Unit 3: Demand and Supply of Agricultural Commodities

• Upon completion of this unit you will be able to:
  ○ Show how demand and supply can be expressed in words, numbers, graphs and equations.
  ○ Define the law of demand and the law of supply and the concept of elasticity.
  ○ Distinguish between a movement along a demand/supply curve and the shift of a demand/supply curve.
  ○ Identify the determinants of individual demand and individual supply, market demand and market supply and elasticity.
  ○ Explain how the equilibrium price and quantity are determined in the market.
  ○ Identify the function of prices and elasticity in a market.
  ○ Explain the relationship between price elasticities and total revenue.
The Concept of a Market

What is a Market:
A market is a set of arrangements through which buyers and sellers exchange goods and services.

The interaction between buyers and sellers determines:
- Quantity of goods or services produced.
- Price at which these are bought and sold

In a Market economy (Capitalist/Free market economy), price of goods is determined by the interaction of demand and supply.

The behaviour of buyers (consumer) is captured by the concept of demand and the behaviour of the seller (producers) is captured by the concept of supply.

Price
A price is what buyers and sellers regard as the value of a product or service and is determined on markets by the interaction of demand and supply.
**Demand Analysis**

**Demand**: Describes the quantity of a good buyers wish to purchase at every possible price, at a particular moment in time or a relationship between price and quantity demanded in a given time period, *ceteris paribus*.

**Market demand**: Obtained by adding the relevant individual demands horizontally, using schedules or graphs. It is the **horizontal summation of individual consumer demand curves**.

**Market demand curve is important for:**

- **Business**: *It helps to define production schedules so as to meet demand expectations.*
- **Consumer**: *Have an interest in the nature of the market demand curve because it have a major effect on market price of goods or service.*
- **Policymakers**: *Have an interest in market demand, both from a commodity policy perspective and from macroeconomic growth perspective.*

**Demand schedule**: Is a table that displays price and quantities demanded.

**Demand Curve**: Shows the maximum amount an individual is willing to pay for an additional unit of a good.
Figure 1: From a Demand Schedule to a Demand Curve

**A Demand Schedule**

<table>
<thead>
<tr>
<th>Price per cassette</th>
<th>DVD rentals demanded per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>$0.50</td>
<td>9</td>
</tr>
<tr>
<td>1.00</td>
<td>8</td>
</tr>
<tr>
<td>2.00</td>
<td>6</td>
</tr>
<tr>
<td>3.00</td>
<td>4</td>
</tr>
<tr>
<td>4.00</td>
<td>2</td>
</tr>
</tbody>
</table>

**A Demand Curve**

- **Points**:
  - A: (4, 2)
  - B: (3, 4)
  - C: (2, 6)
  - D: (1, 8)
  - E: (0.5, 9)

- **Axes**:
  - Quantity of DVDs demanded (per week)
  - Price per DVDs (in dollars)

- **Demand for DVDs**

- **Graph**
  - The graph illustrates the relationship between the price of DVDs and the quantity demanded per week.
The law of demand states that more of a good will be demanded when the price is lower and less of a good will be demanded when the price is higher, other things equal.

**Change in quantity demanded:**
*When the price of a good changes it will cause a change in the quantity demanded and graphically it is shown as a movement along the demand curve.*

**Changes in demand:**
Exogenous variables are factors that cause shifts of the demand curve. A change in anything besides the price will shift the entire demand curve.
Law of Demand: consumers demand more of a good the lower its price, holding constant all other factors that influence consumption.
Figure 3: Change in Quantity Demanded

- Change in quantity demanded (a movement along the curve)

Price (per unit) vs. Quantity demanded (per unit of time)

- $2
- $1
- 0

- 100
- 200

Point A and B on the demand curve $D_1$
Figure 4: Shift in Demand

Change in demand (a shift of the curve)

Price (per unit): $2

Quantity demanded (per unit of time):
- $1
- $2

Points:
- B
- A

Curves:
- $D_o$
- $D_1$
Individual and Market Demand Curves

- A market demand curve is the horizontal sum of all individual demand curves.
  - This is determined by adding the individual demand curves of all the demanders.
Figure 5: From Individual Demands to a Market Demand Curve

