INTRODUCTION TO MINERAL ECONOMICS (MIN 3059)

2014

Dr. Stephens M Kambani

TOPICS

- **Basic economic concepts:** Microeconomics and Macroeconomics

  The study of microeconomics and macroeconomics in relation to mineral economics

- **The role of firms and markets in the micro-economy**

  How business firms fit into the microeconomics picture. The emergence *of entrepreneurship. Structure of contemporary business enterprise. The firm and the market place. The concept of the market. The firm and its corporate strategy*

TOPICS

- **The theory of supply and demand**

  Factors affecting demand. Elasticities of demand

  Factors affecting supply

- **How markets function**

  The model of perfect competition. The model of monopolistic competition. The many models of oligopoly. The case of monopoly. Analysing the strength of competition. Evaluating competition and market performance.

TOPICS

- **The firm and Technological change**

  The concept of production. Production activity. Transforming inputs into outputs. Basic types of production activity. The production function. The impact of technological advance on production functions. The consequences of technological change for production processes. Characteristics of technological progress. R&D spending and firm size. The motivation and pressures for innovation.

TOPICS

- **Production analysis**

  Fixed and variable inputs. Short run and the long run. Short run production functions

- **Cost functions and economies of scale**

  The concept of costs. The many aspects of cost. Cost output relationships. Cost-output relationships in the short run. Cost output relationships in the long-run. Cost behaviour and firm size.

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- **The firm and its goals**

  The ambiguous meaning of profit. Theories of profit. Do business firms seek to maximize profits? Alternatives to profit maximization. Satisficing behaviour. Revenue maximization. Market share goals. Long-run survival goals. The goal of social responsibility. Security, autonomy, and growth. Growth and expansion goals

GRADING

- Assignments: 10%
- Research paper 5%
- Tests: 15%
- Final examination: 70%

TEXTS/REFERENCES

1) Ahuja, H.I , (2004), “Macroeconomics”, S. Chand & company, ISBN 81-219-0335-1.
2) Ahuja, H.I , (2004), “Principles of microeconomics” S. Chand & Company.
3) Class notes handouts

BASIC ECONOMIC CONCEPTS

WHAT IS ECONOMICS?

- *Definition*
- *Key issues in the study of economics*
- *Branches of economics*

SOME DEFINITIONS

- *Economics asks what goods are produced, how these goods are produced, and for whom they are produced.*

- *Economics analyses movements in the overall economy – trends in prices, output, unemployment, and foreign trade. Once such trends are understood, economics helps develop the policies by which governments can improve the performance of the economy*

- *Economics is the study of commerce among nations. It helps explain why nations export some goods and import others, and analyses the effects of putting economic barriers at national frontiers.*

SOME DEFINITIONS

- *Economics is the science of choice. It studies how people choose to use scarce or limited productive resources (labour, equipment, technical knowledge), to produce various commodities (such as mineral resources, missiles, and concerts).*

- *Economics is the study of money, banking, capital, and wealth.*

- **In a nutshell, "economics is the study of how societies use scarce Resources to produce valuable commodities and distribute them among different people".**

BRANCHES OF ECONOMICS

Economics normally studied under two branches:

- ***MACROECONOMICS***
- ***MICROECONOMICS***

What is Macroeconomics?

Studies the functioning of the economy as a whole – examining the economy through a wide-angle lens. Macroeconomics examines how the level of growth of output are determined, analyses inflation and unemployment, asks about the total money supply and investigates why some nations thrive while others stagnate.

Macroeconomics

To evaluate the success of an economy's overall performance, economists look at four areas:

- Output measured by the Gross Domestic Product (GDP)
- Employment (level of unemployment)
- Price stability
- International trade

GOALS AND INSTRUMENTS OF MACROECONOMIC POLICY

Objectives **(Major goals of macroeconomic policies – wish list)**	**Instruments** **(Tools available to accomplish the wish list)**
Output (as measured by the GDP): High level of output Rapid growth rate of output	Fiscal policy: Government expenditure Taxation
Employment: High level of employment Low involuntary unemployment	Monetary policy: Control of money supply affecting interest rates
Price level stability with free markets	Foreign economics: Trade policies Exchange-rate Intervention
International trade: Export and import equilibrium (preferably the existence of trade surplus) Exchange-rate stability (not too strong or too weak)	Income policies: From voluntary guidelines to mandatory controls

HOW DOES MACRO-ECONOMICS AFFECT THE MINERAL SECTOR?

At macro level, government sets sectoral policies (in this case the national mineral policy) which may affect the sector (positively or negatively depending on its structure and promotional aspects).

Through its fiscal policy. Government fixes taxation that may affect investment if discriminatory and uncompetitive and reduce government earnings if set very low by the state (the case of Zambian copper mining industry).

HOW DOES MACRO-ECONOMICS AFFECT THE MINERAL SECTOR?

- Trade policies may affect the manner in which mineral products are traded. Do mine owners retain all the forex? Do they market through government agencies? No limitations on externalization of profits?
- How is the forex rate fixed? Free floating or government controlled? Exchange rate mechanisms affect trade.
- Do employment policies restrict expatriate workers?
- Interest rates have a bearing on the cost of capital and hence affect investment in the sector.

