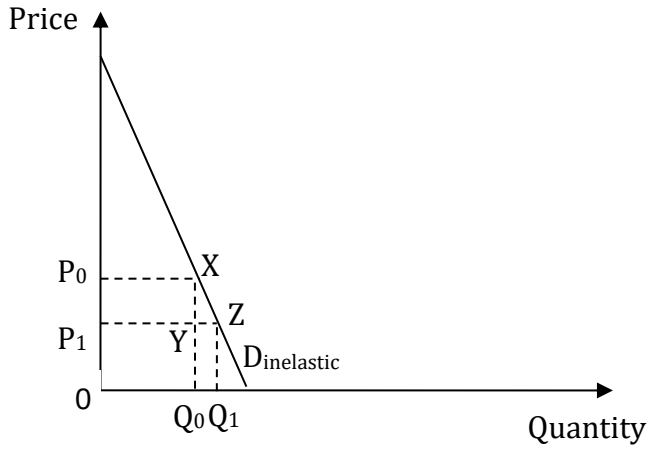


Figure 3: Effect of a change in price on TR when demand is price inelastic

On the other hand, if price increases, total revenue will increase instead. **(Try and see if you can figure out why)**

In conclusion, when the demand for a good or service is ***price inelastic***, a fall in price will lead to a decrease in total revenue, ceteris paribus. Conversely, a rise in price will lead to an increase in total revenue, ceteris paribus.

Case 3: Perfectly Price Inelastic Demand |PED| = 0

At one extreme, demand for a good or service can be **perfectly price inelastic**. This occurs when price elasticity of demand is equal to **zero**. In such a situation, a change in price will not bring about any change in the quantity demanded.

This situation happens when the **same** amount of good or service is demanded at all prices. Ceteris paribus, a change in the price of the good or service **does not cause any change** in quantity demanded. Graphically, a perfectly price inelastic demand curve is represented by a vertical demand curve (Figure 4).

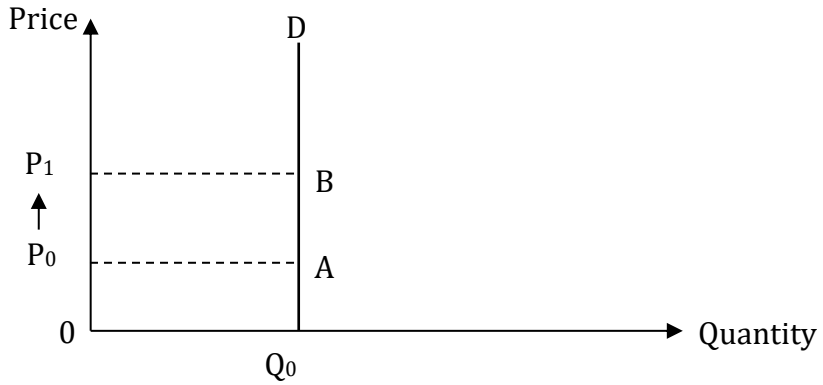


Figure 4: Demand curve with Price Elasticity of Demand = 0

When the price increases from $0P_0$ to $0P_1$, there will be no change in quantity demanded. Hence, total revenue increases from area OP_0AQ_0 to area OP_1BQ_0.

Case 4: Perfectly Price Elastic Demand |PED| = ∞

In the other extreme case, demand for a good or service can be **perfectly price elastic**. The value of the price elasticity of demand is equal to **infinity**.

At price OP_0, consumers are prepared to buy all they can obtain at the market price. The demand goes on and so the quantity demanded is infinite. Graphically, a perfectly price elastic demand curve can be represented by a horizontal demand curve (Figure 5).

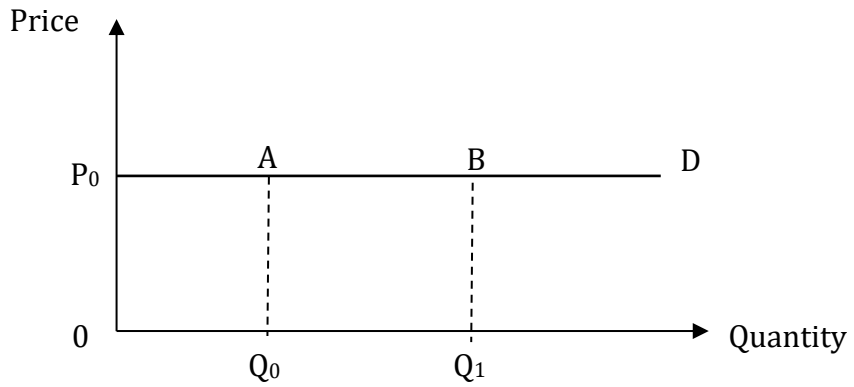


Figure 5: Demand curve with Price Elasticity of Demand = ∞

Small changes in price can lead to an infinitely large change in quantity demanded. If a producer decreases the price to below $0P_0$, it will lead to an infinite increase in quantity demanded. Hence, at price $0P_0$ and any price below it, quantity demanded is infinitely large.

This seemingly unlikely demand curve turns out to be important in explaining behaviours of producers under a condition called perfect competition. In a perfectly competitive market, each producer must accept the market price of P_0. At this price, the producer can sell as much as he can produce. In figure 5, more revenue is earned at Q_1 than at Q_0.

However, if the producer raises the price above $0P_0$, quantity demanded will fall to zero as consumers can switch to other producers who are selling the same product at the price of P_0. As such, the total revenue earned will be 0.

Summary:

Description	Elasticity Value	Effect on Total Revenue	
		If Price Rises	If Price Falls
Perfectly Price Elastic	**Elasticity = ∞**	Decreases to 0	Increases; depends on firm's capacity and ability to produce and sell
Price Elastic	**1 < Elasticity < ∞**	Decreases	Increases
Price Inelastic	**0 < Elasticity < 1**	Increases	Decreases
Perfectly Price Inelastic	**Elasticity = 0**	Increases	Decreases

How would questions that require you to make use of this understanding look like?

Have a look at the following question.
*This question corresponds to **Sect A Qn 1b** of your*
Price Mechanism & its Applications Part 2 Tutorial package.

Section A CSQ 1

(b) With reference to the concept of price elasticity of demand and the extract, explain the expected impact of a price fall on Amazon's total revenue from the sale of electronic readers. **[4]** [3]

1.3. Determinants of Price Elasticity of Demand (PED)

Key Question 3:
What are the determinants of PED?

The following are some factors that affect the price elasticity of demand for a good or service.

(i) Availability of substitutes
(ii) Closeness of substitutes
(iii) Proportion of income spent on the good or service
(iv) Time period
(v) Degree of Necessity of the good

(i) Availability of Substitutes

Availability of substitutes depends on how the good or service is defined. If the good or service is *broadly defined*, e.g., food, the demand for this good or service will tend to be price inelastic because there are few substitutes for food.