<table>
<thead>
<tr>
<th></th>
<th>Price per cassette</th>
<th>Alice’s demand</th>
<th>Bruce’s demand</th>
<th>Cathy’s demand</th>
<th>Market demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>$.0.50</td>
<td>9</td>
<td>6</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td>B</td>
<td>1.00</td>
<td>8</td>
<td>5</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>C</td>
<td>1.50</td>
<td>7</td>
<td>4</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>D</td>
<td>2.00</td>
<td>6</td>
<td>3</td>
<td>0</td>
<td>9</td>
</tr>
<tr>
<td>E</td>
<td>2.50</td>
<td>5</td>
<td>2</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>F</td>
<td>3.00</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>G</td>
<td>3.50</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>H</td>
<td>4.00</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
</tbody>
</table>

Quantity of cassettes demanded per week

Price per cassette (in dollars)
Determinants of Demand

- Income
- Tastes
- Prices of related goods
- Expectations
- Number of potential buyers
The effect of price of related goods

- Substitute goods: an increase in the price of one results in an increase in the demand for the other.
- Complementary goods: An increase in the price of one results in a decrease in the demand for the other.
The Demand Function

- The processed ostrich meat demand function is:

\[ Q = D(p, p_c, p_b, Y) \]

- where \( Q \) is the quantity of ostrich meat demanded
- \( p \) is the price of ostrich meat (dollars per kg)
- \( p_c \) is the price of chicken (dollars per kg)
- \( p_b \) is the price of beef (dollars per kg)
- \( Y \) is the income of consumers (thousand dollars)
From the Demand Function to the Demand Curve

- Estimated demand function for ostrich:

\[ Q = 171 - 20p + 20p_c + 3p_b + 2Y \]

- Using the values \( p_c = 4, p_b = 3.33 \) and \( Y = 12.5 \), we have

\[ Q = 286 - 20p \]

- which is the linear demand function for ostrich meat.
If $p = 0$, then $Q = 286$

If $p$ decreases by $1$ (to N$2.30) then, $Q = 240$

In general,\
$\Delta Q = -20 \Delta p$

= slope $\Delta p$
Price elasticity of demand is a measure of the sensitivity or responsiveness of quantity demanded as a result of price changes.

**Calculation of Price Elasticity**

\[ Ed = \frac{\text{Percentage change in the quantity demanded}}{\text{Percentage change in the price}} \]

We can write this relationship as a formula:

\[ Ed = -\frac{\Delta Q/Q \times \Delta P/P}{\Delta P/P} \]

**Note:** \( \frac{\Delta Q}{\Delta P} \) is the slope of the demand curve.

The formula above is used to calculate point elasticity on the demand curve.
Sensitivity of Quantity Demanded to Price (cont.)

- Along linear demand curve with a function of:
  \[ Q = a - bp \]
  
  - Where \(-b\) is the slope or
  
    \[ -b = \frac{\Delta Q}{\Delta p} \]
  
  - The elasticity of demand is
    \[ \varepsilon = \frac{\Delta Q}{\Delta p} \frac{p}{Q} = -b \frac{p}{Q} \] (3.3)
Arc/Midpoint/ Bow Elasticity of demand

To calculate elasticity using two points on the demand curve we use the following formula (Arc elasticity):

\[
Ed = \frac{\Delta Q}{(Q_1 + Q_2)} \div \frac{\Delta P}{(P_1 + P_2)}
\]
Interpretation of Elasticity:

<table>
<thead>
<tr>
<th>The five categories of price elasticity of demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>We can distinguish between five different categories of price elasticity of demand. They are as follows:</td>
</tr>
<tr>
<td>• Perfectly inelastic demand (Ed = 0)</td>
</tr>
<tr>
<td>• Relatively inelastic demand (Ed &lt; 1)</td>
</tr>
<tr>
<td>• Unit elastic demand (Ed = 1)</td>
</tr>
<tr>
<td>• Relatively elastic demand (Ed &gt; 1)</td>
</tr>
<tr>
<td>• Perfectly elastic demand (Ed = ∞)</td>
</tr>
</tbody>
</table>
Figure 7: Perfectly inelastic demand

- If demand is perfectly inelastic a change in price causes no change in quantity demanded.
- Buyers are completely insensitive to price changes because they cannot do without the product:
- **Examples of goods that could have a perfectly elastic demand are:**
  - Medicine when a person’s life is in danger like insulin for a diabetic.
If demand is relatively inelastic, the percentage change in quantity demanded is smaller than the percentage change in price. **Examples of such goods are:**