MICRO-ECONOMICS

What is Micro-economics?

Analyses the behaviour of individual components of the economy like industries, firms and households. The focus is on trees not the forest. The study is about among other things, how individual prices are set, consider what determines the price of land, labour and enquire into the strengths and weaknesses of the market mechanism. Microeconomics is economics through the microscope.

MICRO-ECONOMICS

In reviewing the subject of microeconomics, we examine the mining firm and the market place.

- *The concept of the market place*
- *How a market functions*
- *The firm and its corporate strategy*
- *The firm and technological change*
- *Cost functions and economies of scale:*
  - *Cost-output relationships in short-run*
  - *Cost-output relationships in long-run*

MICRO-ECONOMICS

THE MINING FIRM AND THE MARKET PLACE

Conventional economic theory instructs that the firm and its business are governed by forces in the marketplace. The firm is depicted as reacting and responding to market supply and demand conditions – conditions that are beyond its purview to control. The market, not the firm is held to be hub of economic activity and the focus of analytical concern.

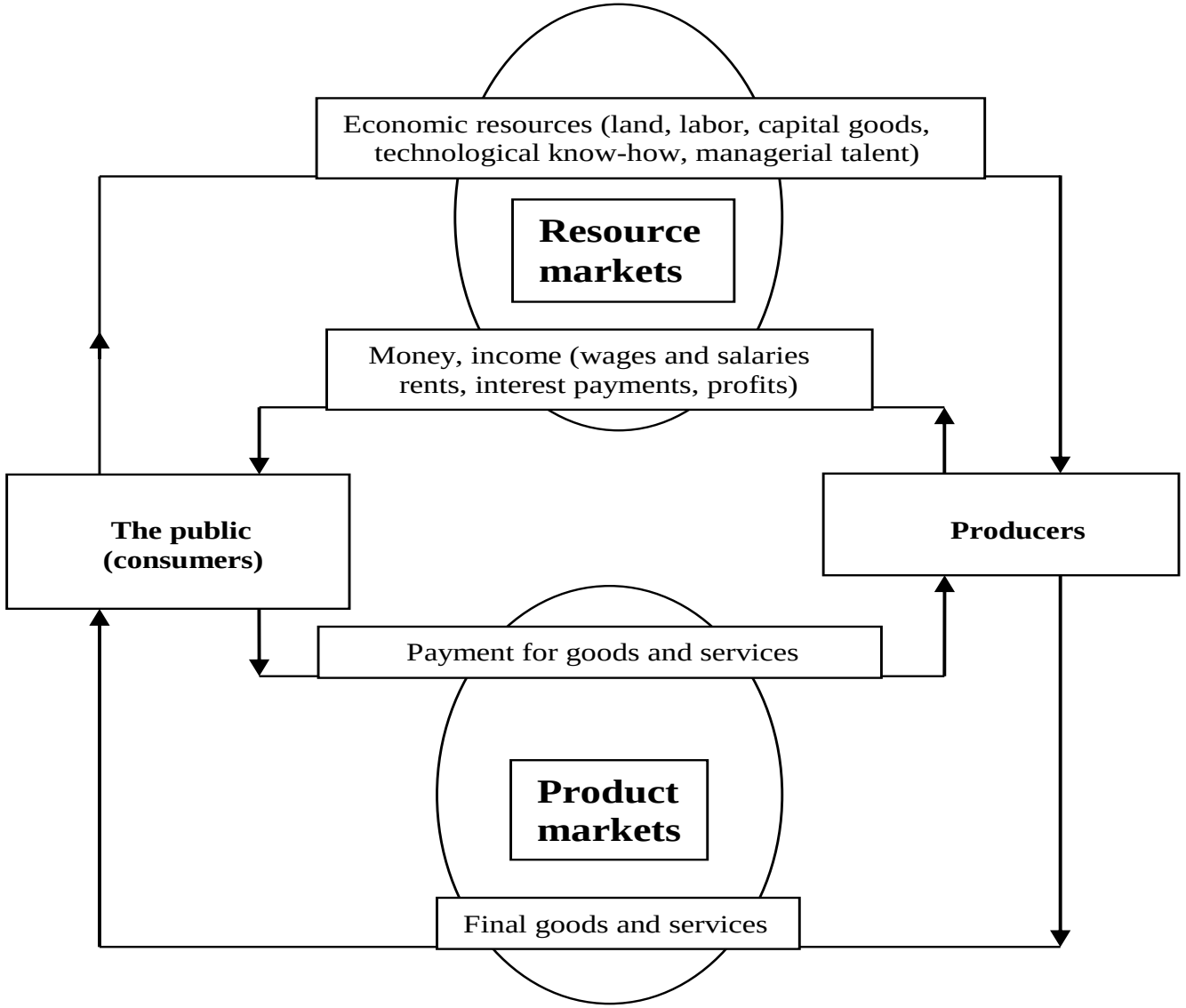
The concept of the market

In a competitive enterprise system, “the market” is held to be the supreme over all other economic units. Its importance is like that of the sun in the solar system – all economic activity revolves around the market. The market is where buyers and sellers conduct business. Therefore the market is two sided: it reflects both demand and supply conditions and does so simultaneously.

