

ST ANDREW'S JUNIOR COLLEGE JC1 H2 ECONOMICS 2023

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.

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Recommended Reading List and Reference

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- Maunder, Peter et al (2000) "Demand and Supply Elasticity" in *Economics Explained*. Revised 3rd Edition. UK: Harper Collins. p75-93
- 3. Parkin, Michael (2000), 5th Edition *Economics*, Addison-Wesley, USA. P87-100
- 4. Sloman, John, Wride, Alison and Garratt, Dean (2012) 8th Edition, Economics, Prentice Hall, UK, p57-95
- 5. Sloman, John (2007), 4th Edition, *Essentials of Economics*. Prentice Hall, UK, p 54-67
- 6. Stanlake, GF and Grant, SJ (2000), 7th Edition, *Introductory Economics, Longman*. UK, p. 76-87, 94-98
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Learning Objectives

By the end of this series of lectures and tutorials, you should be able to:

- Define price elasticity of demand, income elasticity of demand, cross elasticity of demand and price elasticity of supply.
- Interpret the sign(s) and magnitude of coefficient(s) of the various elasticity concepts.
- State the formulas of the various elasticity concepts.
- Explain the relationship between price elasticity of demand and total revenue/total expenditure.
- Explain the main determinants of the various elasticity concepts in the short-run and long-run.
- Explain how the various elasticity concepts influence decision-making by different economic agents (consumers, producers and governments)

Concepts and Tools of Analysis

- Price elasticity of demand
- Income elasticity of demand normal and inferior goods
- Cross elasticity of demand complements and substitutes
- Price elasticity of supply
- Consumer expenditure and producer revenue
- Consumer surplus and producer surplus

1. 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 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 little impact on demand and 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.

2. PRICE ELASTICITY OF DEMAND (PED)

2.1 Definition and 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 $= \frac{\% \ change \ in \ quantity \ demanded \ for \ Good \ X}{\% \ change \ in \ price \ for \ Good \ X}$ $= \frac{\frac{\Delta Qd}{Qd0} \times 100\%}{\frac{\Delta P}{P_0} \times 100\%}$ where $\Delta Qd = (Qd1 - Qd0) \qquad Qd1 = new \ Qd, \qquad Qd0 = original \ Qd$ $\Delta P = (P_1 - P_0) \qquad P_1 = new \ P, \qquad P_0 = original \ P$

For illustration only. Students do not need to know how to calculate and derive the answer.

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

$$= \frac{\% \text{ change in the quantity demanded for Good X}}{\% \text{ change in the price of Good X}}$$
$$= \frac{\frac{\Delta Qd}{Qd0} \times 100\%}{\frac{\Delta P}{P0} \times 100\%}$$
$$= \frac{\frac{60-100}{100} \times 100\%}{\frac{5-4}{4} \times 100\%}$$
$$= \frac{-40\%}{25\%}$$
$$= -1.6$$

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.

2.2 Characteristics of Price Elasticity of Demand

2.2.1 Values of Price Elasticity of Demand

Price elasticity of demand is usually a negative number. However, the negative sign is usually ignored as we only consider the <u>absolute value</u> since the negative sign simply reflects the *inverse relationship between price and quantity demanded*.

2.2.2 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 below, 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,
- 2) less than one,
- 3) equal to one.

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.



2. 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

2.2.3 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

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 $0P_1ZQ_1$.





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

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 4: 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. (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 6).



Figure 6: 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 $0P_0AQ_0$ to area $0P_1BQ_0$.

Case 4: Perfectly Price Elastic Demand

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 7).



Figure 7: 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 OP_0 , it will lead to an infinite increase in quantity demanded. Hence, at price OP_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 7, 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	$1 < Elasticity < \infty$	Decreases	Increases
Price Inelastic	0 < Elasticity < 1	Increases	Decreases
Perfectly Price Inelastic	Elasticity = 0	Increases	Decreases

2.3 Determinants of Price Elasticity of Demand

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) <u>Availability of Substitutes</u>

Availability of substitutes also 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 <u>narrowly define</u> 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) <u>Closeness of Substitutes</u>

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) <u>Proportion of income spent on the good or service</u>

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) <u>Time period</u>

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) <u>Degree of Necessity of the good</u>

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	Food,	PED < 1,
necessities	Water	i.e. demand is price inelastic
High: Addictive Goods	Cigarettes,	PED < 1,
(only for consumers	Liquor, Drugs	i.e. demand is price inelastic
who 'need' these goods)		
Low Luxurious Coods	Overseas travel,	PED > 1,
Low. Luxui lous Goods	Designer bags	i.e. demand is price elastic

2.4 Application of Price Elasticity of Demand (PED)

2.4.1 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.