- Goods with no good substitutes such as electricity and petrol.
- Necessities such as bread and milk.
- Low priced goods such as salt, pencils and matches.
Demand is unit elastic if the percentage change in quantity demanded equals the percentage change in price.
Demand is relatively elastic if the percentage change in quantity demanded is greater than the percentage change in price.
Figure 11: Perfectly elastic demand

- The demand curve is parallel to the quantity axis and this represents the other extreme on the demand side, perfectly elastic demand.
- At the price of N$25 an infinite quantity is demanded.
- At any other price nothing is demanded.
- We say in this case that price elasticity of demand is equal to infinity.

Examples:
Goods that are perfectly elastic in demand have perfect substitutes. In theory, the consumer can switch easily to another product if the price changes. This demand curve is very important in the theory of perfect competition.
Elasticity Along a Demand Curve

- The elasticity of demand varies along most demand curves.
  - Along a downward-sloping linear demand curve the elasticity of demand is a more negative number the higher the price is.
Figure 12: Illustration of Elasticity Along the OSTRICH MEAT Demand Curve

\[ Q = 286 - 20p \]

$p$, $\$ per kg

<table>
<thead>
<tr>
<th>p ($ per kg)</th>
<th>Q (Million kg of pork per year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>14.30</td>
<td>0</td>
</tr>
<tr>
<td>11.44</td>
<td>57.2</td>
</tr>
<tr>
<td>7.15</td>
<td>220</td>
</tr>
</tbody>
</table>

Elastic: $\varepsilon < -1$

Unitary: $\varepsilon = -1$

Inelastic: $0 > \varepsilon > -1$

Perfectly elastic: $\varepsilon = -4$

Perfectly inelastic: $\varepsilon = -0.3$
Price elasticity of demand and total revenue

- Suppose a seller wants to increase the price of his product to increase the firm’s revenue.
- We know that if the price rises, the quantity demanded will fall and the business can lose money.
- *The question is now, what should a firm do to increase its revenue?*
- Price elasticity of demand can be used to determine how the total revenue of a business will change when the price of a product changes.
- A firm’s total revenue can be calculated using the following formula:
- **Total revenue = price x quantity** (TR = P x Q)
Price elasticity of demand and total revenue

A business can apply the following principles when decisions about price changes have to be made:

- **Inelastic demand (Ed < 1):** Increase in price will increase total revenue.
- **Unit elastic demand (Ed = 1):** If demand is unit elastic, sellers should leave the price unchanged because they cannot increase total revenue by increasing or decreasing the price of the product.
- **Elastic demand (Ed > 1):** If demand is elastic a decrease in price will increase total revenue.
Determinants of price elasticity of demand

The following factors may influence price elasticity of demand:

- **Availability of substitutes:** Products with good substitutes will have a more elastic demand. If there are few substitutes, demand tends to be inelastic.

- **Complementary goods:** The demand for these goods tends to be inelastic.

- **Necessity or luxury:** Demand for necessities is inelastic. The demand for luxury goods tend to be more elastic.

- **Proportion of income spent on the product:** The demand for goods on which we spend a large proportion of our income such as houses and cars tends to be more elastic. The demand for goods on which we spend a small fraction of our income, tends to be more inelastic.

- **The time period:** Demand will be more elastic in the long run because consumers will have time to adjust to price changes. In the short run demand tend to be inelastic.

- **Habit-forming products:** Demand is inelastic.

- **Durability of the Product:** The demand is elastic. If goods are non-durable such as food and cleaning materials, the demand will be more inelastic because these goods can be used only once.
Income and elasticity of demand

- The relationship between changes in consumers income and quantity of an item purchased is called an Engel curve.
- As income increases more or less of a commodity may be bought.
  - Normal good: Consumers buy more of it as income increases.
  - Inferior good: Consumers buy less of it as income increases.
- Different Engel curve exists for each commodity and for each individual.
- *Income Elasticity of demand*: Measure the responsiveness of quantity of a good purchased with changes in changes in income, holding all other factors constant.
E.g. Using food as an illustration. The quantity of purchased increases as income rises, but at a decreasing rate. Thus, the proportion of income spent for food decreases as income increases.
Other items such as clothing can be characterized by an Engel curve represented in this figure. The steepening curve shows that the quantity of clothing purchased changes substantially as money income rises.
Sensitivity of Quantity Demanded to Income

- Formally,

\[ \xi = \frac{\% \Delta Q}{\% \Delta Y} = \frac{\frac{\Delta Q}{Q}}{\frac{\Delta Y}{Y}} = \frac{\Delta Q}{\Delta Y} \cdot \frac{Y}{Q} \]

- where \( Y \) stands for income.