A market is seldom a single, precisely defined geographical place. Think of e-commerce!

The Role of firms in markets in the micro-economy

To develop some perspective for a study of microeconomics, it is helps to begin with a feeling for what an economic system is and how it works. The basic economic activities that take place in a modern economy are summarized as:


Economic resources (land, labor, capital goods, technological know-how, managerial talent)
Resource markets
Money, income (wages and salaries rents, interest payments, profits)
The public (consumers)
Producers
Payment for goods and services
Product markets
Final goods and services

The public, as owners of economic resources, sell their resources to producers in resource markets. From a viewpoint of the public, the sale of these resources generates money income; from the viewpoint of producers, the purchase of economic resources represents costs of production. Producers utilize the resources they purchase to make goods and services, which, in turn, are sold to the public through product markets.

The public's source of income to make these purchases is of course, the money income obtained as resource suppliers. From the public's view point, the purchases of goods and services are expenditures; from the producer's viewpoint these same dollar flows are revenues. Bothe the clockwise flow of economic resources and final goods and services and the counterclockwise flow of money incomes and dollar expenditures for final goods and services are simultaneous and repetitive.

Various countries have elected to us different economic systems both in organising resources in the production process and in distributing the resultant goods and services.

Three Basic Economic Systems

A traditional economic system

Relying on custom, habit, social mores, and tried and true methods of achieving economic goals; technology is primitive, changes are slow and production is undertaken in the same way as last year and year before. Tradition and status quo are perpetuated. Examples are abound in most rural areas (life among the Kombai tribe in Papua New Guinea, Pigmies in Congo forests)

Kombai tribe – Papua New Guinea

Kombai tribe – Papua New Guinea

Pigmies in Central African rain forests

Bushmen of Kalahari Desert

Three basic economic systems

A Command Economy System

Relies upon public ownership and centralized control of the basic means of production; severe limitations are placed upon individual choice when such choices conflict with government determined economic priorities. Economic plans and activities are under the control of government. Heavy use is made of governmental directives, the assumption being that the government is in the best position to decide what economic choices and policies are beneficial for the economy and its component parts. Both socialistic and communistic nations are examples of command economies.

Three basic economic systems

A Capitalistic or Market Economic System

Emphasizes private ownership, individual economic freedom, competition, the profit motive, and the price system in the achievement of economic goals. Each economic unit decides what choices and policies are best for it, the thesis being that in encouraging the drive for individual economic self-interest, the outcome proves also to be in the overall best interests of society because of the strong incentives for efficiency, productivity, and satisfaction of consumers.

HOW A MARKET FUNCTIONS
(*The market mechanism)*

The Law of Supply and Demand

The prime movers in our perfect market model are the forces of supply and demand. The interaction of these market forces determine the price of the mineral commodity and the quantity exchanged.

In economics, a perfect market is defined by several conditions, collectively called perfect competition. Among these conditions are:

- Perfect market information
- No participant with market power to set prices
- Non intervention by governments
- No barriers to entry or exit
- Equal access to factors of production
- Profit maximization
- No Externalities

The demand side of the Market:

The following figure represents the demand curve DD.