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 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.

<u>**Creating perceived differences.</u>** 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:</u>

- 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., Unilever partnered with Selena Gomez on a marketing campaign to promote its Cornetto ice cream in 2016.
- 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.

<u>Creating real differences</u>. 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.

2.4.2 Applications 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 9), 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.



Refer to your previous set of notes under 6.3 Indirect Taxes for more info.



Figure 9: 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 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?

<u>Yes:</u> 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.

<u>Subsidy</u>

i) To estimate the amount of government spending on the subsidy Using the price elasticity of demand, government can estimate the size of the government spending. Total spending on subsidy is equal to the subsidy per unit multiplied by the level of output.

A government can use the concept of PED to estimate the total amount it needs to spend on the subsidy. In the market where the 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 11: 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 AE₁. 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 and 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 price. On the other hand, when demand is price elastic, there is a stronger effect on the equilibrium 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 10). When the demand is price inelastic, prices of the goods or services will fall from OP_0 to OP_1 and there will be a less than proportionate rise in quantity demanded from OQ_0 to OQ_1 , assuming ceteris paribus. When the demand is price elastic, prices of goods or services will fall from OP_0 to OP_2 and there will be a more than proportionate rise in quantity demanded from OQ_0 to OQ_2 , assuming ceteris paribus.

3. INCOME ELASTICITY OF DEMAND

3.1 Definition and Formula

The income elasticity of demand measures the degree of responsiveness of the *demand for* a good or service to a given *change in income of the consumers demanding the good or service*, ceteris paribus.

It can be computed using the following formula. Income Elasticity of Demand $= \frac{\% \ change \ in \ quantity \ demanded \ for \ Good \ X}{\% \ change \ in \ income}$ $= \frac{\frac{\Delta Qd}{Qdo} \times 100\%}{\frac{\Delta Y}{Y_0} \times 100\%}$ where $\Delta Qd = (Qd_1 - Qd_0) \qquad Qd_1 = new \ Qd, \ Qd_0 = original \ Qd$ $\Delta Y = (Y_1 - Y_0) \qquad Y_1 = new \ Y, \ Y_0 = original \ Y$

3.2 Characteristics of Income Elasticity of Demand (YED)

3.2.1 Values of YED

The value of YED can be **positive or negative**.

A **<u>negative</u>** YED is associated with <u>inferior goods</u>; an increase in income will lead to a fall in the demand.

A **<u>positive</u>** YED is associated with **<u>normal goods</u>**; an increase in income will lead to a rise in demand.

However, normal goods can further be broken down into necessities and luxuries. Necessities have a positive YED value but it is lower compared to luxury goods. The YED value of necessities is between 0 and 1. The YED value of luxuries is greater than 1.

Value of YED	Types of Goods or Services	Interpretation
Negative (YED < 0)	Inferior good	When income increases, demand for such a good or service falls, e.g., handphone with basic features, without camera function.
Positive (YED > 0)	Normal good (Necessities) (0 < YED < 1) e.g., rice, salt, transport	Increase in income leads to a less than proportionate increase in demand e.g., if income increases by 10%, demand for the good or service will increase by less than 10%, say, 8%.
	Normal good (Luxury) (YED > 1) e.g., cars, club membership	Increase in income leads to a more than proportionate increase in demand for the good or service.

3.2.2 Graphical representation of Income Elasticity of Demand

Unlike price elasticity of demand, when we consider the income elasticity of demand, we are looking at a **shift** of the demand curve because the change in income is a **non-price determinant** of demand.



Figure 12: Changes in the demand for various goods given an increase in income

With reference to Figure 12, an increase in income will cause the demand for inferior goods and services to fall (D_0 to $D_{inferior}$) while the demand for necessities and luxury goods and services will rise by different extents (D_0 to $D_{necessity}$ and D_{luxury} respectively). The larger the value of income elasticity of demand, the larger the shift of demand curve.

3.3 Factors Affecting Income Elasticity of Demand

The value of income elasticity of demand is dependent on the following factors:

- (i) The nature of the good or service
- (ii) The income level of consumers
- (iii) Stages of development of an economy

(i) <u>The nature of the good or service</u>

The more basic or staple a good or service is, the lower the YED value. As incomes of consumers rise, the demand for basic necessities, such as rice, rises less than proportionately. This is because there is a limit to the consumers' intake of basic necessities such as rice. So even if a person's income increases by 100%, he/she will not increase his food intake by more than 100%!

On the other hand, an increase in income can lead to a more than proportionate increase in the demand for luxury goods or services such as smart phones, cars and houses.