- Example
  - If a 1% increase in income results in a 3% increase in quantity demanded, the income elasticity of demand is \( \xi = \frac{3}{1} = 3 \).
  - Formula to calculate arc income elasticity:
    \[ EI = \frac{\Delta Q}{Q_1 + Q_2} \]

Sensitivity of Quantity Demanded to Income: Example

- The estimated demand function for ostrich meat is:
  \[ Q = 171 - 20p + 20p_C + 3p_B + 2Y \]
  - where \( p \) is the price of Ostrich, \( p_b \) is the price of chicken, \( p_b \) is the price of beef and \( Y \) is the income (in thousands of dollars).
  - Using the values \( p = 3.3, p_c = 4, p_b = 3.33 \) and \( Y = 12.5 \)
  - Question: what would be the income elasticity of demand for ostrich if \( Q = 220 \) and \( Y = 12.5 \)
    - \( Q = 195 + 2Y \)

\[ \frac{\Delta Q}{\Delta Y} = 2, \quad \text{then} \]

\[ \xi = \frac{\Delta Q}{\Delta Y \cdot Q} = 2 \frac{Y}{Q} = 2 \left( \frac{12.5}{220} \right) \approx 0.114 \]
Calculating income elasticity of demand

- The arc income elasticity coefficient can be calculated from the Engels function.
- Suppose that income rise from N$200 to N$400 and quantity demanded increase from 10 – 30, determine the arc income elasticity of demand.
  - \[ EI = \frac{10 - 30}{200 + 400} = \frac{20}{600} = \frac{2}{6} = 1.5 \]
  - \[ EI = \frac{20}{40} = \frac{2}{4} \times \frac{6}{2} = 1.5 \]
  - \[ EI = 1.5 \text{ Means that a } 1\% \text{ ↑ in income results in a } 1.5\% \text{ ↑ in the Q purchased.} \]
- Income elasticity of demand is important in determining the impact of income changes on the purchases of farm food items. “The income elasticity for food in the aggregate, as well as for many individual food products, is thought to ↓ as income ↑.
- Income elasticity for non food items increases as income increases.
Income elasticity

- Income elasticity will change over various income levels and can be positive or negative.
  - Positive income elasticity indicate normal goods.
  - Negative income elasticity indicate inferior goods. \((E_I < 0)\)
  - Luxury Good:
    - A luxury good is a specific type of normal good and is sometimes classified differently.
    - It is a good that behaves like a normal good, but as income rises, a higher percentage of total income is spent on the good (it has a high income elasticity). Examples include jewelry, fashionable clothing, and fine alcohols.
      - Luxury goods have \(E_I\) greater than 1. \((E_I >= 1)\)
      - Necessities are Normal Goods but \(0 < E_I < 1\)
Exercise 1

• Consider the following market condition
  The quantity of goods sold in week one = 20
  Income earned per week one = N$ 100

  Quantity of goods sold in week two = 50
  Income per week two = N$ 300

1. Determine the point income elasticity of demand for the goods
2. Use same scenario to determine the Arc income elasticity of demand for the goods
Cross price elasticity of demand

- Measures how sensitive DEMAND for a commodity is to changes in the price of a substitute or compliment commodity.

  - Arc cross price elasticity of demand for commodity X with respect to a small change in the price of commodity Y can be illustrated with the following algebraic expression:

    \[ E_{xy} = \frac{\Delta Q_x}{(Q_{x1}+Q_{x2})} \frac{\Delta P_y}{(P_{y1}+P_{y2})} \]

  - Point cross price elasticity:

    \[ E_{xy} = \frac{\Delta Q_x}{Q_x} \frac{\Delta P_y}{P_y} \]
Cross price elasticity of demand

- If cross price elasticity coefficient is:
  - Positive = The two commodities as substitute. \( E_{xy} > 0 \)
  - Negative = The two commodities are complementary. \( E_{xy} < 0 \)
  - Zero (0) = Independent commodities. \( E_{xy} = 0 \)

- If the cross price elasticity of pork with respect to the price of beef is around +1.5. Meaning, Q of pork purchased will \( \uparrow 0.15\% \) for each 1% \( \uparrow \) in the price of beef, ceteris paribus.