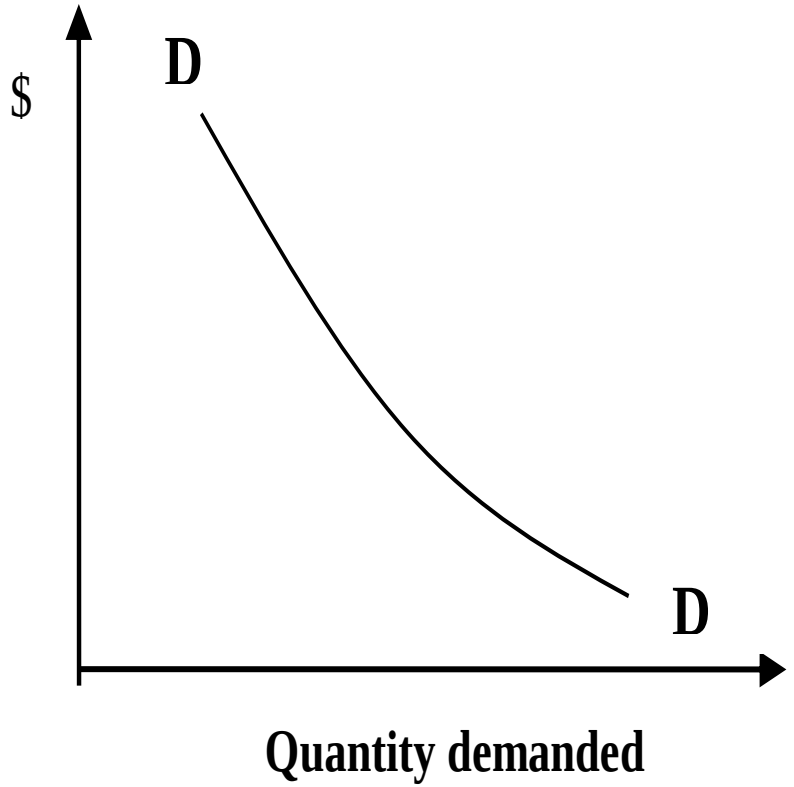


Fig. 1 Demand curve

Demand curve

- Reflects the intensity with which buyers want and are willing to pay for the product in question.
- Represented by a curve showing the various quantities which buyers are willing to purchase at each of various quantities which buyers are willing to purchase at each of various possible prices, all things being equal.
- Conceptually, the curve slopes downward because typically buyers are willing to purchase less at higher prices than lower prices.
- Events such as rising income, changes in the prices of substitute products and shifts in preferences and life styles can and do shift the shape and position of the curve.

What factors affect demand for a mineral?

Determinants of demand can generally be represented by the function:

$$Q_d = f(P, P_r, T, I, E, R, N, O)$$

Where, Q_d = quantity demanded of a particular mineral product

P = market price of the mineral product

P_r = price of related mineral products

T = consumer tast*es* and preferences

What factors affect demand for a product (mineral)?

***I* =** Level of consumer incomes (or purchasing power)

E = consumer expectations about future prices, incomes and product availability

R = range of products available to consumers

N = number of potential consumers (market size)

O = all other factors which may influence $\boldsymbol{Q_d}$

Factors affecting demand

Market price of the mineral product

The interrelationship between the product price and quantities demanded with all factors remaining constant is as shown in Fig. 1 above. Generally more quantities are demanded at lower prices and vice versa.

Factors affecting demand

Price of related (mineral) products:

This is an important demand variable because of interrelationshionships that exist among mineral products. Two types may exist;

i) **Substitutes**

A substitute material must functionally replace the product.

Examples:

- Aluminum has been used to replace copper when the price is high in electrical application.
- Synthetic gemstones and imitations have been used in place of natural ones (emerald, tanzanite, spinel, quartz, diamonds, ruby, etc.)
- Plastics have replaced pipings, car radiators, etc.

Factors affecting demand

ii) **Complimentary**

In the case of complimentary products, the products are demanded jointly.

Examples

- The demand for steel alloys will increase the demand for iron.
- The demand for chrome will increase with demand for chrome alloys
- The demand for jewellerly will increase the demand for gemstones.
- Demand for butter increases with demand for bread.

Factors affecting demand

Consumer Tastes and Preferences

When consumer perceptions of a good or service become less favourable, market demand for the item lessens and vice versa. Consumer taste and preference patterns undergo continuous review and are subject to change, sometimes gradual and sometimes rapid., over time. The emergence of new and better products, changing values and life styles, new information about health and safety features of products, busuiness cycle, rising standards of living, higher levels of affluence, and advertising, to mention a few, all exert a pervasive influence upon consumer tastes and preferences

Factors affecting demand

Consumer Income

Willingness to buy is in itself insufficient; consumers must be able to pay for the commodities they want. Typically, the greater is consumer income the greater will be demand for goods in general and for some items in particular. Only in the case of inferior goods is rising income accompanied by a weakening demand.

Factors affecting demand

Consumer Expectations

Expectations with respect to future prices, income levels, product availability can have an effect on the demand for a mineral commodity.

Factors affecting demand

All other factors that may affect demand

- Is a good a luxury or necessity? This is largely a function a function of life styles and value judgements
- Degree of market saturation for a product
- Discretionary income – This is the residual amount of income remaining after subtracting necessary living expenses and fixed payment charges from disposable personal income. Demand for some goods depends on discretionary income.
- Disasters