If we *narrowly define a good or service* (e.g., white chicken rice), the demand for this good or service is likely be price elastic as there are many substitutes available, e.g., roasted chicken rice, duck rice, etc.

Hence, the **greater the availability of substitutes, the more price elastic the demand for the good or service.**

(ii) Closeness of Substitutes

For goods or services with close substitutes, an increase in price can lead to a more than proportionate decrease in quantity demanded, ceteris paribus. This is because consumers find it easy to switch from the good or service which has become relatively more expensive now to a similar good or service which is ***relatively*** cheaper. **The greater the number of close substitutes, the more price elastic the demand for the good or service.**

Let's take the example of Coca Cola (Coke) and Pepsi. If the price of Coke increases, ceteris paribus, consumers are likely to switch to Pepsi since both are close substitutes. People are more sensitive to the increase in the price of Coke because a close substitute (Pepsi) is available. An increase in the price of Coke thus leads to a more than proportionate decrease in quantity demanded for Coke, ceteris paribus. Demand for Coke is said to be price elastic.

Hence, the presence of ***close substitutes*** for a good or service makes the demand for that good or service ***more price elastic***.

(iii) Proportion of income spent on the good or service

When the proportion of income spent on the good or service is ***small***, demand for the good or service tends to be ***price inelastic***. This is because if the proportion of income spent on the good or service is small, even if the price of the good or service increases, the impact of this increase in price on a consumer's total expenditure is small. Hence, there is very little tendency for him/her to look for alternatives.
For example, consumers spend a very small proportion of a household's expenditure on salt. Hence, even if there is an increase in price of salt, consumers may not significantly cut down on their quantity demanded for salt unlike goods or services such as cars, which take up a much larger proportion of consumers' income. Thus, for such goods or services like salt, $|PED|<1$.

On the other hand, the higher the proportion of income spent on the good, the higher the price elasticity of demand. When expenditure on the goods forms a high proportion of one's income, e.g., cars and housing, an increase in price will provide an incentive to search for cheaper substitutes. Quantity demanded will decrease more than proportionately. Thus, for such goods and service like cars and housing, $|PED|>1$.

(iv) Time period

Since it takes time to find substitutes or change spending habits and preferences, the price elasticity of demand for a good or service may be ***higher*** when the ***time period*** **is** ***longer***.

With a longer period of time, consumers will have more time to change their consumption pattern or habits. At the same time, they are able to find more substitutes given the longer period of time.

For example, the price of crude oil quadrupled between December 1973 and June 1974, which led to similar increases in the price of petrol. There was only a very small reduction in the consumption of oil products. This shows that the demand for oil was very price inelastic as people still wanted to drive their cars.

Over time, however, as the higher oil prices persisted, new fuel-efficient cars were developed, and many people switched to smaller cars or moved closer to their workplace. Demand thus became less price inelastic in the long run as people's reliance on oil is now reduced.

(v) Degree of Necessity of the good

The demand for a necessity is likely to be more price inelastic than the demand for a luxury good or service. For a necessity, the demand is likely to be price inelastic because even if price was to increase, consumers cannot survive without the good or service e.g., food and water. Hence, if prices of necessities such as rice were to increase, quantity demanded for rice will fall by a less than proportionate amount, ceteris paribus.
The table below shows examples of different types of goods and services and their price elasticity of demand values:

Degree of necessity	Examples	Likely range of absolute PED value
High: Basic goods and necessities	Food, Water	$\|PED\| < 1$, i.e. demand is price inelastic
High: Addictive Goods (only for consumers who 'need' these goods)	Cigarettes, Liquor, Drugs	$\|PED\| < 1$, i.e. demand is price inelastic
Low: Luxurious Goods	Overseas travel, Designer bags	$\|PED\| > 1$, i.e. demand is price elastic

How would questions that require you to make use of this understanding look like?

Have a look at the following question.
*This question corresponds to **Sect A Qn 1a & Sect B Qn 6c** of your Price Mechanism & its Applications Part 2 Tutorial package.*

Section A CSQ 1

(a) Explain how the value of price elasticity of demand for Amazon's electronic reader has changed with the entry of new rivals such as Tesco. **[4]** [2]

Section B CSQ 6

(c) **[4]**

(ii) With reference to **Table 1**, explain the value of price elasticity of demand of Premium Seats compared to that of Standard Seats. [3]

1.4. Application of Price Elasticity of Demand (PED)

Key Question 4:
How can the understanding of PED be applied in real world?

1.4.1. Application by Producers

Price Strategies

The producer/firm considers the PED of their products when making pricing decisions. This is because a change in the price of a good or service will bring about a change in its quantity demanded, which in turn affects the total consumer expenditure and therefore, the total revenue of the firm.

If the producer/firm knows that the demand for his/her good or service is price elastic, he/she can increase his/her total revenue by lowering the price of his good or service, for example, through discounts. This is because when prices are lowered, it will lead to a more than proportionate increase in quantity demanded for the good or service, assuming ceteris paribus, thereby increasing his/her total revenue.

Conversely, if the demand for his/her good or service is price inelastic, he/she can increase his total revenue by raising the price of his/her goods or service.

How do we explain the effects of the pricing strategy on total revenue with the use of a diagram?

In planning the price strategies, the producer should also consider the PED value of his/her good or service to different groups of consumers and adjust the price of the good or service for the different groups of consumers accordingly.

One such example is the market for movie tickets. We assume that working adults earn a higher income and therefore the demand for movie tickets tends to be price inelastic for adults and more price elastic for non-working students, the cinema operator would consider increasing the price of movie tickets for adults but reducing the price of movie tickets for students. We will explore more on this pricing strategy (price discrimination) later when we study more about firms' decisions and strategies.

Non-Price Strategies

As the price elasticity of demand is affected by the availability of close substitutes, one strategy the producer can adopt is to reduce the substitutability of their products. This can be done through product differentiation. Examples of product differentiation can happen through creating ***perceived*** or ***real*** differences.

Creating perceived differences: By creating perceived differences, the producer is engaged in product differentiation. The consumer is made to believe that the product sold by the firm is less substitutable by the other products sold by other firms. The producer can create perceived differences through the following methods:

- **Advertisements** using mass media e.g., television, radio, newspaper, and social media e.g., Instagram, Twitter.
- **Celebrity endorsements** is also a way of product promotion e.g., Nike and Adidas engaged Cristiano Ronaldo and Lionel Messi respectively to promote their sportswear.
- **Branding to establish an identity that is easily recognisable and relatable to its customers**, thus instilling brand loyalty in them.

Perceived differences could reduce the substitutability of the firm's products with those of its competitors. This would make the demand for the firm's products more price inelastic, allowing the producer to increase the price of his good or service without suffering from a more than proportionate fall in quantity demanded. This will increase his/her total revenue earned.