(ii) <u>The income level of consumers</u>

Between the rich and the poor, even though the YED value for basic necessities is less than one, the YED for necessities may still be higher for the poor than the rich. This is because an initial increase in the income of the poor is more likely to be spent than saved. Hence, for a given increase in income, the demand for certain essentials e.g., rice will increase more for the poor than the rich. The increase in income presents an opportunity for the poor to consume more rice than they have been consuming.

On the other hand, the rich are already satisfied with the amount of rice they have already consumed and hence even if incomes increase, it is not likely that their demand for rice will increase very much.

(iii) Stages of development of an economy

At different stages of development, the YED for the same product can be different.

For example, in a developing country, we can expect the demand for television sets to be relatively more income elastic than that of a more developed country. Thus, when income in a developing country rises, ceteris paribus, it leads to a more than proportionate increase in the demand for television sets as household can now afford to buy a television set.

On the other hand, because most households in the developed country would already own a television set, there is likely to be a less than proportionate

increase in demand for television sets in the developed country when income increases.



If income elasticity of demand for cars in Thailand is 2, how can you use this concept to explain the traffic jams in the city?

3.4 Applications of Income Elasticity of Demand (YED)

Using the concept of YED can help producers in demand forecasting, which in turn helps producers to decide the type and quantity of goods or services to produce. If the growth of the economy and income are expected to increase, producers can decide to increase their output of goods or services that exhibit positive income elasticity of demand (i.e., normal goods), such as cars and houses to meet the forecasted demand.

Proper estimation of YED values for different types of product help producers avoid over-production or under-production. If producers expect a recession in the near future, they may decide to increase output of goods or services that exhibit negative YED values (i.e., inferior goods), and cut back on the production of goods or services that have positive YED values (i.e., normal goods).

4. CROSS ELASTICITY OF DEMAND

4.1 Definition and Formula

The cross elasticity of demand measures the degree of responsiveness of the *demand* for a good to a given change in the *price of a related good or service*, ceteris paribus.

It can be computed using the following formula. Cross Elasticity of Demand $= \frac{\% change in quantity demand for Good X}{\% change in price of Good Y}$ $= \frac{\frac{\Delta Q dx}{Q dx0} \times 100\%}{\frac{\Delta P y}{P y0} \times 100\%}$ where $\Delta Q dx = (Q dx1 - Q dx0) \qquad Q dx1 = new Q dx, Q dx0 = original Q dx$ $\Delta P y = (Py1 - Py0) \qquad Py1 = new Py, Py0 = original Py$

Given the *positive* value of cross elasticity, we can conclude that Good X and Good Y are *substitutes*. For example, when the price of Coke increases, ceteris paribus, the demand for Pepsi increases. This is because the increase in price of Coke results in Coke being relatively more expensive. As a result, consumers may switch from Coke to Pepsi as they are substitutes.

4.2 Characteristics of Cross Elasticity of Demand (XED)

4.2.1 Values of XED

The value of XED can be **positive or negative depending on whether they are substitutes or complements.**

- The positive sign means that the two goods are substitutes.
- The negative sign means that the two goods are complements.

The significance of the positive or negative sign is explored in the table below:

Value of XED	Type of relationship between the goods or services	Interpretation
Negative XED < 0	Complements	XED for shuttlecocks with respect to price of badminton rackets: When price of badminton rackets increases, ceteris paribus, consumers will <u>buy</u> less shuttlecock.
Positive XED > 0	Substitutes	XED for margarine with respect to price of butter: When <u>price</u> of <u>butter</u> <u>increases</u> , ceteris paribus, consumers will <u>buy more of</u> <u>margarine</u> .
Zero XED = 0	Unrelated goods or services	XED for ink with respect to price of bread: When <u>price of bread</u> <u>increases</u> , ceteris paribus, consumers <u>will not change</u> <u>their spending on ink.</u>

Besides being concerned with whether the value of XED is positive or negative, we are also interested in the **absolute value** of XED. **The absolute value indicates the closeness of the relationship between the two goods or services.** The higher the absolute value, the closer the relationship i.e.:

- When the absolute value is bigger than 1 (|XED|>1), it indicates that the two goods have very close relationship.
- When the absolute value is smaller than 1 (|XED|<1), it indicates that the two goods do not have a close relationship.

4.2.2 Graphical representation of effect of XED

In examining XED, we are considering a shift of the demand curve because the *change in the price of a related good or service* is a *non-price determinant of demand* for the good or service. The larger the absolute value, the greater is the shift in the demand for the related good or service.