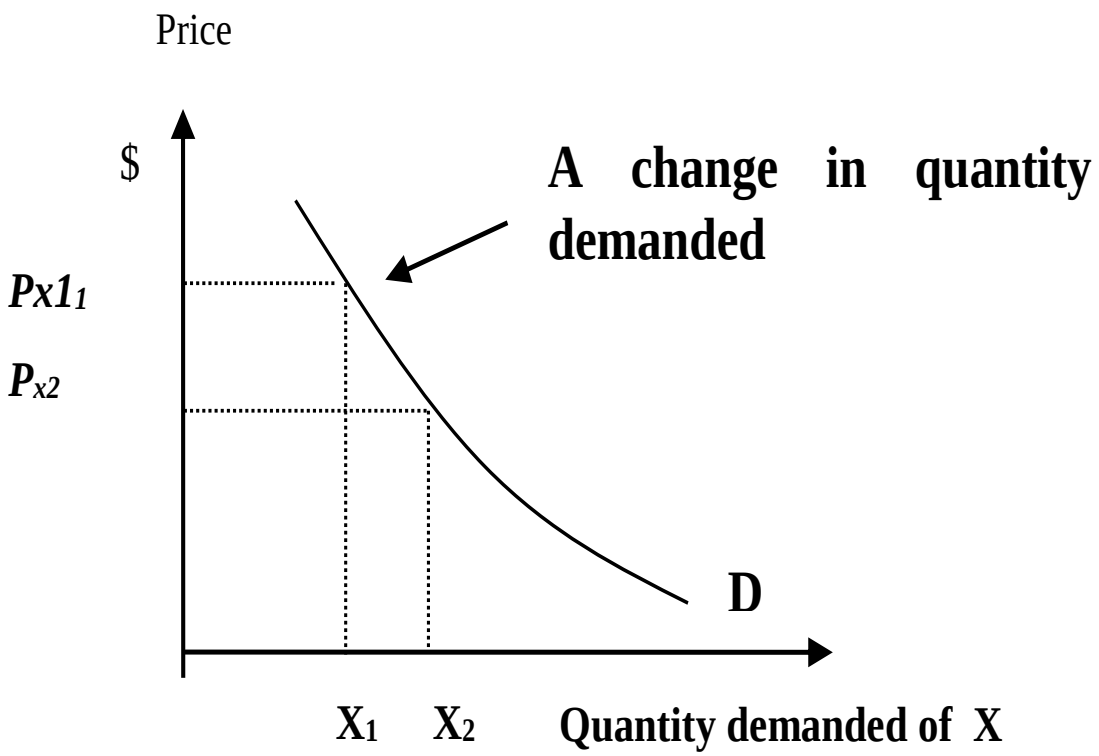


Fig. 2 Demand curve – change in demand

Demand function

In the demand function, with all other factors held constant, the quantities demanded may relate to its market price as indicated in Figure 2. A reduction in the price from P_{x1} *to* P_{x2} results in an increase in the quantity demanded. There is a change in quantity demanded.

Shift in demand may also happen if there is a change in one of the determinants of demand. In this case the entire demand curve may shift outward or inward depending on the causating factor. For instance, if all other factors are held constant and the income level increases, the demand curve may shift outward and vice versa as shown in the figure 3 below.

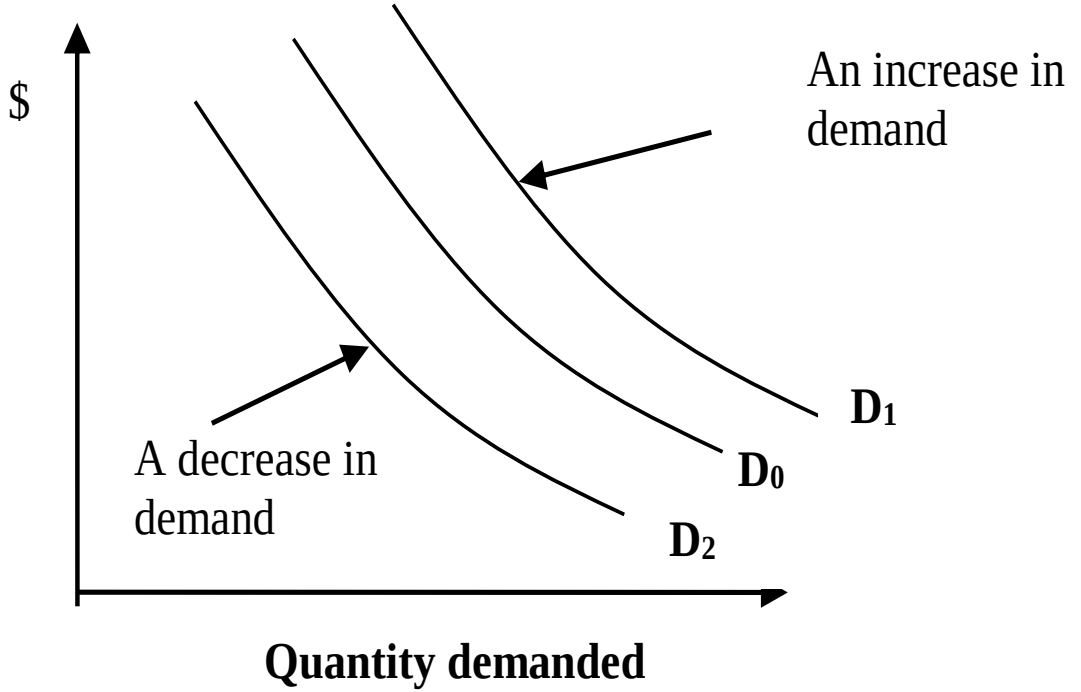


Fig. 3 Demand curve – shifts in demand

Elasticity of demand

The concept of elasticity of demand is one of the most important aspects of demand analysis. In general terms, elasticity of demand measures the magnitude of the responsiveness or sensitivity of the quantity demanded of a commodity to a change in some demand determinant. More specifically, elasticity concerns the extent to which a percentage change in one demand variable causes a percentage change in the quantity demanded.

$$\varepsilon = \frac{\%\text{ change in quantity demanded}}{\%\text{ change in any demand determinant}}$$

Elasticity of demand

There are as many kinds of elasticity of demand as there are numbers of demand determinants for a commodity (price elasticity, income elasticity, etc).