Creating real differences: The producer can also **create real differences** between his product and the substitutes. **Research and development** is a key method to **i) introduce new features to existing products and/or ii) come up with completely new products altogether**. For example, HL's milk is uniquely different from other diary brands as it contains Plant Sterols**.** This would reduce the substitutability of HL's milk products from those of its competitors.

Product that is uniquely different would make its demand price inelastic, allowing the producer to increase the price of his good or service without suffering from a more than proportionate fall in quantity demanded, assuming ceteris paribus, will increase his/her total revenue earned.

1.4.2. Application by Government

Using the concept of price elasticity of demand, governments can evaluate the impacts of both **taxation** and **subsidies**.

i) Estimating amount of tax revenue

By taxing goods or services with price inelastic demand e.g., addictive goods such as cigarettes and alcohol, the government would be able to collect higher tax revenue as compared to taxing goods or services with price elastic demand.

A specific tax (i.e., per unit tax) imposed will cause supply to fall, shifting supply curve to the left by the amount of the tax from S_0 to S_1 (Figure 6), resulting in an increase in the prices of these goods or services from $0P_0$ to $0P_1$ and a less than proportionate fall in quantity demanded from $0Q_0$ to $0Q_1$, assuming ceteris paribus. This is because customers of such addictive goods or services are less likely to change their consumption pattern, especially in the short run.

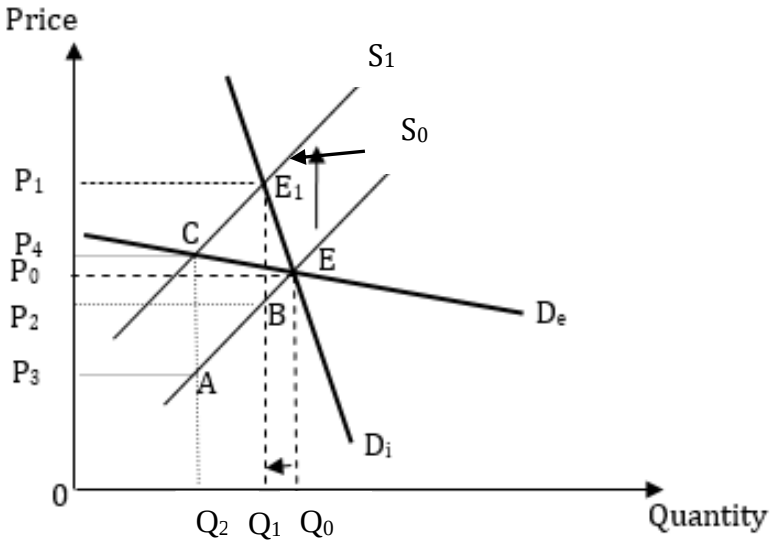


Figure 6: Relationship between Price Elasticity Demand and Tax Revenue

Thus, the tax revenue collected by the government from taxing a good or service with a price inelastic demand is P_1P_2 B E_1. This is higher compared to the tax revenue collected from taxing a good or service with a price elastic demand which is P_3P_4CA.

Tax on a product that has a demand that is price elastic generates less revenue for the government, compared to a similar tax on a good or service that has a price inelastic demand.

ii) Estimating the amount of tax to impose

The government would also like to restrict the consumption of certain goods or services as it deems these goods or services to be socially undesirable. Some

TIPS

When a tax is imposed, the incidence of the tax is always shared between the consumers & producers.

This incidence of tax is determined by the relative PED & PES values.

Note:

You **will not be required** to analyse the incidence of taxes & subsidies in exams.

You may refer to **Annex Section 4.2** to learn more.

examples include cigarettes and alcohol. Taxing the consumption of such goods or services would raise the price of the good or service, making it relatively more expensive and consumers will reduce their consumption of the good or service.

Knowing the price elasticity of demand for the good or service will allow the government to assess the effectiveness of the tax in discouraging consumption. The more price elastic the demand for a good or service, the greater will be the effect on quantity demanded.

Goods with price inelastic demand also include basic goods and necessities. Should the government tax the consumption of such goods?

Yes: In the case of Singapore, the government does tax basic goods and necessities through the Goods and Services Tax (GST). GST was introduced in 1994 to diversify our tax base and reduce reliance on direct taxes such as corporate and personal income tax. The introduction of GST has allowed the Singapore Government to lower personal income taxes from a top range of 33% progressively to 22% today. Such a diversified tax mix allows Singapore to maintain competitive rates of income tax to encourage effort and entrepreneurship by enterprises and individuals.
By applying what we learnt, the government can raise higher tax revenue from the taxation on basic necessities since the demand for such goods is price inelastic.

No: Lower-income families tend to spend a large proportion of income on basic goods and necessities as compared to higher income families who spend a relatively smaller proportion of their income on basic goods and necessities, e.g., a lower-income family might purchase basic regular jasmine rice as compared to a higher-income family who might purchase more luxurious Japanese short-grain rice (not considered a basic necessity). Thus, taxing basic goods and necessities would therefore inevitably raise the cost of living for low-income families more significantly since their spending is primarily on basic goods and necessities as compared to higher-income families who spend a relatively smaller amount on basic goods and necessities since they are likely to purchase more luxurious variations of goods.

Synthesis: The Singapore Government recognises that GST adds to the living costs of the low-income families. To ensure that the GST does not hurt the low-income families, GST vouchers are given to them to offset what they pay for in GST. Moreover, the GST collected allows the government to fund expenditure such as building of infrastructure like schools, roads, hospitals, MRT lines and provide subsidies to key sectors like healthcare, housing and education which in turn increases the standard of living for low-income individuals. Overall, the poor is likely to benefit more from the taxation of such goods which justifies government's decision to tax basic necessities.

Subsidy

i) To estimate the amount of government spending on the subsidy

Using price elasticity of demand, government can estimate the size of the government spending required when they intend to provide a subsidy. Total spending on subsidy is equal to the subsidy per unit multiplied by the level of output.

In the market where **demand is price inelastic**, the **total government spending is lesser** than in the market **where demand is price elastic**.

If the demand is price elastic, then a unit subsidy is likely to cause the quantity demanded to rise more than proportionately and the government will need to disburse a greater amount of subsidy.