With reference to Figures 13(a), 13(b) and 13(c), we can see that when the price of butter increases, there will be a fall in the demand for its complement, bread. This is because as the price of butter increases, consumers will reduce the quantity demanded for butter which results in a fall in demand for bread if they prefer buttered bread, i.e., since consumers are buying less butter, they will also buy less bread. Thus, the value of XED between bread and butter is negative (see Figure 13(a) and 13(b)).

On the other hand, the increase in price of butter leads to a rise in the demand for its substitute, margarine. You have learnt this in the previous chapter where the prices of related goods is a factor of demand. Thus, since butter and margarine are substitutes, the increase in the price of butter will result in the increase in the demand for margarine. Thus, the value of XED between margarine and butter is positive (see Figure 13(a) and 13(c)).

4.3 Factors influencing Cross Elasticity of Demand

The main factor that affects XED is the *closeness* of the relationship between the goods or services. When the two goods or services are closely related, a change in the price of a good tends to lead to a more than proportionate change in the demand for its substitute or complement.

i. Substitutes

If the XED value is **highly positive (XED>1)**, it indicates that the two goods or services are *close substitutes*. The demand for a good or service will fall (increase) more than proportionately when the price of its substitute falls (increases).

For example, when the price of Pepsi falls, it will lead to a more than proportionate fall in the demand for Coke as Pepsi is considered a close

substitute for Coke. Hence, the value of XED for Coke with respect to price of Pepsi is likely to be positive and large.

ii. Complements

If the value of XED **is negative (XED<0) and its absolute value is bigger than 1 (|XED|>1)**, this indicates that the two goods or services are close complements. The demand for a good or service will fall (increase) more than proportionately when the price of its complement increases (falls).

For example, when the price of smartphones falls, the demand for mobile services, which is a complement to smartphones, will increase. Since consumers will need to subscribe to mobile service to use their smartphones. The value of the XED is likely to be **negative (XED<0) and the absolute value is bigger than 1 (|XED|>1)**. This indicates that the two goods or services are *close complements*. The demand for mobile services will thus increase more than proportionately when the price of handphones falls.

4.4 Applications of Cross Elasticity of Demand

The concept of XED allows producers to estimate the nature and closeness of the relationship between his/her product and those of others. Producers can calculate how many rivals (substitutes) it has, and how close they are. It also allows the firm to measure how important complementary products are to its own products.

Producers could then develop strategies to reduce the exposure to the risks associated with price changes by other firms, such as a rise in the price of a complement or a fall in the price of a substitute.

Price Strategies

If a firm expects rival firms to reduce the price of their goods or services, the firm may do likewise if the cross elasticity of demand for one good or service relative to a change in price of the other is highly positive. This can be seen in the pricing policy of SingTel, M1 and StarHub whose services are close substitutes.

For example, if SingTel and M1 has XED = 5 where $XED = \frac{\%\Delta Quantity Demanded of SingTel's Services}{Mathematical Structures}$ $\%\Delta$ Price of M1's Services

A 1% decrease in M1's price will result in a 5% decrease in SingTel's quantity demanded. This will also result in a decrease in SingTel's revenue.

Likewise, if M1 and SingTel's XED = 4,

or $XED = \frac{\%\Delta Quantity Demanded of M1's Services}{M1's Services}$ $\%\Delta$ Price of SingTel's Services

this means that SingTel may respond by decreasing their price by 1%, and this will result in a decrease in the quantity demanded of M1's services by 4%.



If you are the CEO of M1, what do you think are the intended consequences and unintended consequences of your decision to lower price by 1%?

Intended Consequences:

Unintended Consequences:



We will revisit these strategies later when we study more about firms' decisions and strategies.

Non-Price Strategies

Producers may also try to differentiate their products from their rivals to lower the value of its XED relative to a change in price of its competitor's. This is so that a reduction in the price of their rivals' good or service will have a smaller impact on the demand for their good or service. This can be done through product promotion or product differentiation which can help to instil brand loyalty in their consumers. For example, if SingTel successfully reduces the XED with M1 to 0.5, a 1% decrease in the price of M1's service will result in a decrease of the quantity demanded of SingTel's service by only 0.5%.

Similarly, tie-ups or joint promotions of complementary products can be held to boost the sales of their services. For example, SingTel's mobile service and the newest iPhone model are sold together (known as product bundling). In doing so, SingTel's revenue for their services increases when the price of newest iPhone model decreases.

Since SingTel's mobile services and iPhones are complements, $XED = \frac{\% \Delta Quantity Demanded of SingTel's services}{\% \Delta Price of iPhone} = -2.$

Hence, a fall in the price of iPhone by 1% will result in an increase in the demand for SingTel's services by 2%.