Price elasticity of demand

The relation of a commodity price to sales volume is of major interest to business firms as a basis for pricing policy, sales strategy, and achievement of profit and market share objectives.

Price elasticity of demand can be defined as:

$$\varepsilon = \frac{\%\text{ change in quantity demanded}}{\%\text{ change in price}}$$

Elasticity of demand

The coefficient of price of elasticity is always negative. This is because the price and quantity demanded are inversely related.

Two methods of calculating price elasticity exist – the arc elasticity method and the point elasticity method.

Arc method: This is a measure of the responsiveness of the quantity demanded between two seperate points on the demand curve.

Example:

Determine the degree of responsivess of the quantity demanded to a decrease in price from $12 to $10.

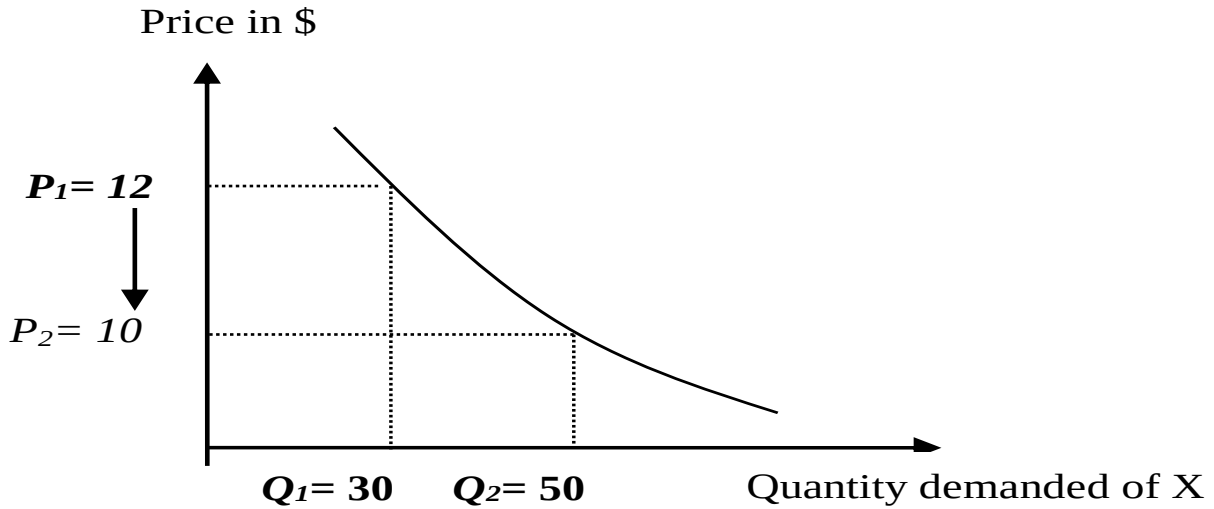


Fig. 4 Elasticity of demand

$$\varepsilon_p = \frac{\%\text{ change in quantity demanded}}{\%\text{ change in price}}$$

$$= \frac{[(Q_2 - Q_1)/Q_1] \times 100}{[(P_2 - P_1)/P_2] \times 100}$$

Where the pairs (Q_1, P_1) *and* (Q_2, P_2) represent respectively, the quantity and price values before and after their change.

Substituting the appropriate values into the formula gives:

$$\varepsilon_p = \frac{[(Q_2 - Q_1)/Q_1] \times 100}{[(P_2 - P_1)/P_2] \times 100} = \frac{(50 - 30)/30}{(10 - 12)/12} = -4.0$$

However, if we compute the sensitivity of the quantity demanded to an increase in price from $10 to $12 (equivalent to moving up the demand curve), the coefficient of price elasticity is

$$\varepsilon_p = \frac{[(Q_2 - Q_1)/Q_1] \times 100}{[(P_2 - P_1)/P_2] \times 100} = \frac{(30 - 50)/50}{(12 - 10)/10} = -2.0$$

Price elasticity of demand

The discrepancy in the two elasticiy coefficients arises because the percentage changes going from $12 to $10 are not the same as those from moving from $10 to $12. This is a troublesome matter but not without a remedy. The ambiquity of arbitrarily using one of the two points as the original or base values for calculating the percentage changes can be partially overcome by using averages of the quantity values as the base for calculating the percentage change in Q and the average of the two prices as the base for calculating the percenatge change in P. Making this adjustment gives the more satisfactory formula

$$\varepsilon_p = \frac{\dfrac{Q_2 - Q_1}{\left[\dfrac{Q_1 + Q_2}{2}\right]}}{\dfrac{P_2 - P_1}{\left[\dfrac{P_1 + P_2}{2}\right]}}$$

In terms of our previous example, the coefficient of price elasticity for a decline in price from $12 to $10 becomes;

$$\varepsilon_p = \frac{\dfrac{50 - 30}{\left(\dfrac{30 + 50}{2}\right)}}{\dfrac{10 - 12}{\left(\dfrac{12 + 10}{2}\right)}} = -2.75$$

Price elasticity

A price elasticity of –2.75 should be interpreted as meaning that over the indicated range of prices and quantities, a 1% change in price will be followed by approximately a 2.75% change in quantity demanded in the opposite direction (verify that the same coefficient is obtained by moving from $10 to $12).