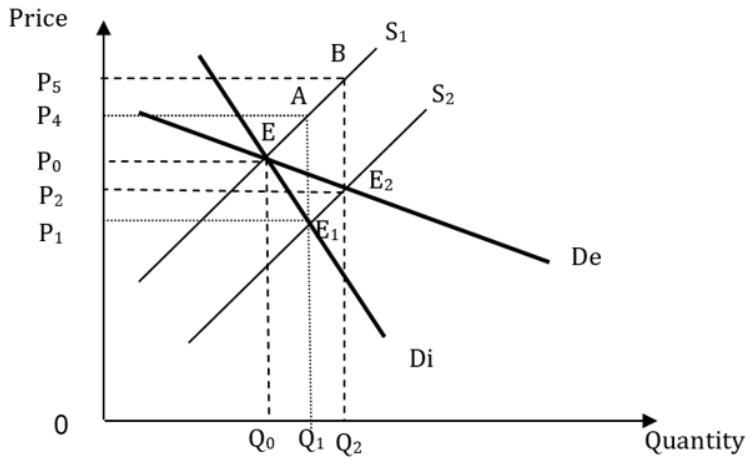


Figure 7 .: Relationship between Price Elasticity Demand and Total Spending on Subsidy by Government

Total spending on subsidies for a good or service with price inelastic demand is P_1P_4 AE_1. This is lower as compared to the total spending on subsidising a good or service with a price elastic demand which is $P_2P_5BE_2$.

ii) Estimating the per unit subsidy to provide

Government subsidies are usually given to producers to reduce the cost of production. This helps to increase output as well as to reduce price. Given the aim of a subsidy is to increase production beyond the free-market level and to reduce price, subsidies are usually granted on goods and services that are deemed beneficial but currently under-produced or under-consumed such as prescriptive medicines and environmentally friendly investments.

However, the effect of any subsidy will depend on the price elasticity of demand. When demand is price inelastic, there is a stronger effect on the new equilibrium

TIPS

When a subsidy is given, the incidence of the subsidy is always shared between the consumers & producers.

This incidence of subsidy is determined by the relative PED & PES values.

Note:

You **will not be required** to analyse the incidence of taxes & subsidies in exams.

You may refer to **Annex Section 4.2** to learn more.

price. On the other hand, when demand is price elastic, there is a stronger effect on the equilibrium quantity.

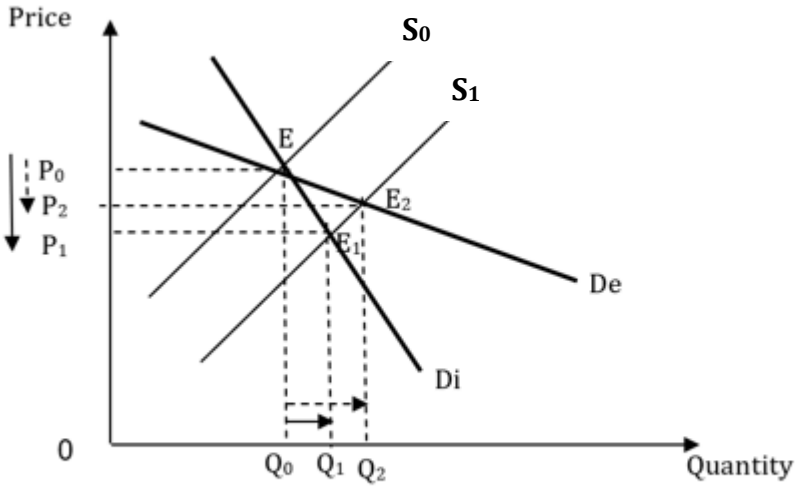


Figure 8: Relationship between Price Elasticity Demand and Subsidy Impact on equilibrium price and quantity

A per unit subsidy given will cause supply to increase, shifting supply curve to the right by the amount of the subsidy from S_0 to S_1 (Figure 8). When the demand is price inelastic, prices of the goods or services will fall from $0P_0$ to $0P_1$ and there will be a less than proportionate rise in quantity demanded from $0Q_0$ to $0Q_1$, assuming ceteris paribus. When the demand is price elastic, prices of goods or services will fall from $0P_0$ to $0P_2$ and there will be a more than proportionate rise in quantity demanded from $0Q_0$ to $0Q_2$, assuming ceteris paribus.

How would questions that require you to make use of this understanding look like?

Have a look at the following question.
*This question corresponds to **Sect A Qn 2 & Sect B Qn 1c** of your Price Mechanism & its Applications Part 2 Tutorial package.*

Section A CSQ 2

(a) Explain the impact of the price elasticity of demand for water on the extent of the tax revenue earned from the imposition of a 'water conservation tax'. **[4]** [5]

Section B CSQ 1

(c) Discuss whether organic farmers such as Panasonic's Agriculture Business Division should use only the concept of price elasticity of demand to increase sales revenue. [8]

2.

2. Price Elasticity of Supply (PES)

Key Question 5:
What is the definition and formula for price elasticity of supply (PES)?

2.1. Definition & Formula

The price elasticity of supply **measures the degree of responsiveness of *quantity supplied*** of a good or service **to a given change in its price**, **ceteris paribus**.

It can be computed using the following formula:

Price Elasticity of Supply (PES)

$$= \frac{\text{\% change in quantity supplied of Good X}}{\text{\% change in price of Good X}}$$

$$= \frac{\frac{\Delta Qs}{Qs0} \times 100}{\frac{\Delta P}{P0} \times 100}$$

where

$\Delta Q_s = (Q_1 - Q_0)$ Q_1 = new Q, Q_0 = original Q

$\Delta P = (P_1 - P_0)$ P_1 = new P, P_0 = original P

2.2. Characteristics of Price Elasticity of Supply (PES)

Key Question 6:
What does the sign and magnitude of PES mean?

2.2.1. Values of Price Elasticity of Supply (PES)

Price elasticity supply values are always positive. This is because there is a positive relationship between price and quantity supplied, as stated in the Law of Supply.

2.2.2. Graphical Representation of PES

Case 1: Supply is price elastic

When **a change in price** leads to a ***more than proportionate* change in quantity supplied of a good or service**, the **supply of the good or service is said to be price elastic.** In other words, a 10% increase in price will lead to a *more* than 10% increase in quantity supplied, say, 15%. This means that quantity supplied is very responsive to a change in price.

Any straight-line supply curve that is upward sloping from left to right and intersects the price axis (i.e., y-axis) is price elastic at every point. This is shown in Figure 9 below. When the price of the good or service increases from $0P_0$ to $0P_1$, it will result in a more than proportionate increase in quantity supplied from $0Q_0$ to $0Q_1$.

Case 2: Supply is price inelastic

When **a change in price** leads to **a *less than proportionate* change in quantity supplied of a good or service**, the **supply of the good or service is said to be price inelastic.** In other words, a 10% increase in the price of a good or service result in a *less than* 10% increase in quantity supplied. In the above example of cauliflower, a 10% fall in price leads to a 2.5% fall in the quantity supplied. This means that quantity supplied is less responsive to changes in price.

Any straight-line supply curve that is upward sloping from left to right and which intersects the quantity axis (i.e., x-axis) is price inelastic at every point. This is shown in Figure 10 below. When the price of the good or service increases from $0P_0$ to $0P_1$, it will result in a less than proportionate increase in quantity supplied from $0Q_0$ to $0Q_1$.