Given that Profit = Total Revenue – Total Cost, how do you think these strategies will affect the profits of a firm?

These strategies would increase a firm's total revenue. However, the increase in cost due to the implementation of various strategies is unclear. If total costs increase more than the increase in total revenue, then the profit of the firm falls.

5. PRICE ELASTICITY OF SUPPLY

5.1 Definition and 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 = $\frac{\% \ change \ in \ quantity \ supplied \ of \ Good \ X}{\% \ change \ in \ price \ of \ Good \ X}$ = $\frac{\frac{\Delta Qs}{Qs_0} \times 100}{\frac{\Delta P}{P_0} \times 100}$ where $\Delta Q_s = (Q_1 - Q_0)$ $Q_1 = \text{new } Q$, $Q_0 = \text{original } Q$ $\Delta P = (P_1 - P_0)$, $P_1 = \text{new } P$, $P_0 = \text{original } P$

5.2 Characteristics of Price Elasticity of Supply (PES)

5.2.1 Values of PES

PES values are usually a positive number. This is because there is a positive relationship between price and quantity supplied, as stated in the Law of Supply.

5.2.2 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 1% increase in price will lead to a *more* than 1% 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 14 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 not very 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 15 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 $0Q_1$.







What do you think the price elasticity of supply would be if the supply curve passes through the origin?

5.3 Factors affecting Price Elasticity of Supply (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.



Can you think of another example of a good where supply is perfectly price inelastic?

(v) <u>Mobility of factors of production</u>

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.

5.4 Applications of Price Elasticity of Supply (PES)

The Market for Primary Products versus Manufactured Products

The PES value of a good or service affects the extent of price volatility when demand changes. 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 16, 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 16: 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 16. 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 16, the price increase is greater when supply is price inelastic (P_0P_p) as compared to the case when supply is price elastic (P_0P_m).



With the aid of diagrams, show the extent of the price change of a good for:

- (a) Different values of price elasticity of supply when demand decreases
- (b) Different values of price elasticity of demand when supply increases
- (c) Different values of price elasticity of demand when supply decreases

6. LIMITATIONS 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.

Price Mechanism and its Applications Part 2:
Elasticities of Demand and Supply

Check-out

Now that you have reached the end of this section, you should be able to:

- Define price elasticity of demand, income elasticity of demand, cross elasticity of demand and price elasticity of supply.
- Know the different formulas of the various elasticity concepts.
- Explain the various signs and magnitude of coefficients of the various elasticity concepts.
- Explain the main determinants of the various elasticity concepts in the short and long run.
- Explain the relationship between price elasticity of demand and total revenue.
- Explain how the various elasticity concepts influence decision-making by different economic agents (consumers, producers and governments).

~ End~

ANSWER TO TEST YOURSELF

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4. If income elasticity of demand for cars in Thailand is 2, how can you use this concept to explain the traffic jams in the city?

Due to the economic development in Thailand, its citizens especially those living in the city have been experiencing an increase in income. As YED>1, the increase in income would lead to a more than proportionate increase in demand for cars in Thailand. As a result, this contributes to excessive number of cars on the roads of the cities of Thailand, leading to traffic jams in the city.

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If you are the CEO of M1, what do you think are the intended consequences and unintended consequences of your decision to lower price by 1%?

Intended Consequences:

1. M1 would gain more market share as Singtel's customers will switch/substitute to M1.

Unintended Consequences:

- 1. A price war could result with Singtel as Singtel might retaliate and lower its price to retain its market share. This may set off rounds of price reduction and not desirable for the firm as profit margins deteriorate.
- 2. Consumers may enjoy greater consumer surplus as prices are lowered.

ANNEX A: 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 2 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 2: Price Elasticity of Demand (PED) along a linear demand curve

From Figure 2, 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, $1 < |PED| < \infty$.

$$= \frac{\% \text{ change in the quantity demanded for Good X}}{\% \text{ change in the price of Good X}}$$
$$= \frac{\frac{\Delta Qd}{Qd0} \times 100\%}{\frac{\Delta P}{P0} \times 100\%} = \frac{\frac{20-10}{10} \times 100\%}{\frac{9-10}{10} \times 100\%} = \frac{100\%}{-10\%} = -10$$

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 < |PED| < 1.

$$= \frac{\frac{\Delta Qd}{Qd_0} \times 100\%}{\frac{\Delta P}{P_0} \times 100\%} = \frac{\frac{110 - 100}{100} \times 100\%}{\frac{2 - 3}{3} \times 100\%} = \frac{10\%}{-33.33\%} = -0.3$$