Price elasticity

In general, the further apart the two points between which arc elasticity is computed, the greater is the discrepancy between the price elasticity coefficients obtained from the two-point arc formula.

Since the sign of the price elasticity of demand is always negative (in accordance with the law of demand), it is the size of the coefficient itself which is most relevant. By convention if:

$\varepsilon_p > 1$ demand is elastic (quantity demanded is sensitive to price changes)

$\varepsilon_p = 1$ demand is unitary or of unitary elasticity

$\varepsilon_p < 1$ demand is inelastic (quantity demanded is relatively unresponsive or insensitive to price changes.

Point Elasticity: Measuring elasticity at a point eliminates the imprecision of the arc elasticity concept. Point elasticity refers to the responsiveness of quantity demanded to very small price changes from a given point.

$$\varepsilon_p = \frac{\Delta Q/Q}{\Delta P/P} = \frac{\Delta Q}{Q} \cdot \frac{P}{\Delta P} = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q}$$

As the changes in price get smaller and smaller and actually approach zero, the ratio of ΔQ/ΔP becomes equivalent to the derivative of the demand function with respect to price.

$$\lim_{\Delta P \to 0} \frac{\Delta Q}{\Delta P} = \frac{dQ}{dP}$$

Therefore the formula for point elasticity becomes

$$\varepsilon_p = \frac{dQ}{dP} \cdot \frac{P}{Q}$$

Similarly, the income elasticity may be derived as

$$\varepsilon_I = \frac{dQ}{dI} \cdot \frac{I}{Q}$$

Cross elasiticity of demand

Cross elasiticity of demand : Mineral commodities can be treated in three ways in as far as their demand is concerned:

i). They may be ***competing products or substitutes***. In this case an increase in the purchase of one is at the expense of the other. Consider plastics substituting metals in motor vehicles and construction.

ii). They may be ***complimentary products***, in which case an increase of one causes a rise in the purchase of another. Complimentary means that commodities are consumed together. Consider the demand for gemstones and gold in demand for jewellery.

iii). Commodities may be ***independent*** implying that the purchase of one mineral commodity has no direct bearing on the demand of another. In this case the commodities are neither consumed together nor in place of one another.

Cross elasticity of demand is a measure for interpreting the relationship between products. For two products X and Y, cross elasticity measures the percentatge change in the quantity demanded of product Y in response to a percentage change in the price of product X.

$$\varepsilon_{y\,x} = \frac{\%\text{ change in quantity of Y}}{\%\text{ change in price of X}}$$

Where $\varepsilon_{y\,x}$ is the coefficient of cross elasticity between X and Y. Again there are two ways of calculating the coefficient of cross elasticity of demand.

The arc formula is:

$$\varepsilon_{yx} = \frac{\dfrac{Q_{y2} - Q_{y1}}{\left[\dfrac{Q_{y1} + Q_{y2}}{2}\right]}}{\dfrac{P_{x2} - P_{x1}}{\left[\dfrac{P_{x1} + P_{x2}}{2}\right]}}$$

The point elasticity formula is

$$\varepsilon_{yx} = \frac{dQ_y}{dP_x} \cdot \frac{P_x}{Q_v}$$

The cross elasticity coefficient may be either positive or negative. Note that when

$\varepsilon_{yx} > 0$	Commodities are substitutes
$\varepsilon_{yx} < 0$	Commodities are complimentary
$\varepsilon_{yx} = 0$	Commodities are independent

Partial Elasticities of Demand:

A more rigorous Concept of Demand Elasticity

In its most general form, the demand function for a good can be expressed as

$$Q_1 = f(P_1, P_2, \ldots\ldots\ldots P_n, T, I, E, R, N, O)$$

Where, Q_1 = quantity demanded of good 1
P_1 = market price of the good
P_2, ... P_n = prices of other goods
T = consumer tast*es* and preferences
I = Level of consumer incomes (or purchasing power)
E = consumer expectations about future prices, incomes and product availability
R = range of products available to consumers
N = number of potential consumers (market size)
O = all other factors which may influence Q_d

The elasticity of demand with respect to any demand determinant refers to the degree of responsivess of the quantity demanded relative to some percentage change in that demand determinant *when the values of all other demand determinants are held fixed.*