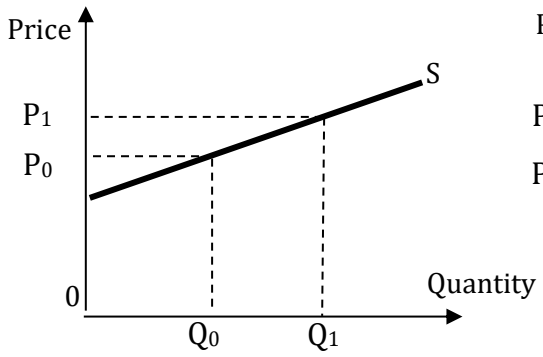


Figure 9: Price elastic supply

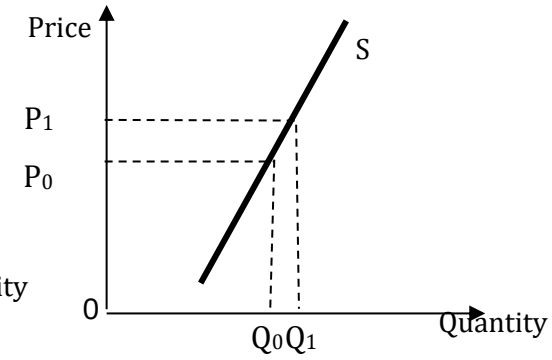


Figure 10: Price inelastic supply

2.3. Determinants of Price Elasticity of Supply (PES)

Key Question 7:
What are the determinants of PES?

The factors affecting PES are:

(i) Length of the gestation/production period
(ii) Existence of spare capacity
(iii) Existence of inventory stock
(iv) Short run vs. long run
(v) Mobility of factors of production

(i) Length of the gestation/production period

This refers to the time required for the goods or services to be produced or the time required for crops to be sowed and harvested. The duration of the time period is dependent on the type of crop production.

When a long gestation period for agricultural products is required, supply tends to be price inelastic, i.e., price elasticity of supply is less than 1 in the short run. Though the price may have risen, the quantity supplied of the good or service cannot be increased readily because the harvest is determined by the decision of how much to sow or cultivate in the earlier period.

In cases where the production of goods or services requires a longer time period to produce, the supply of the good or service will also tend to be price inelastic. This could be due to the need for the firms to search for more resources in order to increase their production.

(ii) Existence of spare capacity

The greater the amount of spare capacity (i.e., unutilised resources) there is in the industry, the easier it will be to increase output if price of the product increases. This makes supply of the good or service more price elastic. For example, in an industry where factories are running at 10% of its capacity, producers can respond quickly to a rise in price by using the excess capacity to increase production. This is, of course, assuming that other inputs such as raw materials are readily available.

On the other hand, if the factories were operating at or near full capacity, there is very limited potential for any increase in output should there be an increase in market price as all the factories are already fully utilised.

(iii) Existence of inventory stock

This refers to the availability of inventory stocks of unsold finished products that a firm has. If the firm is able to keep inventory stocks, the supply of the good or service will tend to be price elastic. This is because when there is an increase in price of the good or service, inventory stocks can be released and the quantity supplied can be increased more than proportionately.

(iv) Short run vs. Long run

A producer's ability to change his level of production is dependent on the availability of factors of production. A producer is constrained in the short run as he/she faces at least one fixed factor of production. A fixed factor of production is one whose quantity cannot readily be changed in a given time period. Examples include equipment and suitable factory space.

For example, if there is a sudden increase in demand for COVID-19 vaccines, producers may not be able to increase their quantity supplied of vaccine much in the short run. This is because it can only change its variable factors (increasing working hours of labour) but not its fixed factors (installing more machinery) in the short run.

Thus, supply tends to be price inelastic i.e., PES is less than one. This means that even if there is an increase in price, producers cannot increase production fast enough to increase their quantity supplied more than proportionately.

However, in the long run, producers are not constrained by its fixed factors such as machinery as all factors are variable. Hence, he/she can respond well to the increase in price of its goods or services by increasing the quantity of the good or service supplied. Supply can thus be price elastic in the long run i.e., PES is more than one.

Going further, we can also look at the example of a good or service for which supply is perfectly price inelastic in the short run. For instance, in England during the Barclays Premier League season, popular clubs such as Liverpool Football Club may want to increase the capacity of Anfield stadium to meet the increase in demand for tickets. However, expanding the stadium takes time and therefore, the supply of seats in the stadium is perfectly price inelastic in the short run. The same explanation applies to the seating capacity in concert halls in the short run.

(v) Mobility of factors of production

Occupational mobility refers to the ease with which factors of production, e.g., labour, can move from the production of one good or service to another. It is enhanced if workers possess a variety of skills, or the skill requirements of both products are similar in nature. For example, customer service relations skills.

Geographical mobility refers to the ease with which factors of production can move from one geographical area/region to another. It is enhanced if the regions are in close proximity or if the transport network is highly developed such that travelling time/cost can be reduced.

The greater the mobility of factors of production, the more price elastic the supply. This is because it is easier to divert factor inputs from the production of one good or service to another or from one region to another to increase output. Firms can respond quickly to the increase in price as it is easier to move the resources to increase quantity supplied.

How would questions that require you to make use of this understanding look like?

Have a look at the following question.
*This question corresponds to **Sect A Qn 6a** of your*
Price Mechanism & its Applications Part 2 Tutorial package.

Section A CSQ 6

(a) Using Extract 1, identify and explain two factors that would determine the price elasticity of supply of cannabis. **[4]**

2.4. Applications of Price Elasticity of Supply (PES)

Key Question 8:
What does the sign and magnitude of PES mean?

The Market for Primary Products versus Manufactured Products

The PES value of a good or service affects the extent of price volatility when faced with changes in demand. If the supply of a good or service is price inelastic, changes in demand will lead to greater volatility in price. This is particularly a problem for primary products. Examples of primary products are agricultural products e.g., wheat, grains and mineral deposits like coal.

With reference to Figure 11, the supply of primary products, such as agricultural products S_p is relatively more price inelastic than the supply of manufactured goods S_m e.g., clothing, electronic products.

This is because it is difficult for primary product producers to respond quickly to changes in demand in the short run. For example, if there is an increase in the prices of agricultural products from an increase in demand, the producers will not be able to increase their production of agricultural products quickly due to long gestation period required to sow and harvest. In contrast, producers of manufactured goods can respond faster to changes in demand by changing their output in the short run. This is due to the greater ability of the firms to increase their quantity supplied of the good in the case of S_m.

For this reason, when demand for primary products changes, there tends to be greater volatility in their prices as compared to the prices of manufactured goods.