- Example

  The Cross-Price Elasticity of Pork and Beef would be calculated as:

  \[
  E_{xy, \text{Pork, Beef}} = \Delta Q_{\text{Pork}} / \% \Delta P_{\text{beef}}
  \]

  **INTERPRETATION:**
  
  If the; \( E_{xy, \text{Pork, Beef}} = + .65 \)

  Then for every 1% increase in the price of beef, the Qd of pork would increase .65%. We also would know that pork and beef are substitutes.
Applicability of Demand Elasticity

- Applicable to Policy makers
- Applicable to farmers
- Applicable to consumers
- Applicable to input manufacturers
- Applicable to food processors and trade firms

NB: Do read more on your own about the importance of Elasticity of demand
SUPPLY - refers to the willingness and ability to sell.

QUANTITY SUPPLIED (Qs) - amount supplied at a particular price for a given period

LAW OF SUPPLY

\[ P^{\uparrow}, Qs^{\uparrow} \] - When price goes up, quantity supplied goes up

\[ P^{\downarrow}, Qs^{\downarrow} \] - When price goes down, quantity supplied goes down

Positive relationship, directly proportional, Why?

Producers/sellers want bigger prices because they want bigger profits.
### Change in Quantity Supplied

<table>
<thead>
<tr>
<th>Price</th>
<th>Qty. Supplied</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>3</td>
<td>70</td>
</tr>
<tr>
<td>4</td>
<td>140</td>
</tr>
</tbody>
</table>

*Figure: A supply curve shows how price influences sellers.*
CHANGE IN SUPPLY

- results from a change in one of the NON-PRICE determinants of supply
- Causes a shift in the position of the supply curve
CHANGE IN SUPPLY

NON-PRICE DETERMINANTS OF SUPPLY (Causes of shift in SUPPLY CURVE)

- technology
- cost of production
- number of sellers
- Prices of other goods
- price expectations
- taxes and subsidies

Price

S2

S1

P1

Q2

Q1

Quantity
Change in supply is not equal to a change in quantity supplied ($\Delta s \neq \Delta Qs$)
LAW OF SUPPLY AND DEMAND

- When supply is greater than demand, price decreases.
- When demand is greater than supply, price increases.
- When supply is equal to demand, price remains constant. This is equilibrium price.
MARKET CONDITION (Qs-Qd)

1. SURPLUS - Qs > Qd
2. SHORTAGE - Qd > Qs
3. EQUILIBRIUM - Qs = Qd
### Table

<table>
<thead>
<tr>
<th>PRICE</th>
<th>QTY. DEMANDED</th>
<th>QTY. SUPPLIED</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>55</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
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<td>30</td>
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<td>40</td>
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<tr>
<td>4</td>
<td>18</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>60</td>
</tr>
</tbody>
</table>

What is the Pe? Qe?
Supply Elasticity

Is the percentage change in quantity supplied associated with a percentage change in price. \( Es = \frac{\% \Delta Q}{\% \Delta P} \)

**Point elasticity of supply**
\[
Es = \frac{\Delta Q \times P}{\Delta P \times Q}
\]

**Arc Elasticity of Supply**
\[
Es = \frac{\Delta Q}{(Q_1 + Q_2)} \quad \frac{\Delta P}{(P_1 + P_2)}
\]

- This is the elasticity of an average between two points.
Interpreting Elasticity of Supply

If
Es > 1 ⇒ elastic supply
Es = ∞ ⇒ Perfectly elastic supply
Es < 1 ⇒ inelastic supply
Es = 0 ⇒ Perfectly inelastic supply
Es = 1 ⇒ unitary elastic supply
Application of Supply Elasticity

- Elastic Products
  Products that can be easily produced in the short run or where producers can easily adjust production or bring output to market in a short time have the highest supply elasticity.

- Inelastic Products
  Products such as fruit, livestock, tea, cocoa etc. where it is difficult for producer to produce for the market in the short run.
END OF UNIT 3

THANK YOU!!!
QUESTIONS???