FACTORS AFFECTING SUPPLY

Determinants of Supply

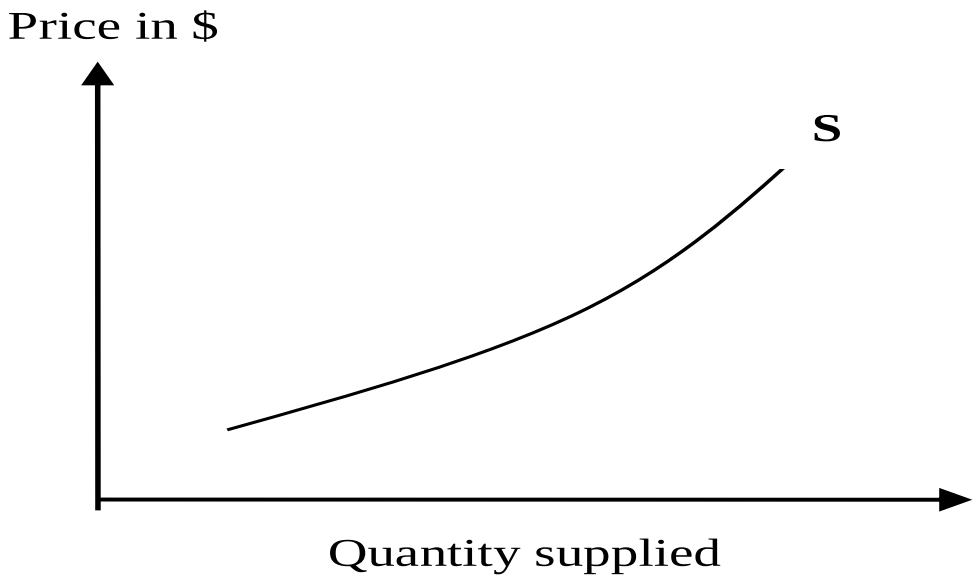


Fig. 5 Supply curve

The supply curve (S) in Fig. 5 represents the marginal cost curve for the industry supplying a particular mineral commodity. Conceptually, supply increases with increase in the market price of the commodity. This is expected because with an increase in the market price, some of the marginal deposits become viable and contribute to the expansion of supply. If the price falls on the market, some marginal mines will become unprofitable and forced to close down thereby reducing the overall supply. Thus the market mechanism regulates supply.

Factors affecting the supply of mineral commodities in the long term are:

- Major new discoveries
- Depletion
- Advance in processing technology (that has made it possible to process low grade ores or enhancement methods used in the treatment of low grade gemstones)
- Recycling (secondary supply)
- Enviromental controls
- Development of substitutes
- Development of new product markets

In the short-term, supply may be affected by

- Labour strikes
- Changes in producer and consumer inventories
- Mine production cut-backs
- Government stockpiles
- Business cycles

In addition to changes in along the supply curve, there could be shifts in the supply curve.

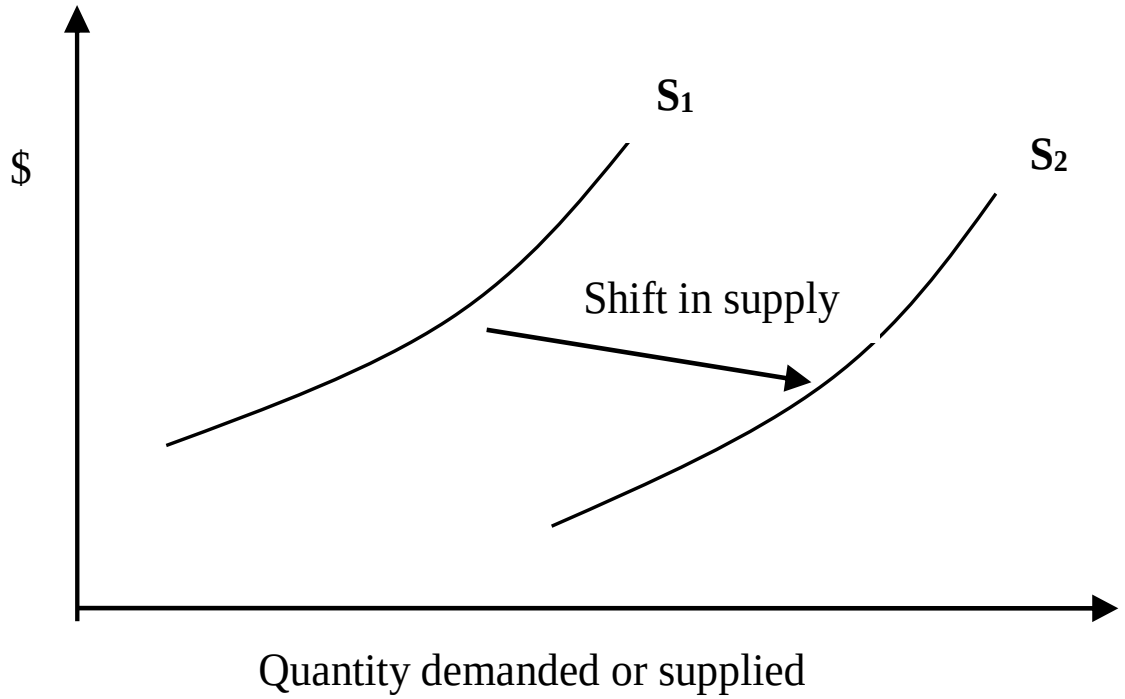


Fig. 6 Supply curve – shifts in supply