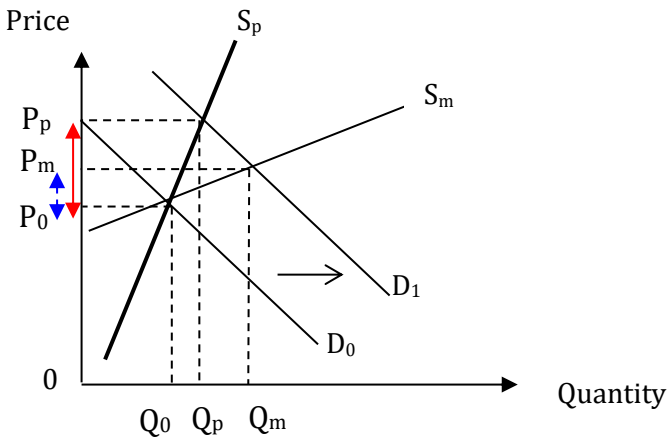


Figure 11: Impact of a change in demand on equilibrium price and quantity of primary products and manufactured products

Let us assume the demand for a particular good or service increases from D_0 to D_1 as shown in Figure 11. When supply is price inelastic (S_p), price increases from OP_0 to OP_p. When supply is price elastic (S_m), price increases from OP_0 to OP_m.

As seen from Figure 11, the price increase is greater when supply is price inelastic (P_p P_0) as compared to the case when supply is price elastic (P_m P_0).

How would questions that require you to make use of this understanding look like?

Have a look at the following question.
*This question corresponds to **Sect A Qn 5b** of your*
Price Mechanism & its Applications Part 1 Tutorial package.

Section A CSQ 5

(b) Explain the difference in value of the price elasticity of supply of a manufactured good such as cars with that of a primary product such as iron ore. [3]**[4]**

How would A-level questions that require you to make use of this understanding look like?

2022 A Level CSQ 1

(e) Comment on the extent to which the information in RESIDENTIAL HOUSING SUPPLY (Extract 1) supports the view that the short-run price elasticity of supply of housing is likely to be inelastic. **[4]** [6]

Test Yourself:

With the aid of a diagram, show the extent of the price change of a good for
(i) different values of price elasticity of supply (PES) when demand decreases.
(ii) different values of price elasticity of demand (PED) when supply increases.
(iii) different values of price elasticity of demand (PED) when supply decreases.

3. Limitations of Elasticity Concepts

Key Question 9:
What are the limitations of the use of elasticity concepts?

We have learnt that elasticity of demand and supply concepts are useful to firms in making their pricing and marketing strategies as well as governments in implementing their policies. However, the use of such concepts is not without its limitations. Some of the limitations are as follows:

1. **Computation issues/Reliability of values**

In practice, it is **difficult to obtain reliable elasticity values**. Firstly, it takes time for the producers to gather information about the market in order to derive the elasticity values. Given the dynamic nature of the economy, estimates of the elasticity values may become obsolete quickly; the demand for the good may have changed.

In addition, elasticity values for various consumer group may differ, due to factors such as income differences or other social and cultural differences. For example, the demand for eating out at a restaurant may be price elastic for the low-income and middle-income. However, the demand for eating out at a restaurant may be price inelastic for the high-income.

2. **Ceteris paribus assumption**

"Ceteris paribus" refers to all other things being unchanged/constant. **The 'ceteris paribus' assumption is a very strict assumption and may not hold in reality**. In reality, more than one factor can change at the same time. Hence, elasticity values used to decide on a strategy, if more than one factor were to change at the same time, may not be effective.

3. **Other considerations**

The producers cannot base their decisions on the elasticity concepts alone, as there **are other factors that must be considered** such as costs of production and productive capacity.

Costs of Production

While PED may be useful to a producer in deciding how to price his good or service to increase revenue, PED is insufficient to analyse the change in profit. The producer needs to know the change in costs of production. For example, if demand for his/her good or service is price elastic, a fall in price will lead to a more than proportionate increase in quantity demanded resulting in an increase in total revenue. However, if total costs of production rise by a larger extent, profit will fall.

Production capacity

The elasticity of demand concepts (i.e., PED, XED & YED) do not take production capacity into consideration. Production capacity is the quantity of

goods or services that can be produced by a firm using all its resources. For example, if demand is price elastic, a fall in price will lead to a larger proportionate increase in quantity demanded resulting in an increase in total revenue. However, total revenue will not rise if there is no excess capacity to increase production.

4. Annex A

4.1. Varying Price Elasticity of Demand Along a Straight-Line/ Linear Demand Curve

When moving down along a straight-line demand curve, the values of price elasticity of demand vary from infinity to zero.

On a downward-sloping, straight-line demand curve in Figure 12 below, price elasticity of demand falls as we move down along the demand curve. Demand is unitary elastic at the mid-point (point M) of the demand curve. Above point M, demand is price elastic and below M, demand is price inelastic.

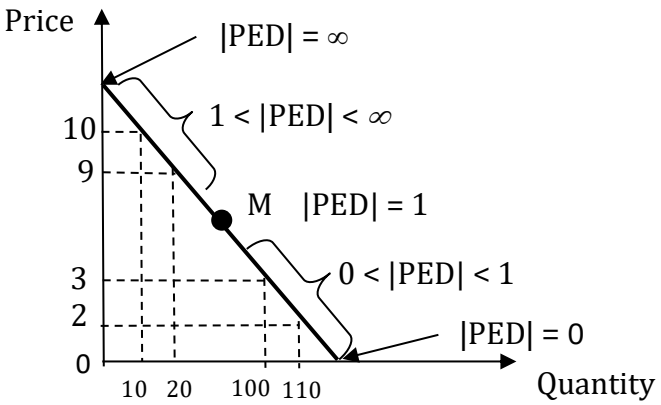


Figure 12: Price Elasticity of Demand (PED) along a linear demand curve

From Figure 12, a decrease in the price from \$10 to \$9 results in an increase in quantity from 10 to 20 units. This results in the following calculation of the PED value. The PED value is calculated to be – 10. In other words, $1 < |\text{PED}| < \infty$.

$$= \frac{\%\ change\ in\ the\ quantity\ demanded\ for\ Good\ X}{\%\ change\ in\ the\ price\ of\ Good\ X}$$

$$= \frac{\frac{\Delta Qd}{Qd0} \times 100\%}{\frac{\Delta P}{P0} \times 100\%} = \frac{\frac{20-10}{10} \times 100\%}{\frac{9-10}{10} \times 100\%} = \frac{100\%}{-10\%} = -10$$

On the other hand, a decrease in the price from \$3 to \$2 results in an increase in quantity from 100 to 110 units. The PED value is calculated to be – 0.3. In other words, $0 < |\text{PED}| < 1$.

$$= \frac{\frac{\Delta Qd}{Qd0} \times 100\%}{\frac{\Delta P}{P0} \times 100\%} = \frac{\frac{110-100}{100} \times 100\%}{\frac{2-3}{3} \times 100\%} = \frac{10\%}{-33.33\%} = -0.3$$

4.2 Applications of Price Elasticities of Demand and Supply to Analyse Incidence of Taxes & Subsidies

Recap: How taxation works

With reference to Figure 13, when a specific tax – of value BE_1 per unit of output is imposed, the supply curve will shift to the left from S_1 to S_2 by the full amount of tax BE_1 at every output level. Thus ***the vertical distance between S_1 and S_2 is equal to the specific tax*** of BE_1. Let's assume that this per unit tax is equivalent to $8 **($14 - $6)**.

Originally, the market equilibrium price was $10. After the tax is imposed, consumers will pay a higher price of $14 but producers will receive only $6 per unit sold because they have to pay a tax equivalent of BE_1 or $8 per unit to the government.

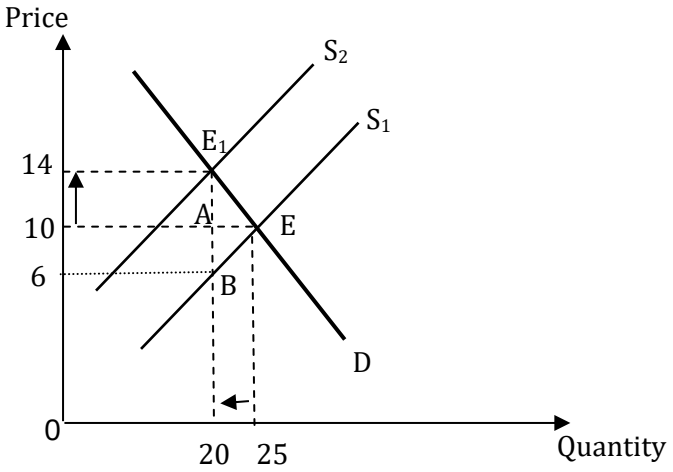


Figure 13: Incidence of specific tax

How much tax revenue will the government be collecting from the imposition of the tax?

Tax revenue = tax per unit x new equilibrium quantity

= $8 x 20 = $160

In the above case, we assume the consumers and producers share the tax burden equally. This distribution of tax burden is known as incidence of tax.

- Consumers pay an additional $4 ($14-$10) for each unit of the good or service. Thus the tax burden on consumers is $80 ($4 x 20).
- Producers receive $4 less ($10-$6) for each unit of the good or service. Thus the tax burden on producers is $80 ($4 x 20) as well.

However, whether consumers or producers bear the larger **tax burden** depends on the **relative elasticities of demand and supply**.

a) <u>Incidence of tax when demand is more price inelastic than supply (PED<PES)</u>

To illustrate the case of PED<PES graphically, we will draw a relatively more price inelastic demand curve and a price elastic supply curve.

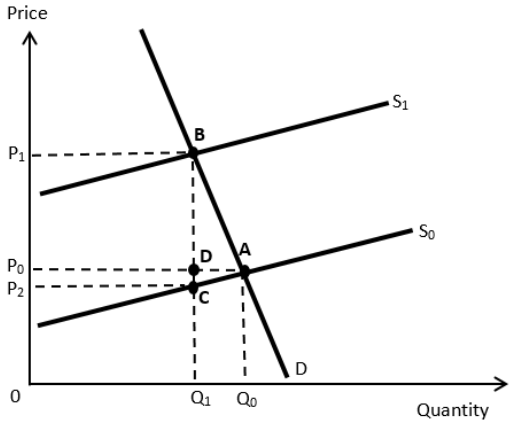


Figure 14: The incidence of a specific tax (PED<PES)

With reference to Figure 14, the tax per unit imposed is equivalent to BC. As a result, an effect similar to an increase in cost of production takes place, causing producers to be less willing and able to produce at each given price. Thus, supply decreases and supply curve shifts to the left from S_0 to S_1. As PED <PES, Hence, equilibrium price increases from P_0 to P_1. Consumers are burdened through a higher price paid per unit bought (P_0 to P_1). Producers are burdened through a lower price received per unit sold (P_0 to P_2).

- Tax burden faced by consumers: Area $P_0 P_1 BD$
- Tax burden faced by producers: Area $P_0 P_2 CD$
- Therefore, under the case of PED<PES, consumers bear greater tax burden.

TIPS

This analysis can also be applied to analyse whether consumers or producers are more likely to bear the cost of price changes due to changes in the cost of production.

For example, if the price of oil increases this will lead to an increase in cost of production and hence the price of many goods and services. Figure 16 shows that the increase in cost will be borne by consumers.

b) Incidence of tax when supply is more price inelastic than demand (PES<PED)

To illustrate the case of PES<PED graphically, we will draw a relatively more price elastic demand curve and a price inelastic supply curve.

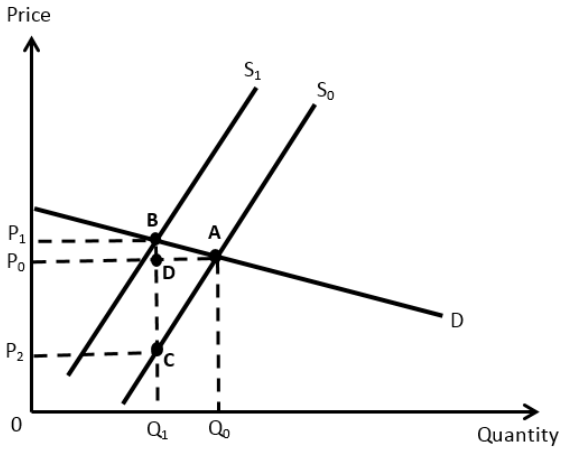


Figure 15: The incidence of a specific tax (PES<PED)

With reference to Figure 15, the tax per unit imposed is equivalent to BC. As a result, an effect similar to an increase in cost of production takes place, causing producers to be less willing and able to produce at each given price. Thus, supply decreases and supply curve shifts to the left from S_0 to S_1. Hence, equilibrium price increases from P_0 to P_1. Consumers are burdened through a higher price paid per unit bought (P_0 to P_1). Producers are burdened through a lower price received per unit sold (P_0 to P_2).

- Tax burden faced by consumers: Area $P_0 P_1 BD$
- Tax burden faced by producers: Area $P_0 P_2 CD$
- Therefore, under the case of PES<PED, producers bear greater tax burden.

Implication:

As seen from Figures 14 and 15, the more price inelastic the demand relative to supply, the greater is the burden of taxation on consumers. Conversely, the more price inelastic the supply relative to demand, the greater is the burden of taxation on producers.

TIPS

The greater tax burden will be borne by the party with lower price elasticity value.

Recap: How subsidy works

With reference to Figure 16 below, when a subsidy of value AE_1 per unit is given, there will be a rightward shift of the supply curve from S_1 to S_2 by the full amount of subsidy (AE_1). Hence, ***the vertical distance between S_1 and S_2 is equal to the subsidy per unit*** i.e. AE_1.

Let's assume that per unit subsidy is equivalent to $8. After the subsidy is given, market equilibrium quantity increases to 25 units. Thus, total subsidy given is $200 ($8 x 25). Consumers benefit from the subsidy as the price they pay is lower by $4 ($10-$6) and producers benefit from the subsidy as the price they receive is higher by $4 ($14-$10).

In this case, consumers and producers enjoy equal share of the subsidy amounting to $100 ($4 x 25) each.

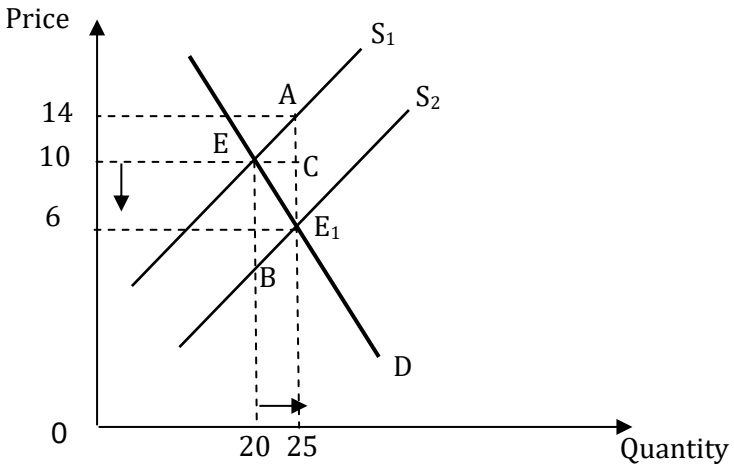


Figure 16: Share of subsidy

However, whether consumers or producers enjoy the larger or smaller **share of a subsidy** depends on the **relative elasticities** of demand and supply.

Share of subsidy

With the aid of diagrams, consider who will enjoy greater share of the subsidy when (i) PED<PES and (ii) PED>PES.

When PED< PES, consumers will enjoy greater share of the subsidy

When PED> PES, producers will enjoy greater share of the subsidy

TIPS

The greater share of subsidy will be enjoyed by the party with lower price elasticity value.

St. Andrew's Junior College H1 Economics (8843)

Topic: Price Mechanism and its Applications Part 2 (Elasticities)

Determinants of Demand

↓

Price

↓ want to measure impact on Qd

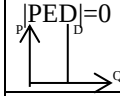
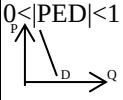
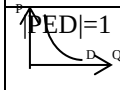
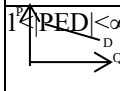
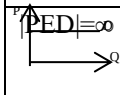
Price Elasticity of Demand (PED)

↓ defined as

The degree of responsiveness of **quantity demanded** of a good to a change in its own price, **ceteris paribus**.

Formula: $\frac{\%\ \text{change in Qd of good X}}{\%\ \text{change in price of good X}}$

↓ interpretation of dir. and mag.

Magnitude	Interpretation
|PED|=0 	Perfectly P inelastic dd: same Qd_X at all P_X. $\Delta P \rightarrow$ no Δ in Qd_X.
0<|PED|<1 	P inelastic dd: $\Delta P_X \rightarrow$ less than prop ΔQd_X. Bottom of str line dd. When $P_X\uparrow \rightarrow$ TR for pdr ↑.
|PED|=1 	Unitary P elastic dd: $\Delta P_X \rightarrow$ proportionate Δ in Qd_X. Shape: rectangular hyperbola
1<|PED|<∞ 	P elastic dd: $\Delta P_X \rightarrow$ more than prop ΔQd_X. Top of str line dd. When $P_X\uparrow \rightarrow$ TR for pdr ↓.
|PED|=∞ 	Perfectly P elastic dd: $P_X\uparrow \rightarrow$ Qd_X falls to zero.

PED sign is **always -ve** (cf. law of DD).

[NB: Total Revenue (TR) = P*Q = TE]

↓ limitations

determined by **SAINT**

Substitute availability
Addictiveness of goods (nature of goods)
Income proportion spent of goods
Necessities or luxuries (nature of goods)
Time period

↓ application/ strategy

Firm's **P strategy**: |PED|>1 → ↓P to ↑TR (**Eval**: ignores cost part of the profit eqn)
Firm's **non-P strat**: Differentiate products to reduce substitutability (i.e. ↓PED) → more P inelas.
Govt: Relative PED/PES values determine **incidence of tax/subsidies**

determined by **MELT**

Mobility of factors of production
Existence of spare capacity
Length of gestation/ production period
Time period (short vs long run)
(ss of primary products tends to be more price inelastic than manufactured gds)

↓ application/ strategy

Prediction of price changes when dd Δs: price inelastic SS → greater **fluctuations**.
Govt: Relative PED/PES values determine **incidence of tax/subsidies**

Affects effectiveness of government policies

if |PED|<|PES| (i.e. demand is relatively more price inelastic), consumers bear more tax burden than producers, and vice versa.

Topic: Government policies to correct market failure

Determinants of Supply

↓

Price

↓ want to measure impact on Qs

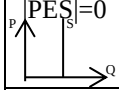
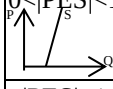
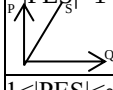
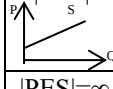
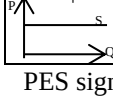
Price Elasticity of Supply (PES)

↓ defined as

The degree of responsiveness of **quantity supplied** of a good to a change in its own price, **ceteris paribus**.

Formula: $\frac{\%\ \text{change in Qs of good X}}{\%\ \text{change in price of good X}}$

↓ interpretation of dir. and mag.

Magnitude	Interpretation
|PES|=0 	Perfectly P inelastic ss: same Qs_X at all P_X. $\Delta P \rightarrow$ no Δ in Qs_X. e.g. stadium seats, COEs
0<|PES|<1 	P inelastic ss: $\Delta P_X \rightarrow$ less than proportionate ΔQs_X. SS curve cuts horizontal axis.
|PES|=1 	Unitary P elastic ss: $\Delta P_X \rightarrow$ proportionate Δ in Qs_X. SS curve passes through origin
1<|PES|<∞ 	P elastic ss: $\Delta P_X \rightarrow$ more than proportionate ΔQs_X. SS curve cuts vertical axis.
|PES|=∞ 	Perfectly P elastic ss: $P_X\downarrow \rightarrow$ Qs_X falls to zero.

PES sign is **always +ve** (cf. law of SS).

↓ limitations

(i) Ceteris paribus assumption: several factors may change simultaneously. (ii) Informational problem: Difficult to obtain reliable elasticity values in real world.